BANK NEGARA MALAYSIA
CENTRAL BANK OF MALAYSIA

BNM-BIS Conference on

FINANCIAL MARKET DEVELOPMENTS AND THEIR IMPLICATIONS FOR MONETARY POLICY

Kuala Lumpur, August 13, 2007

BANK FOR INTERNATIONAL SETTLEMENTS

Papers in this volume were prepared for a conference organised by Bank Negara Malaysia (BNM) and the Bank for International Settlements (BIS) in Kuala Lumpur on 13 August 2007. The views expressed are those of the authors and do not necessarily reflect the views of BNM, the BIS or the institutions represented at the conference. Individual papers (or excerpts thereof) may be reproduced or translated with the authorisation of the authors concerned. This collection of papers is also available as BIS Papers no 39 (www.bis.org).

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Foreword

This conference volume contains the eight papers presented at the BNM-BIS Conference on Financial Market Developments and their Implications for Monetary Policy. The theme of the conference is motivated by the rapid pace of change that we have observed in both the domestic and global financial systems over the last decade, and our own ongoing discussions within Bank Negara Malaysia about how these changes impact on our monetary policy.

Financial globalization and the integration of financial markets across different countries have greatly increased the complexity of the environment in which national monetary authorities operate. As countries have liberalized their capital accounts, there has been a change in the nature of capital flows in favour of more portfolio and other short-term flows. Cross-border capital flows have increased in response to differentials in interest rates and returns on other financial assets. For instance, in recent years, such capital flows have been driven by the low interest rate environment and a global liquidity surplus which has fuelled the search for yields. It has also led to a proliferation of new players and new financial products that have changed the dynamics of the global financial markets in ways that are not well understood. Increased integration has also led to the contagious spread of volatility across financial markets. Arising from these developments, monetary policy makers, particularly in small open economies, face challenges in terms of building resilience to volatile capital flows, managing surplus liquidity, maintaining orderly adjustments of exchange rates and avoiding boom-bust cycles in the asset markets. From the monetary policy perspective, there are open questions about how these developments have affected the way central banks in open economies conduct policy and how that policy is transmitted to the economy. For instance, we have already observed long-term interest rates in the bond markets being increasingly influenced by foreign interest rates and yields rather than domestic factors.

Changes have also occurred in domestic financial systems as a result of liberalization and innovation, leading to the appearance of new players and products. In Malaysia, over the last ten years we have seen the emergence of diversified banking groups arising from consolidations and mergers in the banking industry, while mergers of stock broking companies with merchant banks have created investment banks. The bond market has grown substantially, creating new avenues for financing, but at the same time resulting in some disintermediation from the banking system. Securitization has increased significantly, particularly for housing loans, but increasingly also for other assets. Islamic banking, with its promise of non-interest-rate-based financial intermediation, has grown rapidly. The spread of electronic banking and new payment mechanisms is gradually changing the payment and banking habits of the public. Such financial market developments could potentially influence the way monetary policy works, for instance by changing the relative effectiveness of the different transmission channels. The deepening of the financial system, aside from widening the choice of monetary instruments, could also enhance the role of the financial sector in determining economic outcomes. This could result in a need for changes in the monetary policy framework, for instance in terms of the communication strategy adopted with respect to the financial markets. The conduct of monetary policy itself may have an increasing influence on, and be increasingly influenced by, developments in the financial markets, requiring a greater effort in financial market surveillance on the part of the central banks than may previously have been the case.

Given the broad range of the issues raised by these developments for monetary policy makers, the conference focused on addressing four main areas. It first looked at some of the key recent developments in the financial markets, especially at the global level. The next two sections then covered the implications of financial market developments for the formulation and the conduct of monetary policy, respectively. The final section examined how central banks could extract policy-relevant information from financial markets. The emphasis of the

papers is very much towards providing policy-relevant research and observations that would be useful to central bankers in thinking about the monetary policy implications of developments in their own financial systems.

The success of the conference is owed first to the speakers, whose dedicated efforts produced the papers presented in this volume. I take this opportunity to express my appreciation to all of them. I would also like to thank the BIS, particularly the Hong Kong office, for collaborating with us in organizing the conference. A note of thanks also to my colleagues from other central banks who participated in the conference. Finally, special thanks to my own staff in the Monetary Assessment and Strategy Department of Bank Negara Malaysia, who worked tirelessly on the organization of the conference and the preparation of this conference volume.

Sukudhew Singh
Director
Monetary Assessment and Strategy Department
Bank Negara Malaysia

Conference summary

The conference sought to address four questions: What are the most important recent developments in the financial landscape? What has been, or is likely to be, the impact of these developments on the formulation of monetary policy? On the conduct of monetary policy? How useful are financial market indicators for monetary policy? The eight presentations given during the conference were organized into four sessions, with each session addressing one of these questions. This overview summarizes the conference papers and distils some tentative answers to the questions raised.

Key developments in the financial landscape

The conference began with the session aiming to identify the key recent developments in the financial landscape. In this session, Gudmundsson focused on the key developments in financial globalization. Taking a longer-term view of the issue, he evaluated the effects of financial globalization on the channels of monetary policy transmission and the possible problems and challenges that arise in the context of small open economies. Fitzsimmons, on the other hand, taking a more near-term view of the issue, analyzed the recent developments in global markets and their implications for markets in general and for exchange rates and capital flows in particular.

In his paper, Gudmundsson focuses on financial globalization as one of the key recent financial developments. He argues that while significant progress in financial globalization has been evident in the last decade and a half, a world of full integration has yet to be fully realized. Full financial globalization would imply that the real risk adjusted yield curve would eventually be equalized across countries. In this environment, the monetary policy of a small or medium-sized economy would be completely determined by global interest rates, therefore limiting the effect of domestic interest rates on domestic demand. Nevertheless, the exchange rate channel could still work to provide some countercyclical monetary policy effects, provided that the exchange rates does not exhibit excess volatility and is aligned with fundamentals.

Gudmundsson examines the current evidence on the development of the interest rate channel of monetary policy for two sets of countries: the small and medium-sized developed countries that have adopted a floating exchange rate and an inflation targeting regime; and selected emerging market countries. The findings show that although the interest rate channel has weakened among small and medium-sized mature inflation targeting economies, it remains significant. Similar, but weaker effects are also evident among emerging market economies. The exchange rate channel, however, is expected to work over the longer term, although financial globalization could complicate the process somewhat. The author weighs the various policy options that the small and medium-sized countries could implement in light of the challenges posed by greater financial globalization. These options include allowing the exchange rate channel to work and deliver the countercyclical monetary policy effects, sharpening and realigning existing instruments by shifting the policy mix in the direction of fiscal and other prudential policies, and changing the monetary policy framework by entering a monetary union.

Fitzsimmons, focusing on foreign exchange markets and capital flows, argues that the major development currently taking place in the financial markets is the combination of a global search for yields and complacency about default risk. The former is manifested in the form of carry trades and a narrowing of spreads while the latter takes the form of greater volatility and leverage. He also considers the evolution of agents in the financial markets as the key driver of the changes in the financial landscape, and this includes central banks and their

policy frameworks. He argues that changes in central bank policies and policy frameworks, and their interaction with market practitioners' perceptions, are important factors behind the dynamics evident in the current financial environment. Some of the transformations that are taking place in the foreign exchange market include the transformation and integration of banking firms, increased electronic deal flow, the emergence of new customers, products and trading segments, and rising volumes and volatility in the market.

Impact on the formulation of monetary policy

Having discussed some of the key recent financial market developments, the conference proceeded to discuss their implications for the formulation of monetary policy. This session commenced with the presentation of the paper by Singh et. al. In this paper, the authors examine how monetary policy transmission is affected by financial market developments. They adopt a two-fold approach. The first part of the paper surveys relevant studies and summarizes their key findings with regard to the implications of financial market developments for the monetary policy transmission mechanism. The authors focus on studies that assess the impact on policy transmission of financial liberalization, disintermediation, innovation, and consolidation, the developments in payment instrument technology, and Islamic finance. In the second part of the paper, the authors estimate the interest rate pass-through of five developed countries (the United States, the United Kingdom, Canada, Australia and Germany) and five Asian economies (Malaysia, Thailand, Indonesia, the Philippines and Korea), and analyze the possible types of financial market developments that could potentially influence the pass-through for these countries.

From the literature survey, the authors find that in general, financial market developments tend to strengthen the interest rate and asset price channels, weaken the bank lending channel, and have a mixed impact on the balance sheet channel. As for the empirical estimation, the authors find that financial market developments have tended to strengthen the pass-through from the policy interest rate to market interest rates. The authors also conclude that financial market developments have led to increased competition and more diversified financial markets which tend to strengthen the magnitude and speed of interest rate pass-through.

The second paper in this session, by Genberg, discusses changes in the structure of financial intermediation and their implications for the conduct of monetary policy, particularly with regard to the strategic and operational aspects of policy. From the literature survey on financial intermediation, Genberg argues that the traditional distinction between bank-based and market-based financial systems is becoming outdated and instead should be replaced with the distinction of whether the financial system is categorized as being relationship-based or arms-length in terms of the interaction between borrowers and lenders in that financial system. He also argues that with recent developments, markets are becoming more complete and that risk management and distribution by both institutions and households is becoming more efficient.

In terms of implications for monetary policy operations, Genberg proposes that as financial markets develop, the operations of monetary policy will become more flexible given the greater use of indirect policy instruments. With respect to monetary policy strategy, a stylized representation of a Taylor rule type of framework that contains an explicit role for financial intermediation is used to examine the influence of changes in financial intermediation on the conduct of monetary policy. In this analysis, Genberg shows that the financial intermediation process may change both the neutral policy interest rate and the horizon of the relevant forecast. Thus, the author proposes that changes in the process of financial intermediation need to be and should be factored into monetary policy decisions.

Impact on the conduct of monetary policy

This session focused on how financial market developments impact the conduct of monetary policy. In this session, Broadbent examined whether financial innovations have facilitated the conduct of monetary policy in Australia, while McCauley discussed the mutual relationship between conducting monetary policy operations and developing financial markets.

The paper by Broadbent has two main parts. Part one surveys the types of financial innovations that have contributed to recent financial market developments in Australia. These include greater securitization, the growing role of mortgage brokers, the growth of swaps and bond markets and the decline in the government securities market. Part two of the paper highlights the relevance of these financial innovations for monetary policy operations. The author suggests that these innovations affect the economy's sensitivity to monetary policy and the Reserve Bank of Australia's estimate of the neutral cash rate. He further highlights that, in Australia, the speed of pass-through has increased in recent years, with changes in the policy rate generally feeding directly into the variable rate within a week or so of a policy announcement.

Financial innovation also influences how the Reserve Bank of Australia implements monetary policy. It has allowed the Bank to broaden the range of securities that it can use in its market operations. Some of these instruments include a subset of kangaroo issues which has led to a noticeable expansion of the pool of high quality securities that meet the Bank's repo eligibility criteria. Another major instrument used is FX swaps. These have the same effect on domestic liquidity as open market operations but the FX swap market is deeper and more liquid, thus allowing large transactions to be undertaken to offset big shifts in the system's cash balances. All in all, the paper concludes that financial innovation has made the financial system more efficient and has not affected the Reserve Bank of Australia's ability to implement monetary policy.

McCauley explores how the conduct of monetary policy can facilitate the development of financial markets, and conversely, how the state of development of the financial markets determines the way the central bank conducts its monetary policy. In the first part of his paper, he focuses on how monetary operations can contribute towards financial market development. McCauley highlights that a central bank or monetary authority has a high degree of freedom in terms of the monetary policy instruments it uses in its operations, and that it should exercise this choice judiciously to facilitate the development of the financial markets. Citing the examples of the United States Fed's operations in the repo market and the growing use of repos in Asian countries, McCauley concludes that as a result of the development of the repo market, the liquidity and profile of these markets have increased over the years.

The second part of McCauley's paper touches on the reverse direction of the relationship, i.e. on how developments in financial markets can create constraints and challenges to policy makers. Financial market developments can present a constraint to monetary policy makers, particularly when the amount of government debt is small or the size of foreign assets of the monetary authority is large. In addition, the rising significance of the securities market adds to these constraints, as market participants could shift from bank loans to corporate bonds if, for instance, there is an increase in the reserve requirement. Thus, the author proposes that one of the main challenges for central banks today is that of aligning their monetary operations to the main trends and developments in the financial markets.

Usefulness of financial market indicators for monetary policy

The objective of the final session of the conference was to gauge the usefulness of financial market indicators for monetary policy. For this purpose, Watkins discussed the experiences

of the Reserve Bank of New Zealand in incorporating financial market information into its monetary policy, while Kuttner examined the importance of equity prices as an economic indicator for the Asian countries.

Based on the paper by Watkins, at the Reserve Bank of New Zealand financial market information is used to understand policy expectations as well as the influence and transmission of monetary policy in the financial markets over the short, medium and longer term. The author highlights that market surveillance at the Reserve Bank of New Zealand is a synthesis of both desk-based research and direct contact with market participants. One interesting part of the paper is the example illustrating how financial market analysis was conducted to examine the reasons why increases in the Official Cash Rate (OCR) were not being reflected in retail interest rates, particularly in lending rates.

The author illustrates the methods used for interpreting expectations of the implied policy rate. Using the example of market response before and after the release of stronger-than-expected data, money market expectations of future policy can be estimated for around 12 months ahead, using both Overnight Indexed Swaps (OIS) and bank bill futures. Alternative methods include using survey data of analyst forecasts, options prices, and tactical surveys of traders conducted ahead of each policy announcement. The Reserve Bank of New Zealand's market intelligence also aims to understand the reasons why markets move on a particular piece of economic data, and what the distribution of market expectations, or the risks, around current market pricing are. To analyze longer-term market expectations, the Bank uses implied forward rates from models of the full yield curve. These models describe the yield curve in terms of its slope, curvature and long-run level. The author also discusses how market information is incorporated into the macroeconomic modelling process. He concludes by underscoring the importance of strengthening the relationship between the Bank's desk officers and market participants, further developing quantitative tools, adding information sources by extending market surveys and obtaining more information via settlement and depository systems, and generally improving information flows within the central bank.

The second paper of this session, by Kuttner, discusses the possible role for equity prices as a leading economic indicator and assesses empirically the usefulness of stock price data for Korea, Malaysia, the Philippines, Thailand and Indonesia. One broad conclusion from the analysis is that the information content of stock prices varies a great deal across countries. Equity prices in Korea, Malaysia, and to a lesser extent Thailand, seem to be closely linked to the real economy but much less so in the Philippines and Indonesia. Even for Korea, Malaysia and Thailand, where stock prices are a good in-sample predictor of output, including the stock price into the equations yields only modest improvements in out-of-sample forecasting performance. The results for these three countries are very similar to those for the United States, where stock prices are a useful, but somewhat unreliable, leading indicator. On the other hand, Asian equity prices fail to display a systematic relationship, either in-sample or out-of-sample, with inflation. The author postulates that this is in part because over the sample used in the analysis, inflation resembles a random walk, and consequently it is hard to do better than a naïve "no change" forecast. These results are similar to those for the United States presented in other published research.

Kuttner also explores the relationship between "liquidity", stock prices and the economy. His main conclusion is that, while there are sound theoretical reasons for monetary policy to have an effect on equity valuations, the role of broader concepts of "liquidity" is not well motivated; nor is it clear exactly how "excess liquidity" promotes financial risk-taking. The author also finds that none of the liquidity measures considered in the analysis (money, interest rates and credit aggregates) has any significant predictive power for either real output or stock prices, calling into question the view that "liquidity" is an important driving force in either financial markets or the real economy.

Conference Programme

Monday 13 August

08:30-09:00 Opening of Conference with Introductory Remarks by
Dato' Ooi Sang Kuang, Deputy Governor, Bank Negara Malaysia

Opening Remarks by
Eli Remolona, Deputy Chief Representative of the Office for Asia and the Pacific, Bank for International Settlements

Session I **Key Developments in the Financial Landscape**

09:00-10:30 **Presentation:** **Financial Globalisation – Key Trends and Implications for the Transmission Mechanism of Monetary Policy**

Speaker: Mar Gudmundsson
Bank for International Settlements

Presentation: **Capital, Carry and Complacency**

Speaker: Brendan Fitzsimmons
Medley Global Advisors

Discussant: Claes Berg, Sveriges Riksbank

Chairperson: Sukudhew Singh, Bank Negara Malaysia

Session II **Impact on the Formulation of Monetary Policy**

11:00-12:30 **Presentation:** **Impact of Financial Market Developments on the Monetary Transmission Mechanism**

Speaker: Sukudhew Singh, Bank Negara Malaysia

Presentation: **Changing Nature of Financial Intermediation and Its Implications for Monetary Policy**

Speaker: Hans Genberg, Hong Kong Monetary Authority

Discussant: Kenneth Kuttner, Oberlin College

Chairperson: Eli Remolona, Bank for International Settlements

Session III **Impact on the Conduct of Monetary Policy**

02:00-03:30 **Presentation:** **Financial Market Innovation in Australia: Implications for the Conduct of Monetary Policy**

Speaker: John Broadbent, Reserve Bank of Australia

	Presentation:	**Developing Financial Markets and Operating Monetary Policy in East Asia**
	Speaker:	Robert McCauley, Bank for International Settlements
	Discussant:	Satoshi Kawazoe, Bank of Japan
	Chairperson:	Hans Genberg, Hong Kong Monetary Authority

Session IV **Usefulness of Financial Market Indicators for Monetary Policy**

04:00-05:30	**Presentation:**	**Using Financial Market Information in Monetary Policy: Some Examples from New Zealand**
	Speaker:	Clinton Watkins, Reserve Bank of New Zealand
	Presentation:	**Equity Prices as Leading Indicators: The Asian Experience**
	Speaker:	Kenneth Kuttner, Oberlin College
	Discussant:	Michael Debabrata Patra, Reserve Bank of India
	Chairperson:	Satoshi Kawazoe, Bank of Japan

Opening remarks

Dato' Ooi Sang Kuang[1]

Ladies and Gentlemen,

It is my great pleasure to welcome you to this BNM-BIS Conference on Financial Market Developments and their Implications for Monetary Policy. We are pleased to jointly host this conference with the BIS and I would like to thank the BIS, particularly the Hong Kong office, for collaborating with us to organise this conference.

I would also like to take this opportunity to express my appreciation to our speakers and discussants, for your contributions and for taking time off from your busy schedules to share your expertise and valuable insights with us.

Ladies and Gentlemen,

The topic of today's conference reflects our own recognition of the need to improve our understanding of how the changes that are going on in Malaysia's financial markets, as well as in the regional and global financial markets, are influencing, and how they could potentially influence, both the way we conduct monetary policy and also the impact of our policy on the economy. The topic is timely and of great relevance. We have thus organised the conference to provide a broad overview of the issues that would be useful to policymakers. The presentations are arranged in a manner that we hope will provide ample room for discussions and also for candid exchanges of views among the participants.

Financial markets clearly have a critical role in the conduct and transmission of monetary policy. Broadly, the growth and development of the domestic financial markets are important to the conduct and transmission of monetary policy in a number of ways. Let me mention two. First, deeper markets and greater availability of instruments allow for more effective and efficient monetary operations. Second, changes in financial prices are able to affect a broader scope of economic activities. There are, however, other financial innovations and developments in the financial markets where the implications for the conduct of monetary policy and the effectiveness of its transmission are less clear. The most important of these are financial globalisation, the increasing integration between domestic and global financial systems, and the rapid growth of the derivatives market, structured and leveraged funds. Capital flows in response to interest rate differentials and expectations regarding the direction of exchange rates have clearly made it more challenging to conduct monetary policy aimed at achieving domestic objectives. At the same time, developments in other financial markets have the potential to trigger sharp changes in the prices of financial assets in the domestic markets – note the gyrations of prices across many regional financial markets that have occurred over the two weeks preceding this conference in response to the problems related to sub-prime lending in the U.S. financial system. Also of concern is the rapid growth of the derivatives markets and the spread of highly leveraged funds.

The nature of financial intermediation is also continuously evolving, with traditional players like banks assuming new roles, while new players such as venture capital firms, private equity funds and investment banks create additional avenues for financing and investment. There has been a blurring of lines in terms of which financial institution does what. For instance, insurance companies in Malaysia that had traditionally invested their funds in financial market instruments and government securities are now offering loans at fixed rates to customers. The increasing size of capital markets has provided alternative channels for

[1] Deputy Governor of Bank Negara Malaysia.

financial intermediation that compete directly with the role traditionally played by banks. There is evidence to suggest that the development of capital markets leads to faster interest rate pass-through compared to traditional bank-based financial systems. This development has also made managing market expectations an important part of how we conduct monetary policy.

Financial innovation has given rise to new products and instruments. Securitisation has created new asset classes and opened up alternative sources of financing for banks and investment banks, as well as to distribute risks. Beyond plain vanilla derivative products like options, swaps, futures and forwards, there is now a plethora of other products that go by acronyms such as NDFs, CDOs, CMOs and so on. As you are all aware, recent events have led to questions being raised about whether the financial market experts themselves, such as the rating agencies and investment banks, fully appreciate the risks associated with structured financial products; whether those that hold these products fully understand the risks they are taking, or whether they have the capacity to manage these risks.

The spread of derivative instruments, structured products and highly leveraged funds have multiplied the risks of contagion in financial markets across the world. Where the risks lie is not something that is easily determined. But we do know that with the globalisation of financial markets, risks originating in one market can easily surface in another market. The accumulation of leverage by groups that operate across international borders, and the growth of large financial institutions that have operations in many different markets, can create a chain of linkages similar to an electric circuit whereby a surge in one market can short-circuit financial activity in other markets. The events in the global financial markets over the week leading up to this conference underline this point.

These are issues not just for those who are concerned about financial stability but also for those of us that are concerned about monetary stability, as the consequent sustained market volatility and uncertainty can have a disruptive effect on the monetary transmission mechanism and the financing of real activity.

Ladies and Gentlemen,

Not all of these developments may be occurring in all of our financial markets, but as monetary authorities and regulators, we nevertheless need to understand their implications. They influence the domestic and global environments in which we operate. Some of these developments will enhance monetary effectiveness, while others could do the reverse. I hope that today's conference will help us improve our understanding of the implications and impact of global financial developments with regard to the conduct of monetary policy. I also hope this meeting will help us as policymakers sharpen our thinking about some of the challenges facing monetary authorities today.

Ladies and Gentlemen,

On that note, I wish you all an interesting and stimulating day of discussions and a pleasant stay in Kuala Lumpur.

Thank you.

Financial globalisation: key trends and implications for the transmission mechanism of monetary policy

Már Gudmundsson[2]

Introduction

It is widely acknowledged that the transmission mechanism of monetary policy will evolve as domestic financial markets develop and mature. This development will in turn affect the relative effectiveness of different monetary instruments. Thus the interest rate channel of monetary policy[3] will tend to be weak when domestic bond markets are underdeveloped and banks dominate intermediation of short-term domestic credit and foreign currency denominated funds. In this setting, monetary policy will mainly affect the economy through exchange rate management and/or changes in the domestic money supply. Direct measures, such as politically decided discreet changes in the exchange rate (mostly old style devaluations), and quantitative instruments (eg reserve requirements) will be the dominant tools of monetary policy.

However, the importance of the interest rate channel of monetary policy transmission will grow as domestic financial markets develop and both firms and households finance their expenditure and investment to a greater degree in terms of domestic currency and at ever longer maturities, either in bond markets or through bank credit. This will in turn enhance the role of market-based indirect instruments, primarily interest rates on short-term lending by central banks to commercial banks, and create the conditions for market-determined exchange rates.

There is some debate regarding to what degree, and under what conditions, the external liberalisation of domestic financial systems will further promote the development of the financial system. However, in spite of some financial stability risks, it seems that countries generally benefit through economies of scale, increased competition and deeper and more liquid financial markets, at least if certain minimum conditions are met.[4] The cross-border financial integration triggered by external financial liberalisation will thus in most cases give a further boost to domestic financial market development and, in doing so, to the interest rate channel of monetary policy transmission. However, we also know from economic theory that co-movements of asset returns will increase as cross-border financial integration progresses, which, for small countries that are unable to affect global asset returns, will mean that domestic interest rates at longer maturities will increasingly be affected by global rates. In other words, although cross-border financial integration might initially give a boost to the interest rate channel due to favourable effects on the development of domestic capital markets, it will eventually be its demise.

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[2] Views expressed are those of the author and not necessarily the views of the BIS. I would like to thank Magdalena Erdem and Philippe Hainaut for excellent research assistance. I would also like to thank Claes Berg, Kenneth Kuttner and other participants in the BNM-BIS conference on Financial market developments and their implications for monetary policy held in Kuala Lumpur, 13 August 2007, for useful comments. In addition, I would like to thank the participants of the Bank of England Chief Economists' Workshop on "Policy challenges to monetary theory" held on 16–18 April 2007 in London and Yusuke Horiguchi for helpful and encouraging comments on a still earlier version of this paper.

[3] In this paper the interest rate channel refers to the effects of monetary policy action on inflation that occur through changes in those interest rates that are relevant for demand and employment.

[4] See, for instance, Kose et al (2006).

This paper is concerned with the progress of financial globalisation and the effect it might be having on the transmission mechanism of monetary policy.[5] It focuses mainly on two sets of countries: small and medium-sized developed countries that have adopted a floating exchange rate and inflation targeting (IT) and selected emerging market countries.

The reasons for focusing in the first instance on the mature IT countries are three-fold. First, countries with developed and open financial systems should in general be more closely integrated with the global financial system than emerging market countries. This should therefore bring the effects of financial globalisation as such into sharper focus. In emerging market countries the signs of such effects might be blurred by problems related to structural and institutional vulnerabilities, partly reflected in high and variable country risk premia. Second, both theory and experience demonstrate the trilemma that those countries operating pegged exchange rates and open capital accounts lose control over domestic financial conditions. They neither have nor seek the opportunity to operate independent monetary policy. The issue being investigated in this paper is therefore not strictly speaking relevant for these countries. Third, focusing on the above set of countries makes it possible to use long data series.

However, we are also interested in the degree to which financial globalisation is affecting the transmission mechanism of monetary policy in emerging market countries. Therefore an attempt will be made to replicate some of the analysis for those emerging market countries that come closest to the mature IT countries, either by having adopted an IT regime or by having relatively developed and open financial sectors.

The main questions that will be addressed in the paper are the following:

- How might financial globalisation be expected to affect the transmission mechanism of monetary policy in countries that are developed and financially sophisticated, but not large enough to significantly affect global financial conditions?
- What does the data indicate on the development of the interest rate channel of monetary policy in the chosen sample of countries?
- What is the evidence on the exchange rate channel? To what degree have exchange rate movements been part of a desired monetary policy transmission and economic adjustment, and to what degree have they been decoupled from fundamentals and thus become a source of instability?
- In as much as ongoing financial globalisation creates problems for macroeconomic management in small and medium-sized financially open countries, is there a set of changes to institutions, frameworks and policies that would, at least partly, address such problems?

The rest of this paper is organised as follows: the next section defines financial globalisation and discusses how its progress could be measured. Section II then surveys key trends and looks at different aspects of the progress of financial globalisation.[6] Section III provides a

[5] There is a growing discussion among central bankers and academics on the implications of globalisation for monetary policy (see for instance Bernanke (2007), BIS (2006), Bollard (2007), Rogoff (2006) and Weber (2007)). This debate has two strands: the effect that real globalisation is having on the inflation process and the effect that financial globalisation is having on the transmission mechanism. This paper is concerned with the second aspect.

[6] Financial globalisation is a multifaceted phenomenon. This paper focuses on those aspects that are most relevant for the transmission mechanism of monetary policy. However, there are also important financial stability issues involved, especially in connection with the globalisation of financial institutions. The latest BIS Annual Report includes a special section on the internationalisation of banking where key trends are surveyed and relevant policy issues discussed (see BIS (2007)). IMF (2007a and b) also provides an interesting analytical examination of the financial stability aspect of the internationalisation of financial institutions and asset management. BIS (2006) also covers several aspects of financial globalisation. Finally, the author of this paper discussed both the financial stability and monetary policy aspects of financial globalisation in a recent speech (see Gudmundsson (2007)).

discussion of the implications of financial globalisation for the transmission mechanism of monetary policy. Section IV provides some evidence on the evolution of the interest rate channel among small and medium-sized IT countries and a selected group of emerging market economies. Section V discusses the exchange rate channel. Section VI examines some policy issues and Section VII concludes.

I. What is financial globalisation?

A fully integrated market is one where economic agents face a single set of rules, have equal access and are treated equally. By implication, the law of one price would hold in such a fully integrated market, ie risk-adjusted real returns on assets with the same maturity and other characteristics would be equal. Note, however, that frictions could still be present, but they should be symmetric, ie the same for all agents, sectors and locations (in the case of spatial integration).[7] Using this definition we could define financial integration as the process by which financial markets and institutions become more tightly interlinked and move closer to full integration, under which the law of one price would hold. Finally, given the above definitions, financial globalisation is cross-border financial integration that is reasonably spread around the globe.[8]

It is important to bear in mind that the above definition implies that financial globalisation, or cross-border financial integration, is a process rather than a state of nature. Furthermore, this process is only partly driven by governmental action. Governments can in principle lift legal restrictions on capital movements overnight (although it would in most cases not be advisable to do so). They could possibly also move relatively quickly to harmonise diverse rules, regulations and practices that are impediments to cross-border financial integration, although in practice this is often a drawn out process and differences in legal systems and business practices tend to be significant impediments to free flow of capital. Furthermore, legal freedom to practise financial innovation could be expected over time to reduce frictions to the flow of capital. The abolition of government-imposed restrictions to the flow of capital will thus not instantaneously result in the law of one price holding across countries. It will at least require several years of a market-driven integration process. And even then, the theoretical limiting case might never be reached.

The potential implications of cross-border financial integration provide us with candidate measures of its ongoing process. Some of these implications are:

- Covered interest parity should hold.
- Stronger co-movement of asset returns across countries.
- Greater scope for risk sharing across countries through output and/or consumption smoothing.
- Greater potential to decouple domestic saving and investment.
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These implications provide several potential measures of ongoing cross-border financial integration. Below is a taxonomy of tendencies that would be consistent with a higher degree of cross-border financial integration:

[7] This definition is a slightly adapted version of the one provided by Baele et al (2004) in their study on financial integration in the euro area.

[8] Cross-border financial globalisation involving only a few countries (eg the US and Canada) with the bulk of the world being financially insular would thus not meet the criteria of financial globalisation. Using the same terminology we define regional financial integration as cross-border financial integration that is contained within a specific region.

1. Legal or regulatory measures:
   - Lower level of legal restrictions on capital flows.
   - Lower level of other legal and regulatory-based impediments to cross-border financial integration, including taxation and the design of monetary instruments.
2. Price-based measures:
   - Covered interest rate parity holds.
   - Increased co-movement of asset returns.
3. Quantity-based measures:
   - Higher level of gross cross-border capital flows.
   - Higher level of cross-border assets and liabilities.
   - Reduced home bias in domestic portfolios.
   - Lower correlations of domestic saving and investment.
   - Lower correlations of domestic consumption and GDP.

Taken individually, there are significant caveats associated with several of the measures above.

Taking price-based measures first: measuring real risk-adjusted returns is complicated in the absence of good measures of inflation expectations and direct measures of risk premia. In practice we tend to look at correlations of changes in nominal interest rates of similar maturity and risk or correlations of equity returns. There will thus be a measurement bias, which should, however, stack the cards against detecting the effects of financial integration, due to the statistical result that it biases estimated coefficients towards zero. Additionally, observed co-movements might not have anything to do with ongoing financial integration and might instead be reflecting the existence of common shocks.

The measurement problems might be somewhat smaller in the case of the quantity-based measures. Several of these also have the additional benefit of being available and relatively comparable across a range of countries and time periods. However, there is no clear benchmark in the case of gross capital flows or cross-border assets and liabilities and it is possible to construct examples where these would increase without progress in financial integration, as defined above, and also examples to the contrary, where they would be constant in the face of such financial integration. However, cross-border assets and liabilities would in general be expected to increase, at least so long as financial integration reduces home bias.

II. The progress of financial globalisation

Due to the above-mentioned caveats one should preferably look at a broad range of measures when assessing the progress of financial globalisation. The picture that emerges from such a broad perspective is one that is consistent with significant progress in financial globalisation during the last decade and a half. This is not particularly surprising given that several mature economies still had capital controls in place in the middle of the 1980s that were lifted in the following few years and that a string of emerging market countries removed restrictions to capital movements in the 1990s. Correlations of changes in long-term interest rates have increased significantly during this period, although this could, at least partly, be due to other reasons than financial globalisation. Additionally, both gross capital flows and gross external positions (measured by the sum of foreign assets and liabilities as a

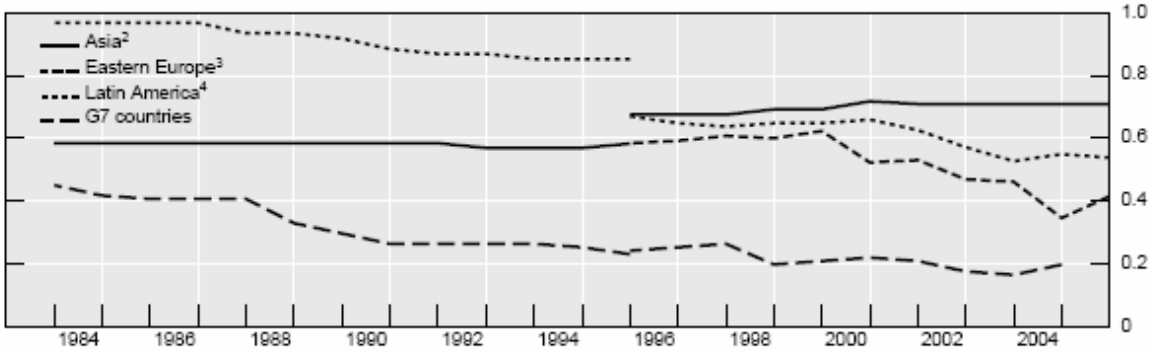
percentage of GDP) have increased strongly during this period. Let us now survey the key trends in more detail.

De jure measures

There are several studies that demonstrate the lifting of formal barriers to cross-border trade in financial assets in recent decades. Thus Stulz (2005) quotes an index of formal restrictions on capital movements based on IMF data that takes the value of 12 when a country is completely financially open and 0 when it is completely closed. This index was 3.5 for the UK in 1950 but reached 12 in 1979. For a constant sample of mature countries it was 4.2 in 1950 but 11.6 in 1999. For a constant sample of 68 emerging and developing countries the index was 5.6 in 1973, but reached 8.3 in 1997. In 2005, the emerging and developing economies were on average at the same level as mature economies were in 1970. This average, however, hides a lot of variation.

Graph 1

Legal restrictions on capital mobility[1]



[1] Average of 1/0 dummy variable indicating the existence of controls on capital account transactions; data for 1983–1995 are from Miniane (2004); data for 1995–2005 are from various editions of the IMF's *Annual report on exchange arrangements and exchange restrictions*. [2] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan (China) and Thailand; prior to 1995, excludes China, Indonesia, Taiwan (China) and Thailand. [3] New EU members, ie Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. [4] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela; prior to 1995, excludes Peru and Venezuela.

Source: García-Herrero and Wooldridge (2007).

Graph 1, which is adopted from Garcia-Herrero and Wooldridge (2007), shows the development of legal restrictions on capital movements among the G7 and regional averages of emerging market countries. The index varies from 1 (full control) to 0 (no restrictions) and is an average of several categories of restrictions that each take the value 1 or 0 according to the IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions. It shows a significant fall in such restrictions in Latin America and emerging Europe, but less of a change in Asia, which also has a higher level of restrictions than the other two regions. This reflects the fact that there are still significant capital controls in place in several emerging Asian countries, not least in China and India.

Covered interest rate parity

Covered interest rate parity states that the interest rate differential of any specific maturity between two countries is equal to the percentage difference between the forward exchange rate of that same maturity and the spot exchange rate. This is a pure arbitrage non-risk relationship and should hold more or less exactly if capital is free to move between bank deposits and fixed income markets in the relevant countries.[9] It is therefore an elementary test of cross-border financial integration and the relationship holds between financially open mature economies. García-Herrero and Wooldridge (2007) look at 3-month money market

[9] Transaction costs might create some divergence.

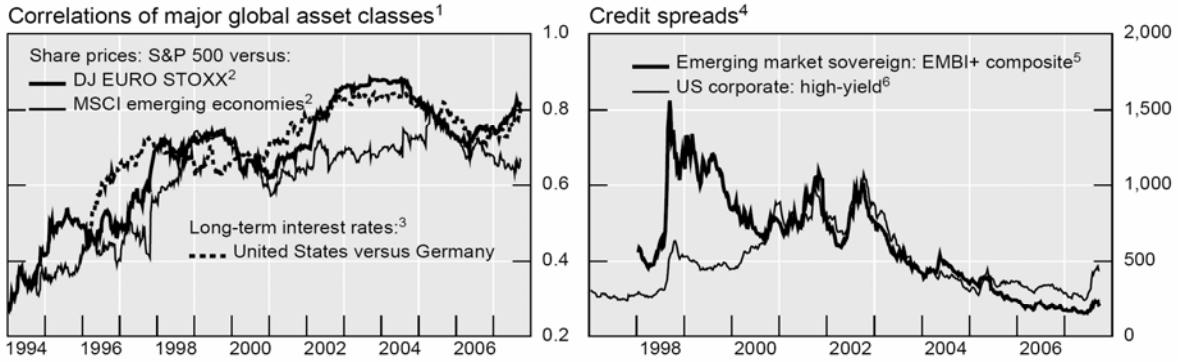
rates for a selected group of emerging market countries. They find that covered interest rate parity tends to hold where legal restrictions on capital movements have been lifted, whereas there are sometimes sizeable deviations where capital controls are still in place.[10]

Co-movements

There are, as mentioned in the last section, several caveats associated with using co-movements of asset returns as indicators of the progress of financial integration. First, we have measurement problems. Second, observed co-movements could be due to other factors, such as common shocks. Third, correlations of stock returns, in particular, tend to increase in bear markets and during periods of heightened volatility in world financial markets. Fourth, correlations of stock returns usually do not correct for differences in industry structure. Bekaert et al (2005) demonstrate the difficulties that these caveats can create for the interpretation of co-movements of equity returns. Only in the case of Europe do they find evidence of a significant positive trend in correlations of stock returns. They conclude that there is no definitive evidence that cross-country correlations of these stock returns are significantly and permanently higher than they were 10 years ago.

Graph 2

Correlations of major global asset classes and credit spreads



[1] Weekly changes using a 2-year moving window. [2] In terms of US dollars. [3] Ten-year government bond yields. [4] Over government bond yields, in basis points; weekly. [5] Stripped spreads as calculated by JPMorgan Chase. [6] Option-adjusted spreads as calculated by Merrill Lynch.

Sources: Bloomberg; Datastream; JPMorgan Chase; Merrill Lynch; national data.

In spite of these caveats it is a worthwhile exercise to look at the evolution of co-movements of asset returns. Apart from the measurement problems in the case of bond yields, most of the caveats are asymmetric in the sense that observed increases in co-movements might not be due to increased cross-border financial integration, whereas the converse is not true, ie there cannot be significant progress in financial globalisation without it tending to increase co-movements. It is therefore a useful check to see if the trend in co-movements is at least consistent with the financial globalisation story.

First we look at the development of correlations of returns on some major global asset classes. Graph 2 (left hand panel) shows that the correlations of stock returns in Europe and among emerging markets with those of the US increased to a relatively high level in the latter half of the 1990s and have broadly remained at that level, although there has been some weakening of the correlation vis-à-vis emerging markets since the middle of 2006. A broadly similar pattern emerges in the case of German and US long-term government bonds. Graph 2 (right hand panel) shows the emerging market sovereign spread and the US high-

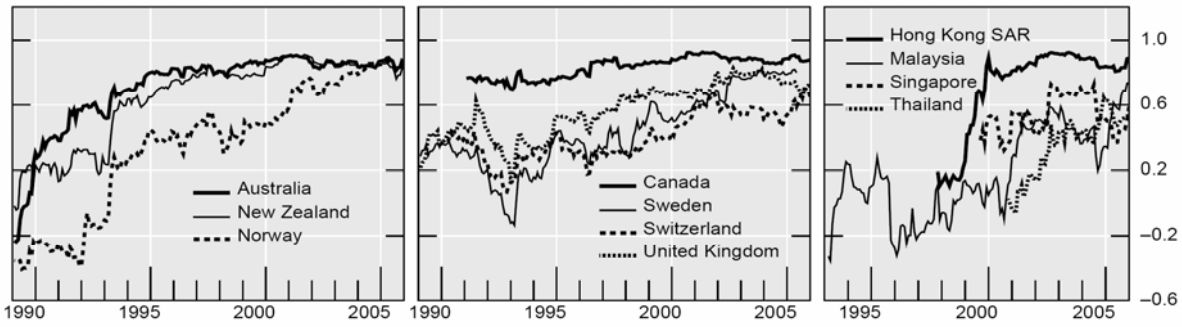
[10] Note in this context that the covered interest rate parity test is only partial as far as overall capital account liberalisation is concerned. It would for instance hold at short maturities for a country that heavily restricted equity flows and foreign direct investments, so long as a forward exchange rate market existed and money market flows were unrestricted.

yielding corporate spread vis-à-vis US treasuries since 1997. The correlation has been rather close this decade, whether that is due to financial globalisation or other factors.

Next we look at correlations of monthly changes in long-term government bond yields with those of US government bonds of the same maturity. Graph 3 shows these for a sample of seven mature inflation targeting economies over the period 1990–2005 and for selected emerging market economies for a shorter period. The correlations have risen significantly among the mature inflation targeting countries, except in those cases where they were already high at the beginning of the period. Correlations have also risen somewhat among the selected emerging market economies, although, as expected, they are lower than among the more globally financially integrated mature inflation targeting countries, except in the case of Hong Kong SAR, which has a currency board vis-à-vis the US dollar.

Graph 3

Correlation of domestic and US long-term interest rates[1]



[1] Monthly changes using a 36-month moving window; for Hong Kong SAR, Malaysia, Singapore and Thailand, 24-month moving window.

Sources: Bloomberg; national data.

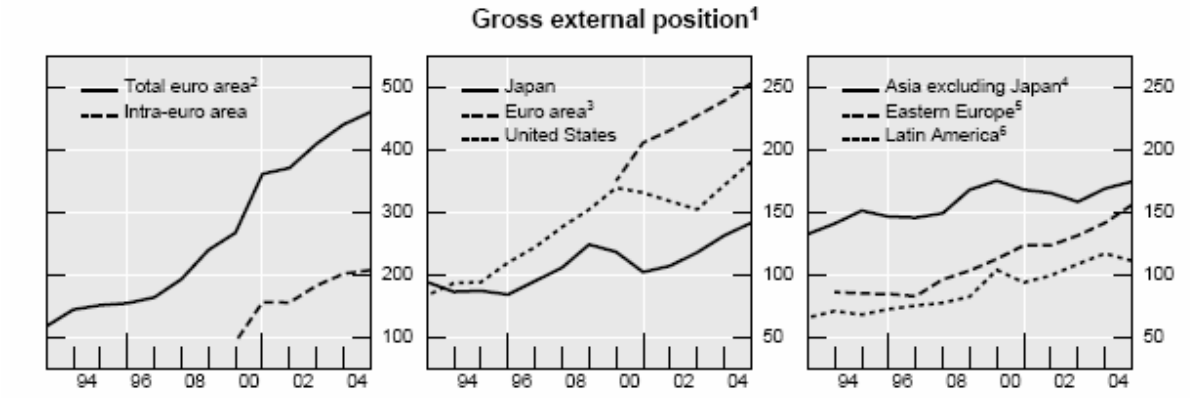
Gross external positions

Gross external positions, ie foreign assets and liabilities as a percentage of GDP, have, following Lane and Milesi-Ferretti (2006) and recommendations by Kose et al (2006), become popular in the literature as measures of the cross-border financial integration of individual countries and regions. However, as discussed in the last section, this measure has its caveats. Graph 4 shows gross external positions since the beginning of the 1990s for different regions of the world. It shows a marked increase in all regions and reveals that emerging Asia is more integrated, on the basis of this measure, than either emerging Europe or Latin America.

Home bias

The high level of home bias in domestic asset portfolios in spite of open capital accounts has remained somewhat of a puzzle. Stulz (2005) and Kho et al (2006) attribute home bias to agency problems in corporate governance, and in particular to the role of corporate insiders, but also to governmental action that can reduce the payoff to corporate outsiders. Kho et al find support for this theory using firm-level data for Korea. If this is case, then home bias might remain high in equity portfolios, even if, at the same time, financial globalisation produces a convergence of returns in fixed income markets, which are to a certain degree more important for the transmission mechanism of monetary policy. In addition to country home bias, the data indicates that there is a regional bias in foreign portfolio allocations (see for instance García-Herrero and Wooldridge (2007)).

Graph 4



[1] Foreign assets plus foreign liabilities, as a percentage of GDP. [2] Including intra-euro area assets and liabilities. [3] Excluding intra-euro area assets and liabilities. [4] China, Hong Kong SAR, India,Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan (China) and Thailand. [5] New EU members, ie Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. [6] Argentina, Brazil, Chile, Mexico, Peru and Venezuela.

Sources: P R Lane and G M Milesi-Ferretti, "The external wealth of nations mark II: revised and extended estimates of foreign assets and liabilities 1970–2004", *IMF Working Paper 06/69*, March 2006; IMF.

Saving-investment correlations

The correlation of saving and investment in individual countries is potentially the most general indicator of the degree of cross-border financial integration. If risk-adjusted real rates of return on capital were equalised across countries then there would not need to be any relationship between the level of saving and investment in a particular country, as all investment projects, independent of location, would have access to the global pool of saving at uniform rates. Feldstein and Horioka (1980) use this idea to assess the degree of global capital market integration by estimating the correlation of saving and investment as a percentage of GDP among 16 OECD countries during the period 1960–74. Their estimates were much lower than implied by full capital market integration, with the coefficient on the savings ratio (or savings retention coefficient) being typically above 0.8, whereas full global financial integration would imply zero.[11]

There are some indications that the original Feldstein-Horioka puzzle has become less prominent. Feldstein (2005) reports new research indicating that the segmentation of global financial markets has persisted among bigger mature economies but has been significantly reduced among the smaller ones. Interestingly, García-Herrero and Wooldridge (2007) report that the savings retention ratio seems to have fallen significantly during the 1990s and this decade for a representative group of emerging market countries. For the whole period 1982–2006, they also report that the savings retention ratio is lowest in Latin America among regions of emerging market countries, being close to zero, whereas it is highest in Asia, at around 0.5.

Summary

Let us now draw some overall conclusions from the different indicators of cross-border financial integration. The main thing to note is that although the evidence is consistent with significant progress of financial globalisation in the last decade and a half, it also indicates that countries are in general a significant way off from the limiting case of full integration. Thus, even if international co-movements of asset returns have increased strongly during this period, in most cases the situation is some way from being perfect. However, there are a few

[11] Feldstein (2005) has described how his estimation was prompted by a meeting of experts that he attended at the OECD 30 years ago, where the assumption of full cross-border financial integration seemed to be taken as a correct description of the real world.

small and medium-sized mature countries where correlations of changes in long-term interest rates with US rates have in recent years reached almost 90%. Furthermore, it seems that this development can only partly be explained by common shocks as some of these countries (eg New Zealand and Australia) were dealing with demand pressures at the same time as the US was trying to revive demand. That raises the question addressed in the next section of what will happen to the transmission mechanism of monetary policy as financial globalisation progresses.

III. Financial globalisation and the transmission mechanism of monetary policy

Taking a highly stylised view, monetary policy in mature economic systems can be seen to affect domestic demand through two channels.[12] The first of these is what this paper calls the interest rate channel: interest rates at medium and long maturities are partly driven by unanticipated current and expected future changes in short-term rates, which are in turn tightly aligned to policy rates, at least in normal times. This effect on longer-term rates is important as investment and consumption demand is generally much more responsive to medium- and long-term rates than to short rates. The second is the exchange rate channel: changes in policy rates change the interest rate differential vis-à-vis abroad, which in turn affects the exchange rate. For a small open economy that is not able to influence global interest rates, economic theory predicts that financial globalisation will gradually weaken the interest rate channel, and could even block it completely. However, the exchange rate channel would still be available to hit any inflation target in the medium to long run and potentially retain some countercyclical force in the short run, provided of course that the authorities allow the exchange rate to be flexible.

The prediction that financial globalisation will weaken the interest rate channel in small open economies might seem puzzling if it is assumed that the central bank will retain control of interest rates at the very shortest maturities. Note that this assumption is needed for the mechanism through which changes in policy rates are assumed to affect the exchange rate, ie through changes in the short-term interest rate differential. Furthermore, it seems to be well supported by experience. Thus those countries that have experienced weaker effects of short-term rates on longer-term rates have not been constrained in moving policy rates and have in general been able to control short-term rates rather tightly (eg New Zealand). If that is the case and interest rates at longer maturities are driven by expected short rates, how then can financial globalisation block the interest rate channel? The answer might be that it is expected global short-term rates, rather than domestic short-term rates, that increasingly drive domestic long-term rates in small open economies as financial globalisation progresses. If indeed financial globalisation is responsible for the observed high correlation of, for instance, New Zealand and US long-term rates,[13] even though the monetary stance of these two countries moves on occasions in the opposite direction, then it is due to current and expected US policy rates mattering more for New Zealand long rates than New Zealand policy rates, and not because the expectations theory of long-term rates as such is no longer relevant.

[12] These effects are in general only short- to medium-term. Thus in this paper it is taken as given that monetary policy has no long-term effects on variables like demand, output, employment and the current account. However, it has short-run effects on demand and output and hence shifts actual and expected inflation around. In the long run monetary policy thus only determines the inflation rate. However, in order to do so it has to either have a short-term effect on demand or affect price determination directly, for instance through changes in the exchange rate.

[13] As discussed in other parts of this paper it is still an open question to what degree this high correlation is due to financial globalisation as such or other factors (eg correlated shocks or even global convergence of inflation targets and monetary policy frameworks as suggested by Berg in discussing an earlier version of this paper).

Let us assume a world of full financial globalisation and a number of floating currencies. In this scenario, investors will be able to transfer huge amounts of funds between countries at negligible transaction costs. They will do so based on comparisons of expected real risk-adjusted returns across assets that are denominated in different currencies. They will thus have to form expectations about exchange rate movements over the relevant maturities. They will calculate real returns in terms of their own consumption baskets. For the average investor in each currency area, this is equivalent to comparing nominal risk-adjusted returns in terms of their home currency. The implication is that, for the average investor, expected real risk-adjusted rates of return will tend to equalise. What it means for actual risk-adjusted real returns measured in terms of different currencies and price levels (eg New Zealand real interest rates versus US real interest rates) depends, however, on how expectations are formed and how price levels behave.

One interesting benchmark is that of simultaneous full real and financial globalisation. In a similar fashion to the definition of financial globalisation we can define real globalisation as the cross-border integration of markets for goods, services and factors of production. In the extreme case, ie when real side globalisation has run its full course, all goods would be traded, ie there would be no domestic non-traded goods sector. Furthermore, there would be instant factor mobility, implying that factor returns are equalised across borders and that the domestic output gap becomes irrelevant and meaningless. In fact, there would be no specific national resource constraint. This state of affairs would probably be incompatible with national nominal rigidities and purchasing parity would hold at all times. Given "reasonable" assumptions about expectations (ie on average correct over the medium to long term) then this would also mean that equalisation of real risk-adjusted rates of return in terms of the currency of the investor will also imply such equalisation in terms of all currencies.

For the small open economy that is unable to affect global financial conditions this means that monetary policy will not be able to affect domestic real interest rates, at least not at longer maturities. Its ability to affect domestic demand through the interest rate channel would then, in the most extreme case, disappear.

Any weakening of the countercyclical force of monetary policy that this would entail need not be a problem. The reason is that countercyclical policy is not called for here as there is no domestic output gap that needs to be stabilised. However, monetary policy would be able to use the exchange rate channel to deliver any inflation target that the authorities would want. By creating deviations of the domestic nominal policy rate from the global rate, the domestic inflation rate can be made to diverge from the global interest rate. The law of one price would still hold, ie there would be real interest rate parity and purchasing power parity would be in force. This is really back to the world of perfect markets and the quantity theory. Monetary policy has no real effect. The only effect it has is to determine the inflation rate, which is also neutral in its effect on the real economy.

The above case is of course a theoretical abstraction and the countries of the world are in most cases still far from this state of affairs. However, the result regarding the tendency of real risk-adjusted rates of return to be equalised will also hold in many other cases where there is full financial globalisation, in the meaning of negligible transaction costs and speedy arbitrage across national financial markets and currency zones, but still not full real side globalisation. Thus if longer-term nominal rates tend to be correlated due to financial globalisation, and nominal price levels are sticky, then there would also be a tendency for real rates to co-move, measured in terms of each country's currency.

These results are of course not new. Bob Mundell demonstrated in a series of articles in the early 1960s (eg Mundell (1963) and Mundell (1964)) that for the small open economy monetary policy working only through the exchange rate would be a powerful stabilisation tool when the exchange rate floats but totally ineffective when it is fixed. The reverse would hold for fiscal policy. Mundell's model was heavily "Keynesian". He assumed that money,

wages and the price level were fixed as there were unemployed resources and constant returns to scale. The implication is that there is no pass-through from changes in the exchange rate to the price level and there is no need to make the distinction between nominal and real interest rates. Furthermore, there was only one interest rate in the model and monetary policy operated through changes in the money supply. Given these assumptions and that of totally free capital movements, the domestic interest rate was pegged at the global level.[14]

This section has demonstrated that financial globalisation will under many plausible conditions weaken the interest rate channel of monetary policy transmission in small open economies and, in the most extreme cases, block it completely. To what degree that is a problem will depend partly on how well the exchange rate channel operates. If it works smoothly then there might not be much cause for concern. However, if there is excess volatility and exchange rates show tendencies to be decoupled from fundamentals then there is more to worry about. It is interesting in this regard that in some of the countries that seem to have been more strongly subject to the forces of financial globalisation, like New Zealand, there has been concern about the potential overburdening of the exchange rate channel and about excess volatility and misalignments potentially having detrimental effects on the traded goods sector. We will come back to this issue in Sections V and VI.

IV. Recent evidence on the interest rate channel

This section investigates the evolution of the interest rate channel of monetary policy transmission for a group of mature and emerging inflation targeting countries, mostly with open capital accounts. The focus is on the relative influence on domestic long rates of policy rates on the one hand and a representative global rate on the other. The analysis is based on a few assumptions that need to be spelt out. First, it is assumed that neither monetary policy nor the long rates of each of the countries in our sample affect the global long rate. That means that the global long rate can be taken to be exogenous for the determination of the domestic long rate. Second, it is assumed that central banks are able to exercise tight control over domestic short-term money market rates. Again, that means that the domestic short rate can be taken to be exogenous for the purpose of determining the domestic long rate.

It has to be stressed that the correlations and econometric relationships investigated in this section cannot give definite results on whether financial globalisation is weakening the interest rate channel in small open economies or not. At best, it can tell whether the data is, or is not, consistent with the financial globalisation story. When coupled with plausible stories and auxiliary evidence, we might get further.

It has already been mentioned that stronger co-movements of long-term interest rates could be due to other factors than financial globalisation, such as common shocks. However, if we were to observe the opposite, no strengthening of co-movements, or even a weakening, then we would have a pattern in the data that would be hard to reconcile with the financial

[14] Mundell realised the extremity of this case, but also that what we now call financial globalisation is a process rather than a state of nature. In his own words: “I assume the extreme degree of mobility that prevails when a country cannot maintain an interest rate different from the general level prevailing abroad. This assumption will overstate the case but it has the merit of posing a stereotype towards which international financial relations seem to be heading” (Mundell (1963)). “I hope my assumptions are unrealistic. If they were not, I could not have made a contribution to theory” (Mundell (1964)). Making extreme assumptions is of course paramount to economic theory making but this has to be kept in mind when applying the theory to actual economic conditions. Macroeconomic textbooks rightly make the jump from totally controlled capital movements to frictionless capital movements from one page to the next. However, it might create the wrong impression that such an overnight transition can be made in the real world by governments abolishing all restrictions with a stroke of a pen.

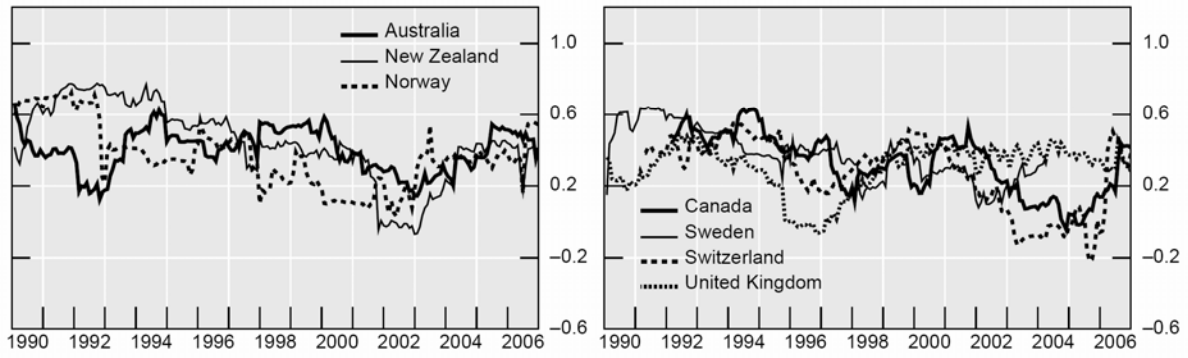
globalisation story. Similar reasoning applies to the effect of changes in policy rates on longer-term rates. In a small open economy, a weakening of the relationship, and in the most extreme case its disappearance, could be due to financial globalisation where longer-term rates reflect more and more global, rather than domestic, current and expected future policy rates. But it could also be due to something else, where a credible fully anticipated monetary policy is a prime candidate. However, again, no weakening or even strengthening of the relationship would on the face of it be inconsistent with the financial globalisation story.

Mature inflation targeting economies

The assumptions above (ie open capital accounts, flexible exchange rates, etc) and data availability issues limit the sample to small and medium-sized mature economies and a few emerging market economies. For the first group of countries the investigation looks at monthly data for the period 1990–2006 for Australia, Canada, New Zealand, Norway, Sweden, Switzerland and the UK.

Graph 5

Correlation of domestic short-term interest rates and domestic long-term interest rates[1]



[1] Monthly changes using a 36-month moving window.

Sources: Bloomberg; national data.

First we look at simple rolling correlations of interest rate changes (36-month window of monthly data) for the sample of developed countries (see Table 1 and Graphs 3 and 5) during the period 1990–2006. Three sets of domestic interest rates are considered, ie 3-month money market rates, medium-term (2- to 3-year) government bond rates and long-term (10-year) government bond rates. The correlations reported are the following: domestic short-term and medium-term rates, domestic short-term and long-term rates, domestic long-term and US long-term rates and domestic medium-term and US medium-term rates. Across the maturity spectrum and locations the following pattern should be expected:

- Domestic short-term rates being more strongly correlated with medium-term rates than long-term rates.
- Domestic long-term rates being more strongly correlated with US long-term rates than domestic medium-term rates are with US medium-term rates.

The pattern through time that would be consistent with ongoing financial globalisation is the following:

- Domestic long-term and medium-term rates becoming more correlated with US rates, with the tendency being more pronounced in the case of long-term rates.
- The link between domestic short-term and long-term rates becoming weaker (and possibly also that between short-term and medium-term rates).

Table 1

Correlation of domestic and foreign interest rates[1]

	Domestic short-term and longer-term rates				Domestic and US rates			
	1990–93	**1997–99**	**2001–03**	**2004–06**	**1990–93**	**1997–99**	**2001–03**	**2004–06**
Medium-term								
Australia	...	0.6	0.2	0.4	...	0.5	0.6	0.3
Canada	...	0.4	0.5	0.4	...	0.8	0.7	0.8
New Zealand	0.9	0.7	0.6	0.5	0.2	0.6	0.6	0.4
Norway	0.9	0.6	0.6	0.7	0.0	–0.1	0.4	0.7
Sweden	0.8	0.6	0.6	...	–0.3	0.3	0.7	...
United Kingdom	0.6	0.5	0.6	0.3	–0.1	0.7	0.8	0.5
Long-term								
Australia	0.5	0.6	0.3	0.4	0.5	0.8	0.9	0.9
Canada	0.5	0.2	0.1	0.4	0.7	0.9	0.9	0.9
New Zealand	0.7	0.4	0.2	0.4	0.2	0.8	0.8	0.8
Norway	0.4	0.2	0.3	0.5	–0.1	0.4	0.7	0.8
Sweden	0.5	0.3	0.3	...	–0.1	0.6	0.8	...
United Kingdom	0.4	0.4	0.4	0.3	0.2	0.7	0.8	0.7

[1] Monthly changes.

Sources: National data; BIS estimates.

The results are broadly consistent with these priors. As can be seen in Table 1, domestic short-term rates are in general more correlated with medium-term rates than long-term rates and the correlation with US rates increases with maturity. It further emerges that correlations of domestic long-term rates with US rates have in most cases been increasing through time but that the tendency is less clear in the case of medium-term rates. Finally, there seems to be some tendency for the correlation between domestic short-term rates and long rates to weaken. However, the tendency is not uniform and there are clearly periods where it weakens significantly and then comes back, which is not consistent with progressing financial globalisation.

Simple correlations of the above type can at best be only indicative. They do not address issues of causality, although our assumptions, if correct, take care of that. Neither do they take into account lags in the relationships or joint determination by several variables. In order to deal with these added complexities an error correction model of the domestic long-term interest rate is specified below. Although plausible, it is somewhat arbitrary by assuming two co-integrating vectors where only one of the exogenous variables (domestic short rates and US long rates) enters each. These restrictions remain to be tested at a later stage but for the current investigation of the evolution of the interest rate channel we let it be.

$$\Delta i_t^l = \alpha + \beta_s \left(c_1 + i_{t-1}^l - \gamma_s i_{t-1}^s\right) + \beta_g \left(c_2 + i_{t-1}^l - \gamma_g i_{t-1}^{lg}\right) + \sum_{i=0}^{T} \phi_i \Delta i_{t-i}^s + \sum_{i=0}^{S} \lambda_i \Delta i_{t-i}^{lg} + \sum_{i=1}^{R} \theta_i \Delta i_{t-i}^l \qquad (1)$$

i = nominal interest rate, l stands for long, s stands for short and lg stands for global long (proxied by US rates).

Equation (1) could be simplified by constraining both the γ's to be equal to 1. This is not a strong assumption as any other value will imply that there is a trend increase (or decrease) in the slope of the domestic yield curve and the long-term interest rate spread vis-à-vis the US. Neither is plausible given the sample period and the countries involved. Given this constraint we get (2),

$$\Delta i_t^l = \alpha * + \beta_s \left(i^l - i^s \right)_{t-1} + \beta_g \left(i^l - i^{lg} \right)_{t-1} + \sum_{i=0}^{T} \phi_i \Delta i_{t-i}^s + \sum_{i=0}^{S} \lambda_i \Delta i_{t-i}^{lg} + \sum_{i=1}^{R} \theta_i \Delta i_{t-i}^l \qquad (2)$$

where $\alpha* = \alpha + \beta_s c_1 + \beta_g c_2$

The βs are measures of adjustment speeds to the long-run equilibrium levels (provided they exist). They should therefore have negative signs. If a β is not significantly different from zero then there is no long-run relation. Care should be exercised in interpreting the implications of non-significant β, especially in the case of the short-long relation. It does not mean that there is no interest rate channel. We do not expect monetary policy to be able to exert long-run influences on long-term real interest rates. If inflation expectations over the medium term are anchored at a stable inflation target, as should be the case in the current sample of countries, then the same would apply to nominal long rates. All that is required for there to be an interest rate channel is for monetary policy to have influence on longer maturity rates over the short and medium term.[15]

Equation (2) is estimated for seven mature small and medium-sized inflation targeting countries, both with and without the error correction terms. The results are given in Tables 2 and 3. The regressions explain 40–70% of the changes in domestic long rates, with the error correction terms not adding much explanatory power.[16]

[15] Note that what is being tested here is different from the tests of monetary independence in Obstfeld and Taylor (2004). They look at the ability of countries to set short-term interest rates different from a base country. That ability is not being questioned in this case. All these countries have floating exchange rates and one has only to look at the short-term interest rate differentials to see that they can set different rates from the US. Frankel et al (2002) are also of relevance in this connection. They look at a large sample of developing and industrialised countries during the period 1970–99 and find in most cases full long-run transmission of international interest rates to domestic rates, even for countries with floating exchange rate regimes. The only exceptions are the very largest developed countries, which can thus benefit from independent monetary policy in the medium to long run. However, all we need for monetary policy to play a role through the interest rate channel is short- to medium-run monetary independence. Again, Frankel et al use short-term rates.

[16] All the estimated equations include one lag of the dependent variable (domestic long-term rate), current value of the domestic short-term rate and up to two lags, and current value of the US long-term rate and two lags.

Table 2

Coefficients on long-run relations

	Short and long interest rates (β_s)			Long domestic and US interest rates (β_g)		
	1990–2006	**1990–98**	**1999–2006**	**1990–2006**	**1990–98**	**1999–2006**
Australia	–0.01	–0.01	0.01	–0.02**	–0.02	–0.04*
Canada	–0.02**	–0.03**	–0.00	–0.01	–0.05*	–0.01
New Zealand	–0.02*	–0.04**	0.01	–0.04***	–0.04**	–0.04**
Norway	–0.02*	–0.02	–0.02**	–0.04***	–0.06*	–0.01
Sweden	–0.02	–0.02	–0.07	–0.03***	–0.04*	–0.03
Switzerland	–0.02***	–0.02**	–0.02	–0.04**	–0.04	–0.05
United Kingdom	–0.01	–0.02	0.02	–0.01	–0.03	–0.06*

Sources: National data; BIS estimates. *, **, *** denote coefficients significantly different from zero at the 10%, 5% and 1% level, respectively.

Table 2 gives the results for the coefficients on the error correction terms (β_s and β_g). Looking first at the coefficient on the short-long relation, for the whole period there is only a strongly significant relationship in the cases of Canada and Switzerland. Splitting the sample gives some indication of a weakening relationship. The main exception is Norway, but these results are probably coloured by the fact that Norway operated a fixed exchange rate policy until the late 1990s. The results for the coefficient on the level relationship between domestic and US long rates do not give a particularly clear pattern. There is some indication of a faster adjustment speed and/or a more significant relationship in some countries (Australia and UK), weakening in others (Canada, Norway and Sweden) and unchanged in two cases (New Zealand and Switzerland).

The cumulative impact of first difference terms only might provide additional indications (see Table 3). There seems to be an almost uniform tendency of a weaker cumulative impact of first differences of short-term interest rates on the corresponding change in the long-term interest rates, with it almost disappearing in the case of Australia, Canada and New Zealand. The only exception is Norway, but then it operated exchange rate targeting until the late 1990s. The cumulative impact of the first differences of US long-term rates on the change in the domestic long rates is high for the whole sample period. However, in most cases it is lower in the second half of the sample period than in the first half. This might seem to contradict the results of the simple correlation.

Emerging market economies

Mohanty (2007) summarises findings at the BIS and discussions from a December 2006 meeting of Deputy Governors from emerging market countries on recent changes in the transmission mechanism of monetary policy in emerging market economies.[17] For the same meeting Moreno (2007) looks specifically at the issue of the determination of long-term rates in these countries and the relative influences of policy rates and global long rates (proxied by

[17] A similar meeting a few years earlier discussed in broad terms the progress and effects of financial integration in emerging market countries (see Andersen and Moreno (2005) for an overview). One of the papers for that meeting addressed the issue of whether financial globalisation had reduced monetary independence in emerging market economies (see Mohanty and Scatigna (2005)). Wooldridge et al (2003) analyse the changing links between mature and emerging financial markets.

US rates). Not surprisingly, the picture that emerges is mixed. Many emerging market economies are still in the phase where the development of the domestic financial system is strengthening the interest rate channel of monetary policy transmission and several of them still have significant capital controls. However, at the same time some emerging market countries are experiencing a stronger influence of global long rates on domestic rates, which in some cases is stronger than the influence of the domestic policy rate. These influences were both confirmed by answers to a questionnaire and econometric estimation. Thus Moreno (2007) estimates a vector autoregression system in first differences of the domestic short-term and long-term rates and the long foreign rate using daily data from the beginning of 2001 to the end of September 2006. Different maturities of long-term rates were used, ie 1-, 3-, 5- and 10-year, for India, Korea, Malaysia, the Philippines, Thailand, Brazil, Mexico, the Czech Republic, Hungary and Poland. Although there was significant country variation in the results it emerged that foreign long-term rates sometimes have a larger impact than domestic short-term rates and the influence of foreign rates has increased with time.

Table 3

Cumulative impacts[1]

	Short-term interest rates on domestic long-term interest rates			US long-term interest rates on domestic long-term interest rates		
	1990–2006	**1990–98**	**1999–2006**	**1990–2006**	**1990–98**	**1999–2006**
Australia	0.18	0.16	0.02	0.92	1.04	0.79
Canada	0.14	0.14	0.04	0.89	1.06	0.63
New Zealand	0.25	0.27	–0.01	0.72	0.73	0.74
Norway	0.22	0.22	0.31	0.68	0.60	0.76
Sweden	0.17	0.16	0.16	0.84	0.88	0.75
Switzerland	0.38	0.47	0.25	0.83	0.88	0.75
United Kingdom	0.29	0.30	0.21	0.67	0.76	0.49

[1] Calculated as the ratio between the sum of the coefficients of contemporaneous and lagged domestic short-term interest rates and one minus the sum of the coefficients of lagged domestic long-term rates. Monthly changes in domestic long-term interest rates were regressed on monthly changes in domestic short-term interest rates, monthly changes in lagged long-term domestic interest rates and monthly changes in long-term interest rates of the United States.

Sources: National data; BIS estimates.

Summary

The results of this data exercise are not conclusive. There is evidence of a close and strengthening relationship between domestic and US long-term rates. There is also some evidence of a weak and/or weaker relationship between domestic long-term rates and current and lagged short-term rates. Both of these tendencies are consistent with ongoing financial globalisation but also with common shocks and more credible and more anticipated monetary policy. In general, even if the interest rate channel might be getting weaker, it cannot be proclaimed dead.

V. The exchange rate channel

In Section II it was shown that cross-border financial integration will make the domestic interest rate channel of monetary policy transmission weaker, and in the most extreme cases, inoperative. However, this will still leave the exchange rate channel to determine, in the long run, the inflation rate. Depending on the state of real cross-border integration and short-run wage and price rigidities it could also provide some short-run stabilisation through its effect on the traded goods sector.

How well the exchange rate channel will work in this regard will to a significant degree depend on how closely exchange rates are aligned with fundamentals. That is, however, where the concerns seem to arise. Evidence seems to suggest foreign exchange markets exhibit excess volatility and that exchange rates diverge from fundamentals for lengthy periods. The existence of carry trades can in some sense be taken as evidence of this, as it involves a bet that interest rate differentials are not fully compensated by exchange rate movements, ie that uncovered interest rate parity does not hold. According to the theory of uncovered interest rate parity, low-yielding currencies should be expected to appreciate and high-yielding currencies to depreciate. However, what we observe over lengthy periods is the reverse, followed by sharp corrections.[18] In this regard, one could reflect on the yen versus the New Zealand dollar.

The basic problem is that the exchange rate has a dual nature. On the one hand it is a macroeconomic adjustment tool and probably the most important relative price of small and medium-sized open economies, and on the other hand it is an asset price with all the potential problems that can be associated with that. This means that the exchange rate can potentially be both a tool for stabilisation and a source of shocks. What aspect dominates in this regard is ultimately an empirical question and will in specific cases depend on structural features of individual countries and might be affected by the constellation of monetary, fiscal and prudential policies.[19]

The Great Moderation (greater stability of real growth and inflation) does not show up much in real exchange rates. Table 4, however, indicates that the volatility of real effective exchange rates at a monthly frequency is less for the majority of the countries included in the Table during the last five years than it is for the two preceding six-year periods starting in 1990. However, there are a few examples among the IT countries where volatility is higher (Canada, New Zealand, Norway and Chile). Furthermore, visual inspection of Graph 6 seems to indicate that although the high-frequency volatility might in many cases be lower in the last few years, the overall swings do not seem to have been noticeably reduced. To take examples, both Australia and New Zealand had two exchange rate cycles during this period. If the amplitude of each cycle is measured by the average of the changes from peak to bottom and back again, then in the case of Australia the first one was 15% and the second 28%. The respective figures for New Zealand are, strikingly, 27% and 41%.

[18] Plantin and Shin (2006) provide a theoretical analysis of carry trades and speculative dynamics. Their findings suggest that markets such as the foreign exchange market, which combine significant costs of carry and low "resiliency" have the pre-conditions for large and persistent deviations of prices from fundamentals, followed by abrupt reversals. Their model predicts that UIP will fail and that a high-yielding currency will go "up by the stairs" and come "down with the elevator".

[19] Ho and McCauley (2003) give a good review of the experience of inflation targeting emerging market economies in living with flexible exchange rates and provide an interesting discussion of the associated policy issues.

Table 4

Volatility of real effective exchange rate[1]

	1990–95	1996–2001	2002–06
United States	1.49	1.17	1.40
Japan	2.64	2.73	1.46
Germany	0.98	0.93	0.74
Australia	2.16	2.21	1.65
Canada	1.23	1.12	1.51
New Zealand	1.29	1.82	1.94
Norway	0.76	1.11	1.63
Sweden	1.97	1.32	1.10
Switzerland	1.42	1.19	0.88
United Kingdom	1.81	1.48	1.13
Hong Kong SAR	1.47	1.57	1.30
Korea	1.47	4.52	1.38
Malaysia	1.46	2.99	0.98
Singapore	0.85	1.38	0.93
Thailand	0.82	3.84	0.95
Chile	2.22	1.75	2.15
Mexico	4.83	2.32	1.90
South Africa	1.32	3.15	3.89
All economies[2]	1.68	2.03	1.50
Mature IT countries[2]	1.57	1.51	1.34
Selected emerging Asian economies[2]	1.21	2.86	1.11

[1] Measured as the standard deviation of monthly changes; in terms of relative consumer prices. [2] Unweighted average.

Sources: Central banks; IMF; BIS.

How much does this matter? The real economic costs of exchange rate volatility have proven hard to quantify. Estimates of the effects on trade and growth are usually much smaller than seem to be implicit in the discussions of many politicians and businessmen.[20] Furthermore, there does not seem to be a significant trade-off between exchange rate volatility and the volatility of important macroeconomic variables.[21] On the other hand there is a literature that indicates that the existence of separate currencies might be a significantly stronger impediment to trade. Thus, Andrew Rose has in several empirical papers found that

[20] See, for instance, Rogoff (1998). Levine and Carkovic (2001) obtain similar results in a panel study of the growth equation covering 73 countries over the period 1960–95.

[21] See Flood and Rose (1995).

membership in a monetary union increases trade with the other members very significantly at the same time as trade diversion seems to be small. Increased trade in turn increases growth.[22] Further evidence is provided by Frankel and Wei (1995), using a gravity model of bilateral trade, who find that membership in the EU increases trade with other EU members by at least 60%.

One possible way to square these results is to say that if you do have your own currency then its volatility within the bounds usually observed does not matter that much. However, if de facto and expected volatility vis-à-vis natural trading partners goes all the way to zero then the effects will be strong. It is only at that point that expected exchange rate volatility goes to zero and associated risk premia in domestic interest rates disappear.

A possible conclusion from all of this is the following: the exchange rate channel will work at the end of the day, although financial globalisation might be making the road bumpier. That might not matter too much, partly because financial globalisation is also providing the instruments (hedging etc) to reduce the cost of exchange rate volatility. However, if the cost of excess volatility in exchange rates is judged to be too high for small countries to bear, then they might consider entering a monetary union.

VI. Some policy issues

The problems and challenges created for macroeconomic management in small but financially developed economies by ongoing financial globalisation can on the basis of the discussion in the sections above be summarised as follows:

- It is becoming more difficult to be out of sync with the rest of the world;
- The interest rate channel of monetary policy is becoming weaker and less predictable;
- Speculative capital flows are creating volatility in the exchange rate and at times significant decoupling from fundamentals;
- Such exchange rate volatility and overburdening of the exchange rate channel can have detrimental effects on the traded goods sector.

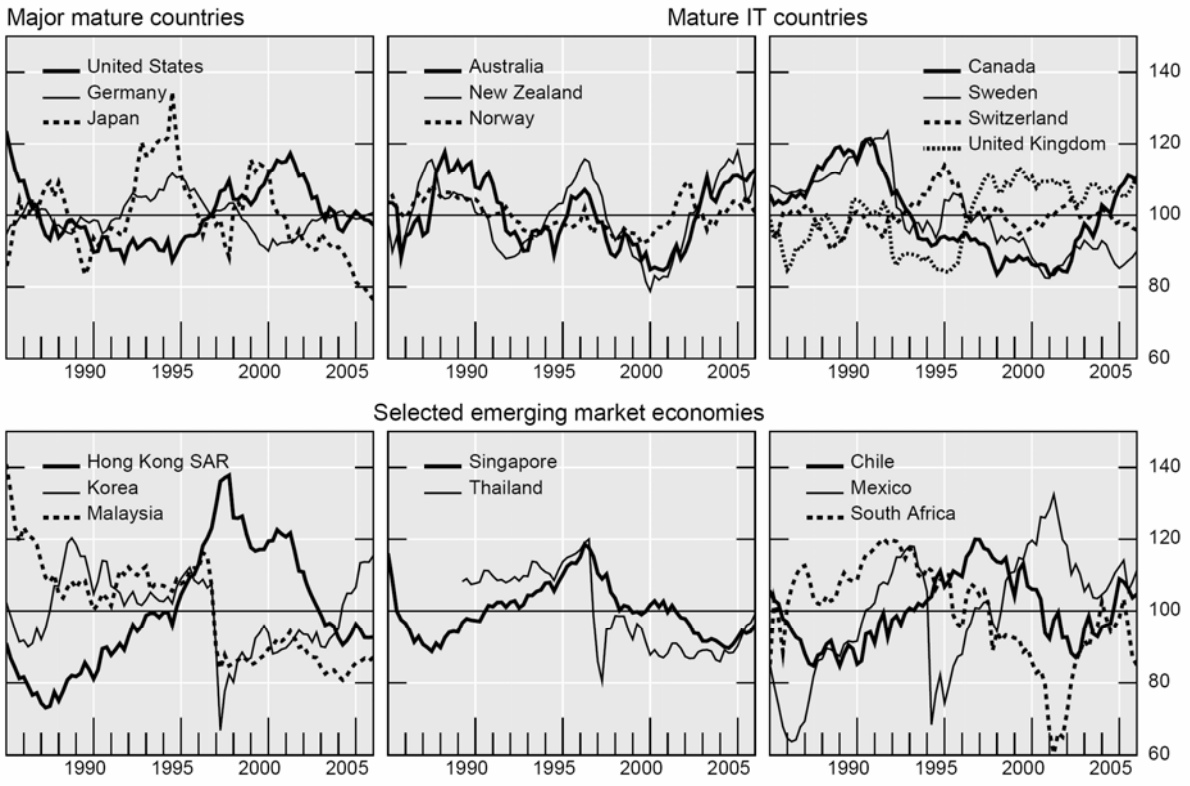
This short section will not provide a lengthy discussion of the potential policy responses to these problems. There is already an interesting discussion of those in several countries, not the least in New Zealand. Thus, for instance, the authorities in New Zealand have initiated a major review of its macroeconomic and prudential policies (see, for example, Reserve Bank of New Zealand (2006)). However, we can sketch the general directions that small and medium-sized countries can take when faced with a weakened interest rate channel and a misbehaving exchange rate. It seems that they have basically three options.

First, they can decide to live with it. After all, they will eventually be able to deliver their inflation target. The road will be bumpy in terms of exchange rate volatility and potential misalignments but it is not clear how strong the detrimental effects on the traded goods sector really are, partly because a sophisticated financial sector can provide hedging instruments.

[22] See Frankel and Rose (2002). These results have also been strongly disputed.

Graph 6

Real effective exchange rate developments[1]



[1] In terms of relative consumer prices; 1986–2006 = 100.

Sources: Central Banks; IMF; BIS.

Second, they can try to sharpen and realign existing instruments in order to reduce the burden on monetary policy and exchange rate adjustment with the aim of reducing adverse effects on the traded goods sector. This would involve measures like shifting the policy mix in the direction of fiscal policy, recalibrating prudential instruments with a view to minimising procyclicality, reviewing the tax and incentive structures of asset markets, particularly housing, and maybe even an occasional foreign exchange intervention. This seems to be the road upon which New Zealand, the pioneer of inflation targeting, is currently embarking. However, it remains to be seen how much mileage can be got out of measures of this type; there are, for instance, political economy problems with using fiscal policy for short-run stabilisation purposes, especially if there is already a significant fiscal surplus.

Finally, they could radically change the framework by entering a monetary union. Each country faces different options and its particular pros and cons in such regard. However, it is clear that, as both real and financial globalisation progress, the relative attractiveness of entering a monetary union increases, everything else being equal. The reason is that the world is heading in a direction where, for small economies that are unable to influence global interest rates, countercyclical monetary policy will be both impossible and unnecessary. However, in many cases, especially among emerging market economies, we are still far from that state of affairs, and might never completely get there.

VII. Conclusions

The interest rate channel of monetary policy will strengthen as domestic financial markets develop. Furthermore, liberalisation of capital movements will in most cases provide an

additional impetus to domestic financial market development, thus strengthening the interest rate channel still more. However, theory predicts that financial globalisation will gradually weaken the interest rate channel in small open economies that are unable to affect global financial conditions, and in the most extreme cases block it completely. That will leave the exchange rate channel to deliver the inflation target and provide some short-run stabilisation.

Financial globalisation is a process and not a state of nature. It is therefore important to attempt to measure where individual countries and the world as a whole are in the process. This paper has surveyed various measures based on legal and regulatory frameworks, prices and quantities. What emerges is a mixed picture. Although there has been significant progress in financial globalisation in the last decade and a half, most countries are a significant way off from the limiting case of full integration. However, there are a few small and medium-sized mature economies where correlations of domestic long-term bond yields with global yields have become very high. This is consistent with the financial globalisation story but might also be caused by other factors, such as common shocks. However, there are a few cases (eg Australia and New Zealand) where common shocks cannot plausibly explain the correlation.

The data indicates that the effects of changes in policy rates on interest rates at longer maturities have become weaker among small and medium-sized mature inflation targeting countries. Similar, but weaker, effects can be found among emerging market economies. However, the data does not yet support proclaiming the interest rate channel dead. Moreover, although this trend is consistent with ongoing financial globalisation, it is also consistent with other explanations, such as more strongly anticipated credible monetary policy. It remains a challenge, and a matter for further research, to statistically distinguish between these two.

A weakening of the interest rate channel might be seen as a problem if the exchange rate channel is not well behaved due to excess volatility and decoupling from fundamentals. There is currently a lively discussion of the associated policy issues. Broadly speaking, small open economies face three options: to live with the situation, sharpen and realign existing policy instruments, or enter a monetary union. It will be interesting to observe how the policy discussion will unfold in the years to come.

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Capital, carry, & complacency: key developments in the financial landscape – dynamics of the foreign exchange market and capital flows

Brendan Fitzsimmons

Introduction

In the discussion of the current dynamics of the foreign exchange (FX) market and capital flows in the recent period, what stands out is the combination of a global search for yield – manifest in FX carry trades and narrowing spreads – and a default complacency about risk – manifest in selling volatility and increasing leverage, facilitated by innovations in the products available to more market participants at lower costs, and, until recently, a lesser attention to credit quality and creditworthiness in many deals in order to continue to generate volume in new transactions. Unprecedented liquidity, particularly mushrooming sovereign and retail pools, amplifying the past provision of liquidity by global central banks, and the increasing leverage in financial products and volume of deal flow intersected to provide a self-reinforcing reduction of friction in the system.

Equally important in discussing these dynamics is consideration of developments among agents: central bank policy makers and their policy frameworks and the market practitioners' perceptions of them. The proliferation of more independent, rules-based central banks, operating policy with increasing transparency and less volatility has underpinned an unprecedented increase in synchronous, interdependent economic growth and moderate inflation over a larger portion of the global system. However, one consequence of this signal policy framework success has been that it has also facilitated some of the risk taking in the financial economy. Strong global growth, low volatility, and ample liquidity conditions have combined with financial innovation to impede central bank policy transmission. This impedance has been strengthened and extended by the market perception of the opportunity costs of a more rules- and forecast-based approach in central banking: loss of both the will and capacity for short-term, discretionary market management by central banks against the background of the gradual removal of the unprecedented liquidity provided from 2001–2003. As a result of innovation and liquidity markets have become more short-term oriented at a time when policy is seen as more medium-term focused: in the gap between the two the importance of perception/misperception and uncertainty increases.

The issue of market perception/misperception and the expectations generated from it has been and will remain critical to framing the discussion of the challenges facing policy making in this current cycle: perception/misperception of the economic cycle and its sub-cycles, whether temporal, regional, or sectoral, and how insulated one can remain from the rest; of whether shocks are confined primarily to the financial sector or extend to the real economy; and of the nature of policy frameworks' flexibility and the reaction function at various central banks. One area where the issue poses a question is in the evolving discussion – among central bankers, and between central bankers and market practitioners – on optimal communication and transparency under conditions of uncertainty: whether increased communication and transparency can work against or at least not assist policy execution (and market perception of it) under persistent uncertainty or increasing risks to both inflation and growth. A less often discussed dimension is whether policy frameworks, particularly inflation referencing regimes developed over the last two decades, utilizing their existing policy target frameworks are or will be optimally suited to the current and future cycles: whether policy frameworks are flexible or evolutionary enough to adapt to the challenges of

the evolving market is a source of uncertainty, creating a unique set of conditions for the financial landscape and driving FX dynamics and capital flows.

The uncertainty created in the interplay of central bank policy and market perception is set against and amplified by the historic evolving structural shift in the balance of economic power and the degree of innovation and participation within the global financial system: the increasing integration of major developing economies (particularly in greater Asia, where growth has been the strongest, accumulation of FX reserves greatest, and FX flexibility modest) and the proliferation of the volumes, instruments, complexity, and atomization of participation in the financial system. This shift is creating a critical dimension of additional future uncertainty: uncertainty attending the broad transition away from what has been a structurally constructive environment for policy making over the last decade-and-a-half, largely characterized by tailwinds: i.e. the confluence of increasing globalization of economic factors and trade linkages allowing an unprecedented expansion and deepening of the global economy (in particular characterized by the increasing integration of China and India, of Eastern Europe and the former Soviet Union, and of the post-crisis recovery of East Asia), the elaboration and increasingly widespread success in adopting, operating, and diffusing rules-based central banking frameworks referencing price stability as the *sine qua non* of policy credibility and effectiveness, and the global trend towards increased central bank independence and transparency, in the context of generally more flexible exchange rate regimes. After more than 15 years, however, there is little doubt that we are at or near an inflexion point, transitioning to a less certain and possibly less constructive, more contentious policy environment: i.e. one characterized by an absence of tailwinds and some potentially notable headwinds.

In the developing economies there are the questions around the current and next stages of development, of better balancing of savings, investment, and consumption, and of whether adjustments will take place in terms of deepening and integrating domestic financial markets and increasing flexibility of exchange rate regimes, particularly given the reserves that have been built up and accelerating over the last five years. In the advanced industrial economies there are the questions of how to cope with demographic and underfunded liabilities challenges, the diffusion of economic power to more poles and to previously less-developed countries, and the potential domestic criticisms of globalization, particularly surrounding uncertain or less obvious gains which could fuel protectionist critiques and populist policy responses. For the global system broadly there are the questions of where the non-contentious growth will come from given the paucity of new integrators in contrast with the last two decades (i.e. no new China, FSU and Eastern Europe, or post-crisis Asia), how central bank policy frameworks facing reduced or mitigated policy transmission will evolve to cope with pressure from conditions whereby the global growth rate may not continue to accelerate yet while inflation pressures, despite the proliferation of targeting regimes, may continue to build.

In considering this environment of potentially less constructive conditions, the two intertwined sources of medium-term risk and uncertainty looming for markets in general and for FX and capital flows in particular remain the dynamics and evolution of the US current account deficit and the stores and flows of Asian savings. So far, even in the recent period where global growth and employment have continued to record historic highs despite what is already four quarters of sub-trend growth in the US and an orderly, though not equally distributed, depreciation in the US Dollar, little sustained progress has been made in reducing the pressures in the global system. In fact the symbiosis between US deficit and Asian saving and recycling dynamics is still reinforcing the pressures in the system.

The present transition period is defined by coming to terms with less capacity for policy to "manage" the near term, under conditions of greater uncertainty, and with more unintended consequences, against the background of the continuing structural power shift. These challenges will be steeper and potentially more problematic in the future if the current multi-year, globally synchronous recovery and expansion slow sooner and more significantly than

expected, or if it becomes less synchronous, accentuating the lack of substantive success in reducing global imbalances. Given the scope for market misperception, such an outcome could further reduce the already constrained room for policy maneuver, highlighting existing tensions in an environment of policy transmission impedance and uncertainty.

1. Key developments in the financial landscape

The discussion of key developments in the financial landscape can be distilled to one of capital, carry, and complacency. That is, the dynamics in foreign exchange and capital flows have been a function of liquidity in the system, carry opportunities created both by the liquidity in the system and by rate differentials among key economies, and complacency about the persistence of a low volatility environment. This low volatility environment, stemming from and driven by liquidity conditions, has facilitated, focused, and reinforced the attention of the market on the global search for yield. An added dimension of this complacency, which also derives from liquidity in the system and views on its structural character, is directly related to global central bank policy making and strikes to the heart of the most interesting element: the perception-expectation dynamic between the market and policy makers: in this case, regarding complacency, the perception that policy is at the mercy of liquidity.

The starting point for any discussion with market practitioners has been the structural and cyclical sources of liquidity and how they have been evolving, which is to say increasing for several years – from the sovereign side, the retail side, and the financial side. In fact, this starting point is often not even articulated anymore; it has become a default assumption. For several years the factor fuelling the attention given to the liquidity in the system was the unprecedented accommodation from global central banks in response to the bursting of the investment led and equity bubble in 2000–2001, which was then exacerbated by the impact of September 2001, and prolonged by accounting and research scandals and the war which together further dampened the environment for risk taking into 2003. After three years of normalization, that central bank cyclical liquidity condition has changed – the first variable in the equation to do so. In fact, it is potentially entering a new phase, as the global central banking stance has transitioned from extreme accommodation, to the phased, measured removal of accommodation, to the approach of some of neutrality, and finally to questions of policy restrictiveness in theoretical and prudential terms for others. What remains to be seen is how the evolution of this policy making, as it affects with a lag, will interact with the evolution of the other variables in the equation – sovereign, retail, financial.

One global expansion, many different starting points and sensitivities

Central banks have been tightening policy for some time but where they are rate-wise and why they are tightening differs, and each of these banks has faced periods of misperception in the market. In thinking about the present spectrum of core and peripheral advanced industrial economy banks, they can be grouped as either vanguard or rearguard in terms of when they got started and where they are currently located:[23] the BoE is the core bank in the vanguard group but the group more notable for the "vanguard of the vanguard" peripherals is led by the RBNZ and the RBA. In the rearguard, the ECB is the core bank but this group also has interesting peripherals such as the SNB, Riksbank and the BoC. Two important core banks – the BoJ and the Fed – sit at the margins or between the two groups. The broad contour of the policy trajectory has been similar across the spectrum: a policy of normalization, conducted gradually but consistently until a zone of more or less neutral observation is reached (allowing observation of the past policy as it affected with a lag and to observe various global elements affecting their economies, including developing country

[23] This is not a comment on policy efficacy or credibility.

growth, commodity demand, and global liquidity), before an extended period considering whether to tweak policy in either a more or less restrictive direction.

The BoJ can be seen as at the tail-end of the rearguard group, falling farther behind a still hiking SNB. Some, indeed, would put the BoJ in its own class and question even whether the bank has truly escaped the shadow of the ZIRP (zero interest rate policy) and deflation and whether it can further normalize policy, particularly if the global cycle were to peak before much more normalization can be effected. From a global relative perspective the BoJ certainly looks rearguard, if even that; but from a relative Japanese perspective it could be seen as vanguard or at least anticipatory, rather than reactive. I note this distinction because in the market it is a sport of sorts to dismiss the BoJ as hopeless or at least helpless, as not having a real and financial economy to work with and so ultimately incapable of joining the league of normal central banking. But against the experience of the late 1990s and the beginning of this decade, one could argue that the BoJ has demonstrated elements of clearly forward-looking policy aimed in part at creating new expectations and joining other normalizing banks.

Most importantly, there is the case of the Fed. Acting as the fulcrum, the Fed lies between the two main groups with its actions and the market perceptions of the prospects for its action as critically important to the environment and scope for both vanguard and rearguard policy making. The Fed can be seen as an out-of-phase core bank of the vanguard group in the way that it initiated its easing cycle in 2001, the way it has approached and conducted the normalization of policy off the extreme accommodation of 1% from 2004, in 2005 and 2006 when it was almost the only bank conducting policy rate changes (while the rearguard banks retained their accommodative policy stances and vanguard banks were in their period of neutralized observation), and in the present period of observation with restrictive leanings for 15 months.

As mentioned, the vanguard-rearguard phenomenon is temporal relative to the last several years rather than qualitative. What is shared across the spectrum from the RBNZ to the BoJ is that each bank has bucked market assumptions over this cycle in terms of starting, staying in train, or delivering additional policy after having stopped. Markets have repeatedly tried to fit the present and the future of this cycle into the experiences of past cycles, effectively defaulting to using the past cycle as an inductive template for assumptions about and context for viewing current cycle policy, creating multiple individual and collective misperception events. Markets have also over-predicted activity. Sometimes this has been primarily a function of a backward-looking default in the market against forward-looking, medium-term policy framework focused policy action (or inaction). At other times the misperceptions have come from the struggle to interpret how various structural or environmental forces are intersecting with individual economies – e.g. liquidity, commodities, etc.

2. Changes in the landscape of the business of FX

Along with the issues of market psychology, policy framework basis and communication, and global economic integration, it is important to note some of the ways in which the business of FX has been transformed in recent years and how these changes and the sheer growth of the market are affecting the transmission and deployment of capital in global banking and integration, with implications for carry, liquidity, transparency, and uncertainty.

The primary transformations which are taking place include structure, process, and product offerings at banks and brokers, ventures between banks, brokers, and other providers aimed at driving and capturing electronic business, the proliferation of new trading strategies that rely on increasingly rapid executions harnessing increased computing power, and the rise of new target growth markets among retail, institutional, and sovereign customer bases.

As with other industries there may be a period of adaptation where technological advances outstrip the ability of management structures, processes, and techniques to absorb and fully harness them.

Bank transformation, integration

Banks have been undergoing unprecedented general consolidation at the national and international level and consolidating various types of business to try to drive efficiencies, reduce costs, and capture more business, whether from investment banking, sales and trading, private equity, hedge funds, or asset management and insurance. Within banks there has been a drive to consolidate previously separate businesses such as FX and Interest Rates and Commodities franchises under one umbrella to maximize efficiencies, capture synergies, and develop new products. There has been a similar trend towards integrating previously separate geographical centers under global remits based in key money centers. Finally, within banks as within the market there has been a tendency to blur the line between previously distinct G3/G10 and Emerging Markets (EM) businesses. Integration has been reinforced both in EM countries as business growth has come from expansion of EM business, and through the increasing scope and scale of EM products available to clients globally, but particularly those in mature markets looking to enhance yield and diversification.

Increased electronic deal flow

One of the areas of particularly notable recent growth is in acquisitions and ventures between banks and online trading platforms and electronic communications networks (ECNs). Some recent examples include ICAP's acquisition of EBS, as well as the creation of FX MarketSpace, a venture between the CME (Chicago Mercantile Exchange) and Reuters. Examples of alliances between banks and online trading platforms include Deutsche Bank with FXCM and ABN with OANDA. Additional deals mooted involve Goldman Sachs Asset Management and HotSpotFX, and Barclays and UBS have also been mentioned as looking to ally with partners.[24] Two key drivers for many of these link-ups are the increasing role of electronic broking and the competition for market share and cross-selling to the increasingly large retail investor business. Current survey research suggests that 56% of all FX trading was done electronically in 2006, with estimates rising to 75% for 2010.[25] Not to be left out, it has been suggested that central banks have also seen the utility of the ECNs, with the RBNZ mentioned as having used Reuters to intervene in spot Kiwi on June 11.[26]

New customers, products, and trading segments

Beyond the past strength of FX-dedicated hedge funds on the buy-side, the number and nature of participants has noticeably broadened. Central banks themselves are now bigger players than ever, in addition to those increasing overlay, and asset managers looking to enhance international returns through aggressive trading of FX. There has been an increase in the number and complexity of instruments, new platforms and venues for transactions, a proliferation of volume in buy-side and proprietary activities, of exposure among non-traditional and passive investors (asset management, pension funds gaining mandates for exposure to FX and FX overlay products, as well as to more international exposure), and a very substantial growth in retail business, with the expectation of further acceleration.[27]

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[24] Darlow J (2007): "GSAM jumps on Hotspot FX bandwagon", *FXWeek*, p 2, June 11.

[25] Robinson S (2007): "Expert hails algo trading", *FXWeek*, p 2, July 16.

[26] Robinson S (2007): "RBNZ uses Reuters to intervene in spot market", *FXWeek*, p 4, July 2.

[27] Robinson S (2007): "New technology boosts retail fx volumes", *FXWeek*, p 2, July 23.

An example of some of the new products on offer include Citi's recently launched "Alpha" and "Beta" FX indexes, six tradable FX indexes employing active management and FX options to generate returns via "trend, carry, emerging market carry, economic factor model, long volatility and short volatility" strategies in the former case, and "G10 carry, emerging markets carry, and purchasing power parity strategies" in the latter.[28]

One major new trading segment that is driving growth and pushing the harnessing of technology and application development forward is algorithmic trading. Because of the quantitative component and the requirement for millisecond-measured execution, this new segment of growth is particularly suited to maximizing access to the fastest electronic networks and best integrated platforms, which banks and others are developing in house or seeking to ally externally with in order to capture volume. It is one of the primary drivers of increased buy-side volumes.

One footnote, given the turmoil in the CDO (collateralized debt obligation) and CLO (collateralized loan obligation) markets over the past several weeks: the launching in May of the first rated CFXO (collateralized foreign exchange obligation). This instrument had maturities of three to five years, with an underlying portfolio basket of 10 currency pairs at a time selected by the manager from a slate of 25–30 currencies from G10 and most liquid EMs, and was expected to pay coupons of 80–100 bps on the AAA-rated tranche and return 20% on the equity tranche. Not surprisingly, the notation of the launch highlighted the marketed customer base as "insurance companies, pension funds, private clients and banks" and state that regionally strong institutional investor demand was expected in Western and Eastern Europe.[29]

Volumes and volatility

FX volumes continue to rise dramatically and highlight the trends in the space. Notable drivers include the continuing rise of FX as an asset class, the above-mentioned proliferation and facilitation of algorithmic trading strategies, the gains in retail and passive institutional growth, and the acceleration in carry trades. This aggregate strength can be seen in some survey-based data from 2006, collected by Greenwich Associates, where overall volumes were reported as 17% higher, driven by retail volume gains of 54% (bettering the 40% growth in 2005) and 23% growth among fund managers and pension funds, both of these groups in contrast with more muted growth among hedge funds and corporates (7% and flat, respectively v 2005).[30] More recent BIS data covering the first quarter of 2007 highlight the strength of favored carry trade currencies, in particular the Kiwi, Aussie, Yen, and Swissie: while overall trading volumes for listed FX derivatives contracts saw 26% growth, Kiwi contracts more than doubled, Aussie volumes increased 85%, Yen 65%, and Swissie 42%.[31] The most recent data from June volumes at the CME illustrate the acceleration in 2007 v 2006, as recent volatility in currency, interest rate, and credit markets contributed to record volumes for both voice and electronic brokers: at the CME average daily volumes in FX products were up 41% v June 2006, while average daily volumes in electronic broking were up 48%. ICAP's electronic broking crossed the $1 trillion threshold on June 7 and 8 (v $842 billion average in June, up 32% v last June) as the RBNZ intervened and Aussie and Cable volumes were also driven higher.[32]

[28] Gordon-Walker A (2007): "Citi launches advanced alpha indexes", *FXWeek*, p 2, July 2.

[29] Gordon-Walker A (2007): "Merrill Lynch launches first rated CFXO", *FXWeek*, p 1+, May 7.

[30] Gordon-Walker A (2007): "Retail investors drive strong FX trading volumes", *FXWeek*, p 1+, May 21.

[31] Robinson S (2007): "BIS report highlights trade growth", *FXWeek*, p 8, June 18.

[32] Robinson S (2007): "Currency volatility sparks record trading volumes", *FXWeek*, p 2, July 9.

3. Cases

Two representative currency cases – the New Zealand Dollar, the "Kiwi", and the Canadian Dollar, the "Loonie" – are presented to capture some of the contending issues that have been observed in conversations with market practitioners regarding the interplay of specific domestic and common global currency drivers; the perception/misperception dynamic and some of the inductive assumptions regarding policy and policy makers; as well as FX market environmental elements regarding mandates which may have amplified the observations and be indicative of continuing contributing factors going forward.

The cases of the Kiwi and the Loonie over the last 12–18 months illustrate episodes where the same currency can trade very differently depending on which among many and changing factors become primary drivers in market perception and pricing: where on the rate policy spectrum a bank is, how active or inactive the bank is perceived to be, how sensitive the economy is perceived to be to regional trade and financial linkages, and whether other asset markets' trends become drivers (e.g. commodities).

Kiwi: from pillar to post

There is perhaps no better example over the last 12–18 months of a bank buffeted so strongly by a presumptive market, the nexus of specific domestic and common international developments, evolving data and forecasts, and challenging policy choices and their communication than the Reserve Bank of New Zealand (RBNZ). And throughout the period, the currency and capital flows issue has been a particularly salient factor, never less than in the last two months as global sentiment joined with consecutive policy rate hikes from already the highest level among advanced industrial countries (with apologies to Iceland) to produce a further acceleration in the appreciation of the Kiwi, up from levels already described as unsustainably and unjustifiably high. This confluence of domestic and international factors forced upon policy makers the challenge of acting to try to affect one-way sentiment by backing up words with intervening action to sell its currency, even as it became clear that it was not yet done hiking the policy rate. As we have seen again, even more recently, in the case of the Bank of Korea, the RBNZ is not alone in this predicament and it is not inconceivable that it might be joined by other central banks.

This episode has been remarkable also in terms of the discussion of the changing landscape of global participation of market practitioners initiating or increasing exposure to peripheral country currency trading – a development akin to the expansion of mandates to increase exposure to EM among previously more strictly mandated portfolios. And the performance over the past year may only encourage more of such participation given portfolio managers' desire to find something that "moves" and "trends".

The experience of the last six months stands in contrast to the six months following the previous moves by the RBNZ at the end of 2005. At that time many of the same market participants were convinced that the policy rate of 7.25% would prove the death knell for the Kiwi and further tighten the noose around the New Zealand economy, making it more likely that the RBNZ would sooner have to admit the coming of a sustained easing cycle. This view was being reinforced to a degree by the coincident expected easing cycle priced for the BoE, based on market assumptions about the necessity of a sustained easing cycle in the context of housing, credit, employment, and sentiment tailing off and in the presence of an over-valued currency. The predominance of this type of view of the RBNZ's presumed policy trajectory was reflected graphically in both the rates and currency markets: the money market curve became inverted by more than 120 bps and the Kiwi weakened 17% (against the US Dollar) in less than four months (by 22% against the Yen).

The turn in this tide of sentiment came from a reconsideration of both domestic and international developments. Domestically, as burgeoning signs of a second wind to the economy emerged, the gap was narrowed between what the markets had assumed and

what the RBNZ was seeing and forecasting. This domestic reconsideration came in the context of and was amplified by external environment developments: notably developments in the US and Japan which dramatically altered market perceptions and assumptions about growth, inflation, and central bank policy, and from this attention to yield differentials and implications for carry. In the US, the spring 2006 inflation scare and market assumption of a Fed falling behind the curve and potentially needing to go to a 6% policy rate were challenged by the Bernanke Fed's elaboration of a pre-emptive, forward-looking and forecast-based holding of the policy rate at 5.25%, the sharp initial correction in the third quarter in housing, along with the pressure on consumption and business investment sentiment from new record highs in energy and other commodity costs. In Japan, the success of the BoJ's ending of QEP (Quantitative Easing Policy) and emergence from ZIRP gave way to the worse than expected reduction in the recalculation of inflation in August 2006 and then earlier and stronger challenges to the BoJ's baseline outlook for both stable positive inflation and the strengthening of domestic demand on the basis of consistent increases in wages flowing through to consumption and sentiment.

The last six months have provided another set of episodes where market perception and expectations created room for significant reorientation risk as the RBNZ delivered additional policy to the upside. As recently as February there was still some debate among market participants as to whether the RBNZ would deliver *any* additional policy and, if so, how necessary, credible, or effective it would be given the long period of policy inactivity. Some in the market had seen a case for the RBNZ to hike in the fourth quarter of 2006 (expectations of a hike rose to ~66% at the peak in October 2006) and saw its failure to deliver as an indication of timidity in face of non-tradable inflation and persistent strength in property, activity, and sentiment, but perhaps mitigated by attention to the strength of the currency and the risk that additional policy would exacerbate existing, and already worsening imbalances.

Even after late February 2007, when the market recognized the likely move in the policy rate up from 7.25%, the battle only migrated to whether that move would or could be described as sufficient, again with quite a lot of discussion among market participants as to the issue of the RBNZ having been on the sidelines for more than a year. As it became clear that neither the risk re-appraisal consequent of the market-joined events in US subprime credit nor China A-share equities were impacting the domestic drivers of policy in New Zealand, and with some help from heightened attention to the potential requirement for additional policy in Australia, the next battle was over how strong a third wind was blowing in the New Zealand economy and how much additional policy would be necessary to contain it, particularly given the aggravating issue of the continued high level of the currency.

The perception and expectation dynamic in the market was clear in conversations with market practitioners, who came to the conversation with views which included that the RBNZ should have done more earlier – this from a combination of post-hoc fitting as well as a certain nostalgia for the imagined past, and past policy makers: e.g. "Brash (previous RBNZ Governor) would have done 50s and he'd already be cutting by now" was a sometimes common refrain.[33] Ironically, despite having seen the RBNZ as too timid in moving away from 7.25%, many of these same people did not expect back-to-back moves (in March and April 2007) based on the view that the RBNZ would not act on an OCR review meeting and would instead wait for a policy statement meeting (i.e. wait three months between moves rather than six weeks). This assumption was further shattered when the RBNZ delivered a third and ultimately fourth consecutive move, the last one, to 8.25% in late July, coming even as the

[33] Incidentally, this script has been interchangeable over the last year with the Fed ("Greenspan would have hiked beyond 5.25% and would already be cutting"), the BoE ("Eddie George would have moved sooner, more strongly to staunch inflation…") and even, and most recently, the RBA, in the context of April's non-move after the "obvious" signal of the speech in March by Malcolm Edey ("Macca would have gone sooner, without hesitation…"). Such are the fertile and at times conspiratorial minds that populate the global trading community, where the tendency is to seek extremes and confrontation: boring or consistent policy is, well, boring, and often lousy for volatility and trading.

currency had strengthened – despite physical intervention to sell the Kiwi in June by the RBNZ – and also in the face of noises coming from the Finance Minister regarding potential alteration of the RBNZ's policy target agreements.

Beyond the idiosyncratic elements relating directly to New Zealand conditions and RBNZ policy, the issue of global risk re-appraisal and carry trade unwind episodes have also been strongly witnessed in the Kiwi market. For a period of time in late February and March, it became immaterial that the RBNZ had hiked to 7.5% and could conceivably have more work to do than previously imagined; equally immaterial was the weakness in Japan and the fact that the BoJ had barely cobbled together the consensus to move its OCR to .5% and looked like having gotten that second move away from ZIRP at the cost of being unable to deliver additional policy any time soon. Such fundamental elements, conducing to the risk of the widening of the carry differential over the rest of 2007 at both ends of the Kiwi/Yen cross, were pushed to the background as the sudden global risk re-appraisal unilaterally strengthened the Yen and weakened the Kiwi (Kiwi/Yen weakened by nearly 10% in 10 days in late February and early March 2007).

But the February–March risk re-appraisal episode, like many such episodes over the past few years, proved short-lived. Speculative carry positions were rinsed, but the underlying policy stories at both ends of the cross were only reaffirming the outflows and eventually even the acceleration of Japanese retail investor participation in the carry trade. Soon after, speculative positions returned in the context of abundant global liquidity and a widening of the rate differential by an additional 75 bps, firmly reinforcing the fundamentals of the carry driver: Kiwi/Yen strengthened more than 25% over 12 weeks as weak data and questions about when the BoJ would be able to move again lingered and, over the same period in NZ, the acceleration in housing, higher than expected dairy payments, and stronger data underpinned the three additional tightenings by the RBNZ.

Loonie: in the shadow of a weak US and commodity volatility

A second case to consider in terms of market dynamics and the impact of policy perception is that of the Canadian Dollar, the "Loonie", over the last 12–18 months. It has generally gained less attention (than say the Kiwi or Aussie) not least since the Bank of Canada (BoC) had, until recently, been inactive; and from a carry perspective, the Loonie suffered not only from negative carry versus the US Dollar but also stood out against other dollar-bloc currencies or commonwealth currencies (Kiwi, Aussie, Sterling) for its low rates. Furthermore, the Loonie and broader Canadian story has been viewed more often in terms of non-domestic drivers: i.e. caught either in the shadow of the presumed weakness of the US story or driven by commodity trends, particularly in energy. But it is exactly with regard to the shadow of the overly pessimistic view of the US story, or at least the several bouts of over-prediction of Fed policy easing, and the commodity story that makes the Loonie interesting to observe for the periods when it has broken out of this presumptive correlation and gained attention. When those external drivers have reached turning points there have been opportunities for the domestic conditions to come to the fore and drive de-coupling from US expectations. What stands out over the last 12–18 months is the shifting of the market-perceived drivers and the assumptions built around them regarding price and policy, both in absolute and in relative terms.

In the spring of 2006, as the US faced an inflation spike and the market over-priced expectations of Fed tightening, market expectations about BoC policy were likewise marked up after an initial hesitation. Then, as would be seen again this past April, domestic data and a strengthening theme in commodities conduced to strengthen the Loonie ~7%, pushing it above 91 cents/US Dollar, before the disappointment of building hopes for an additional summer move to 4.5%, which were then further amplified by the subsequent disappointment of Fed tightening assumptions in July for 5.5% in August. As a result, the Loonie quickly weakened along with and even relative to the US Dollar.

For much of the period from August 2006 until this past March the Canadian money market, with a few exceptions, traded closely with US market assumptions about the Fed in light of risks to the US economy. Specifically, the episodes over-predicting risks of Fed easings were mirrored in the pricing of the policy horizon of the BoC and the weakening of the Loonie in absolute and relative terms. The weakening became even more pronounced as energy prices sharply corrected between September 2006 and January 2007 and as Canadian GDP disappointed, joining with the intensification of perceived US weakness after ISM first printed below 50 in November, which was seen through the lens of past cycle experiences as signaling proximity of Fed easings and reinforced a pre-existing attention to a period of six months between a last Fed tightening and the presumptive beginning of a subsequent easing cycle.

The Loonie's weakness continued well into March 2007, despite initial signs of a basing in commodities, as US factors still predominated, with the escalating concern with US subprime credit problems extending the drag from housing. It was only at the end of March that a significant de-coupling started to occur. The transformation was notable less for what was new and surprising than for successfully distracting the focus from the US weakness driver, and distinguishing Canadian economic strength, as well as seeing the amplifying effect that could come from the commodity driver. The first catalytic event was the domestic data surprise from February CPI (reported in March) which forced a reconsideration of assumptions of benign domestic inflation. When this was followed by further signals of strengthening activity, a set of reinforcing elements for appreciation was in place.

Throughout the spring, prospects for solid growth and somewhat higher inflation forced a further reconsideration: that the BoC would remain stuck at 4.25%, while the Fed was still seen as at best remaining on hold. The concomitant re-pricings in the currency and the money markets were consolidated as the BoC signaled and delivered the policy tightening to 4.5%, without ruling out further policy, and further by the rebound in crude prices to a record in late July. The Loonie strengthened more than 7% in as many weeks. After having substantially underperformed in the first quarter of 2007, the Loonie gained 13.5% against the US Dollar (and more than 20% against the Yen) in the period between late March and late July.

4. The current turmoil

As one closing, real-time example of the tension between perception and expectations, and the operation of market psychology during a crisis, here below is a presentation of direct initial feedback from market practitioners on the events of Thursday and Friday August 9–10 2007 regarding the responses from various central banks – both verbal and physical – to the acute illiquidity and the extraordinary blow-out of critical interbank lending rates. Three distinct general judgments were expressed, particularly in comparing and contrasting the responses from the ECB and the Fed.

ECB as leader; Fed as laggard

In this view, some were strongly of the opinion that it was the ECB which demonstrated leadership and resolve in immediately providing a formal statement of support bolstered by the massive amount of available liquidity provided to the system in the initial tender and in the generous collateral acceptance, which together provided a sense that the bad situation would not be allowed to metastasize. The size of the liquidity provided, both on the Thursday and again on the Friday (August 9–10) may have been questioned by some, but it was seen as appropriate both to meet a physical need and to provide needed psychological bolstering. Among those holding this view, there was a concomitant opinion that the Fed did not demonstrate leadership and that, in particular in not issuing a statement and only providing modest additional liquidity (on Thursday August 9), it allowed an already fragile situation to

deteriorate further and create additional risks to the global system as Friday opened in Asia and Europe.

One key perception articulated by partisans of this view was that the ECB was quickly able to distinguish between short-term liquidity and less immediate monetary policy; and in making clear that the tender on Thursday was aimed at stabilizing short-term liquidity without question, it also maintained policy flexibility such that the signaled expected tightening of the policy rate at the September ECB meeting might still be executed and that the two actions would not necessarily be viewed as contradictory.

In contrast, the Fed was seen as having left liquidity and monetary policy still confused and ending up bolstering neither: i.e. its actions – and inaction in terms of no formal statement until Friday August 10 – resulted in the short-term illiquidity problem persisting, if not worsening, and the expectation that near-term, if not immediate, monetary policy easings would be required being not only not dispelled, but intensified. Some took this critique further in suggesting that the confusion of liquidity and monetary policy was something shared by both Greenspan and Bernanke and that the current response could be seen as a direct result of the former: i.e. Greenspan was seen as too quick to provide too much liquidity and confidence by easing monetary policy and not making a distinction between the two, which then created additional medium-term problems for both liquidity and policy, whereas Bernanke's response was seen as still confusing the two but in the opposite direction – in providing too little liquidity and confidence and still not bolstering monetary policy – and taken as a demonstration of clear opposition to the Greenspan response function.

Fed as measured; ECB as too accommodating

An alternative, equally strongly held opinion was that the ECB may have over-reacted and provided too much liquidity, thus introducing a risk of moral hazard, while the Fed acted prudently and maintained a degree of flexible response which could be modulated as events unfolded and additional feedback from the market was obtained. In this view the Fed reacted but did not over-react and did not inject moral hazard, though this at the risk of being seen as insufficiently sensitive to the nature and risks of the dislocations in the interbank funding market. The subsequent statement and provision of additional liquidity on three occasions on Friday was seen again as a prudent response, reflecting the feedback over the preceding 24 hours and creating the necessary stability without injecting moral hazard. In this view the ECB actions over the two days were seen as at one extreme, the BoE's lack of statement or additional liquidity operations at the other extreme, and the Fed in the middle, joined to lesser degrees by the BoC, BoJ, and RBA.

To each their own

A less judgmental, though minority view held that both ECB and Fed responses reflected the conditions in each market at the time and given the respective systems and instruments: i.e. that the triggering event first arose in Europe, European banks had been and were still the most vulnerable to the specific illiquidity, even though the underlying problem stemmed from US subprime credit, and the fact that the ECB operated on one-week repos on Tuesdays necessitated the larger, broader, and more explicit response; whereas, the Fed confronted a less extreme immediate problem, was not captive to one-week repos, and was able to judge by the time the US market opened that the problem was less acute for the US, though perhaps in part as a result of the previous ECB action. Some noted that the size and nature of the ECB tender created a condition at the US market open which generated a default expectation of a similar statement and response from the Fed, and the absence of such led to a renewed deterioration in conditions, opening up questions for some in the market that, whatever the responses, there ought to have been better or at least more clearly coordinated actions among the core central banks to avoid the appearance of a lack of

coordination and thus being seen as adding to the destabilization and uncertainty in the market.

Are the events of the last few days (acute perception of system-wide funding problems) and the last few weeks (second wave of subprime-sourced but broad scale risk re-appraisal) likely to prove a watershed event for market practitioners and central bank policy makers alike? Without yet having any perspective it is still possible to sketch the framework of the debate and risks, and it again encapsulates the issues of capital flows, carry, and complacency. On the one hand, there is a case that might be made that this current episode is merely a different magnitude version (longer-lasting, more deeply and extensively impacting) of past episodic bouts of risk re-appraisal over the past few years, where short-term illiquidity issues will be overcome, risk re-pricing will be prudential and ultimately beneficial, but the fundamental drivers of structural liquidity will be re-asserted and attention will again be re-focused on carry and the search for yield, though likely with somewhat less gearing. On the other hand, there is a case that might be made where unintended consequences of misperceptions, among both market practitioners and policy makers, result in adverse and reinforcing dislocations under conditions of multiple equilibria, where both bad credits and good credits face correlation risk and markets go beyond temporary illiquidity and affect solvency and the basic allocation of funding, contributing to a systemic shock that could have implications for months if not years to come. However the current turmoil is resolved a key determinant will be psychology – both in the market and in policy making.

5. Market feedback

In the course of recent meetings in Europe, North America, and Asia, we have asked members of our client base[34] to offer their views and feedback on issues related to the dynamics of FX and capital flows.

FX

- The biggest mistake made this year and in recent periods has been to look for a unified field theory in FX… looking for a broad-based and consistent explanation rooted in fundamentals of policy frameworks and current account positions and models of under-/over-valuation. If you expected fundamentals to predominate you have been carted out amidst the relentless, insidious depreciation of the Yen, albeit punctuated by brief but sharp corrections… and this despite the ending of Quantitative Easing Policy (QEP), subsequent first exit from Zero Interest Rate Policy (ZIRP), the promise of continued normalization of policy, and in context of the healthiest Japanese economy in more than 15 years with a large current account surplus and huge reserve position… this is a market notable for its distraction from such fundamentals and attention to carry and liquidity conditions.
- Perception creates its own reality these days… take the US Dollar from beginning of May through early July – the period prior to the latest bout of housing-credit-initiated concerns and risk re-appraisal: a period of increasing yields, a steepening of the curve, and the capitulation regarding the idea of Fed cuts… already, going into the June Fed meeting, the dollar's slight rally (~2% in dollar index) had nearly entirely evaporated after the benign core CPI print mid-month and then was dealt a further blow from the outcome of a non-event: the manufactured tension about the Fed's re-focusing of its inflation attention towards headline versus core. The Fed was actually confirming in its more sanguine view on growth, still steadfast in its attention to inflation as the predominant policy risk, with not a whiff of a move from 5.25%

[34] A cross-section of banks, hedge funds, and asset managers.

nominal rates and with some greater confidence in deceleration of core inflation (i.e. likely higher real rates). And yet, when the imagined alteration of inflation focus did not occur it opened up a gulf (>2% depreciation to new multi-year lows in less than two weeks).

- Leveraged positions have been squared; there is risk aversion… some days; but there have been quick reversion days… people don't want to hold positions as long and it is harder to get out of large positions. But you also see an appetite to re-load carry positions. The real question is "do you see turbulence beyond 2–3 months?" (turbulence that forces a change in strategy). So far you have created p&l volatility but you haven't seen a full-fledged withdrawal from the market.
- FX as a portfolio asset, and investors looking to diversify, means it has generally spread all over the globe, funding with G10 Yen/Swiss and long carry in EM: there is no longer a real distinction between those asset classes; it is totally blended. It is now a total Portfolio Approach, driven by liquidity – liquidity drives everything – and willingness and need to invest. Not looking at contagion spreading from one country to another, but as soon as spreads widen someone is tempted to come in and close it. Argentina was trading at implied 20% last week and it sure was tempting to some deep pockets. No fear of sustained blow-up or contagion fuels this. In addition, funds have FX as part of a broader portfolio, so linkages to other market moves are a stronger variable now relative to what is going on in a given country's economy. For example, in a CDO blow-out last week funds needed to make a margin call, and as the FX market is so liquid – a blow-out there means that the spread widens from 2 to 5 pips, not like CDOs where the price disappears – they liquidated their carry trades to cover margins. With calm, the reverse has happened. So you had for example the Nikkei selling and yen strengthening – not weakening – because it was part of the CDO liquidity story, not a "sell Japan" story.
- If you come to trade FX in Asia after working in North America or Europe… you'd better have a hobby! (re: absence of volatility in the market)
- A much larger percentage of G10 FX is being transacted electronically, even over this last year or two; the buy side uses the API software provided to get prices between the bid/ask of banks and find the best buyer/seller. Banks are starting to get more sensitized and throw unprofitable customers out now. Even CTAs, who are traditionally seen as liquid market trend followers, trade every instrument that is available on the IMM and FINEX: USD/BRL, EUR/HUF, USD/ZAR, USD/MXP, and even within developed markets they will trade more exotic EUR/NOK for example rather than EUR/USD. Would say up to 40% of volume that is going through now is EM related.
- The key question to be answered in the next year or two is whether or not Asian currencies – not only China's, though the scope of Chinese move will be a key factor – appreciate in a meaningful way and whether their economies diversify growth more towards consumption and see a fall in savings. If this doesn't happen the tensions already present will only multiply and increase the risk of a greater dislocative adjustment later.

Carry

- "Mrs Watanabe is not panicking" (re: retail carry trade)… it is not by and large a leveraged trade and they have had a great run over the last few years. This is hard to dislodge from the standpoint of yield and in the absence of confidence in local returns. And it is further reinforced by retail banking in Japan: they don't have anything better to flog to retail clients, so banks will keep flogging it.

- As long as we are in a relatively liquid environment over the medium term, despite bouts of illiquidity, people will look to put the carry trade on, particularly if equities and fixed income are going to trade sideways.

Credit

- No one has a good handle on the current credit spread blow-out… there are manifold uncertainties… at least with LTCM (Long-Term Capital Management in 1998) you knew the root cause was off-the-run treasuries and the problem was that everyone was in the same trade. Today you just don't know… you know the risk is coming from nominally AAA-rated stuff that is dodgy but you don't know where it all turns up, when, or how much even those who are exposed – e.g. in commercial paper or money markets – know that they are exposed and whether they had a sense of the potential scale of the risks when they loaded up on this stuff, even if only as enhanced-yield short-term parking for dollars.
- It is premature to say that the worst is over in the credit sphere. The initial subprime crisis became a wider credit problem, then a funding crisis gradually taking out any/all structures built on low volatility/guaranteed liquidity assumptions. Risk in the market now is on two fronts: one is what you have seen to date: the high yield ("toxic waste") credits move the most savagely and to the point where they have now become cheap. Banks are in fact starting to take on long positions on some of these instruments because pricing has become so conservative. That in part is why Wednesday was one of the heaviest issuance days of the year in the US credit markets. Against that, however, some of higher rated credit, whilst wider, has not moved enough. Those have to feel more pain because the real damage to credit will occur when end investors in structured credit products start to want out. These are the Belgian dentists who have three-year/five-year and most recently 10-year deals looking for yield. Look to Europe for guidance on this as Europe is the big buyer of debt, at both wholesale and retail level. If Europe starts looking for an exit and banks don't/can't hold this back on the books (because they can no longer fund them on their own balance sheet) then the investment bank originators will have to try and break the structures down into individual credits again and sell those back into the market on that basis, no doubt cascading on top of the backlog of issuance that is building up during this current bout of dislocation. That is when the trouble will really start, and when the credit markets will be most vulnerable to locking up. Once that difficult period is negotiated then there is a belief that the markets will settle down and the machinery will kick back into life, though with a normal rather than incredibly flat credit curve... which is what officials have been asking for these past couple of years. It will be interesting to see how central banks work around trying to establish just how much additional tightening of monetary policy this shift back to steeper credit curves equates to.

6. Issues and questions for further discussion[35]

- Sustained illiquidity, risk of contagion: Will the current bout of credit market turmoil, illiquidity, and risk re-appraisal be different, create a sea-change – for market practitioners and central bankers alike – in the approach to capital flows, carry, and risk, or will the strength of structural liquidity and a search for yield be reasserted? Can being more reactive rather than proactive create as many problems as it avoids

[35] Based on recent meetings and conversations with market practitioners.

(moral hazard avoided but at greater risk of illiquidity becoming more entrenched, more difficult to restore)?

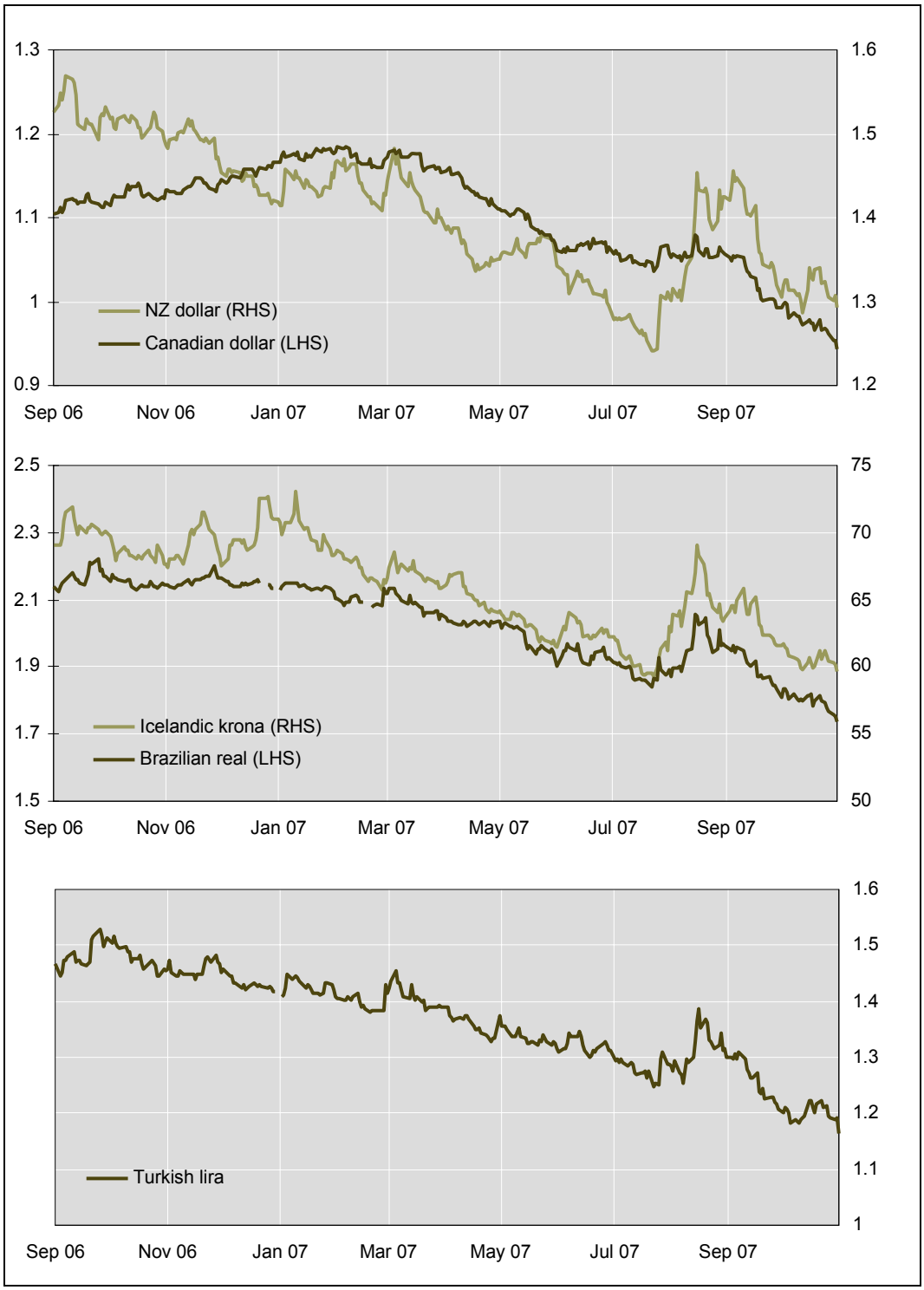
- Liquidity antagonism and policy communication: Between short-term systemic cyclical liquidity challenges and optimal monetary policy in the context of unprecedented structural liquidity, can central banks in the current environment differentiate between providing short-term systemic-functioning liquidity and operating medium-term macro monetary policy and communicate the difference, even/especially when they are perceived as contradictory (e.g. ECB, RBA, BoJ, BoC adding day-to-day liquidity against backdrop of actual or potential macro policy tightening)? Will market practitioners give such central bank actions credence or is there a risk of perceived moral hazard?
- Retrospective myopia: There is a tendency to try to fit the present and future into past experiences and cycles – nostalgia for increasingly less applicable past analogues. Policy makers may be increasingly more forward-looking in their approach to making policy but many in the market start from the point of putting the current economic cycle and policy into the context of past cycles and the lessons or expectations gleaned from them.
- Capacity constraints, productive allocation of factors: Whether global capacity constraints are resolved in terms of investment in productive new capacity or whether they add more inflationary impulses that have to be countered by more restrictive monetary policy.
- Inflation tension: Tensions underlying the discussion and interpretation of recent trends in core and headline data and their effect on policy formulation and implementation. What if the current energy and agriculture impulses are not temporary shocks but structural transformations in the context of the global growth trend of the last two decades, the scarcity of resources, and increased costs of extraction, particularly now and going forward as more and more of the developing world increases consumption and becomes more urbanized, and thus more energy intensive?
- Sovereign liquidity: Sovereign pools of FX reserves: how will the continued expansion of sovereign pools develop; how well will the flows be intermediated and distributed; do international fora facilitate agreement on best practices, and if so, how; and how do sovereign investment funds seeking increased returns affect capital flows and investment – impedance of policy or facilitation of stability?
- Central bank control: Are central banks losing control, or will they in future (or do they matter as much as before, at least in the near term), particularly strict targeters? Has policy become less effective even as or because it has become more ordered, or is it merely a question of different lags in policy transmission/ impedance? Is this a temporary issue of impedance or something likely more structural? If policy has become less effective, is it an issue that can or should be addressed by the central banks or is it simply an objective fact of life that has to be acknowledged and adapted to by agents?
- New contagion risks: We need to think about confronting new contagion risks in a fundamentally less controllable environment. Given the sheer size and degree of integration of the global economic and financial systems and the acceleration of trading volumes, and given less predominance of one source of bailout consumption or liquidity provision, how should/will market practitioners and/or policy makers adapt/respond? Are current practices and frameworks for monitoring risks in the system sufficiently adapted to the changes in the nature of lending (more dispersed, less concentrated – spreading out risks on the one hand but also meaning that there

is no small group of connected lenders that can call time out and focus on orderly workouts)?

- Cycle risk: 2008… the end of the upgrades? Is there downgrade risk? Could it be brought forward to the latter part of 2007? What if it is not enough to clearly make a case for global policy reversal? In other words, what if we get through the illiquidity episode in terms of stabilizing primary lending quickly and eventually start working out broader credit inventory and indigestion issues, but still have to pay in terms of a hangover effect, one dampening the currently still extraordinarily positive global forecasts? What if policy, even boring, measured policy, even after having been impeded for long periods by massive liquidity, inverted yield curves, etc.… what if that past and current policy does catch up with its lag on a maturing global cycle facing some sustained tests to confidence, but only just? And what if, paradoxically, this global lagged policy tightening is amplified by busted conundra, as nominal curves disinvert despite an absence of unstable, uncontained inflation, such that what tightening that hits a decelerating global economy is magnified by the long sought after re-pricing of risk, only coming slightly more suddenly and less orderly than the ideal? For good measure, what if there is a bit more atmospheric uncertainty – say from a bit of post-Olympics indigestion in China, some post-power transfer indigestion in Russia, some geopolitical and US political – and global populist protectionist noises get louder, mixing with the increased financial market risk aversion, continued corporate risk aversion, and continued food and energy inflation pressure on policy frameworks? Is anyone really ready for the party to end with a whimper?

Spot exchange rates (Sep 2006–Oct 2007)

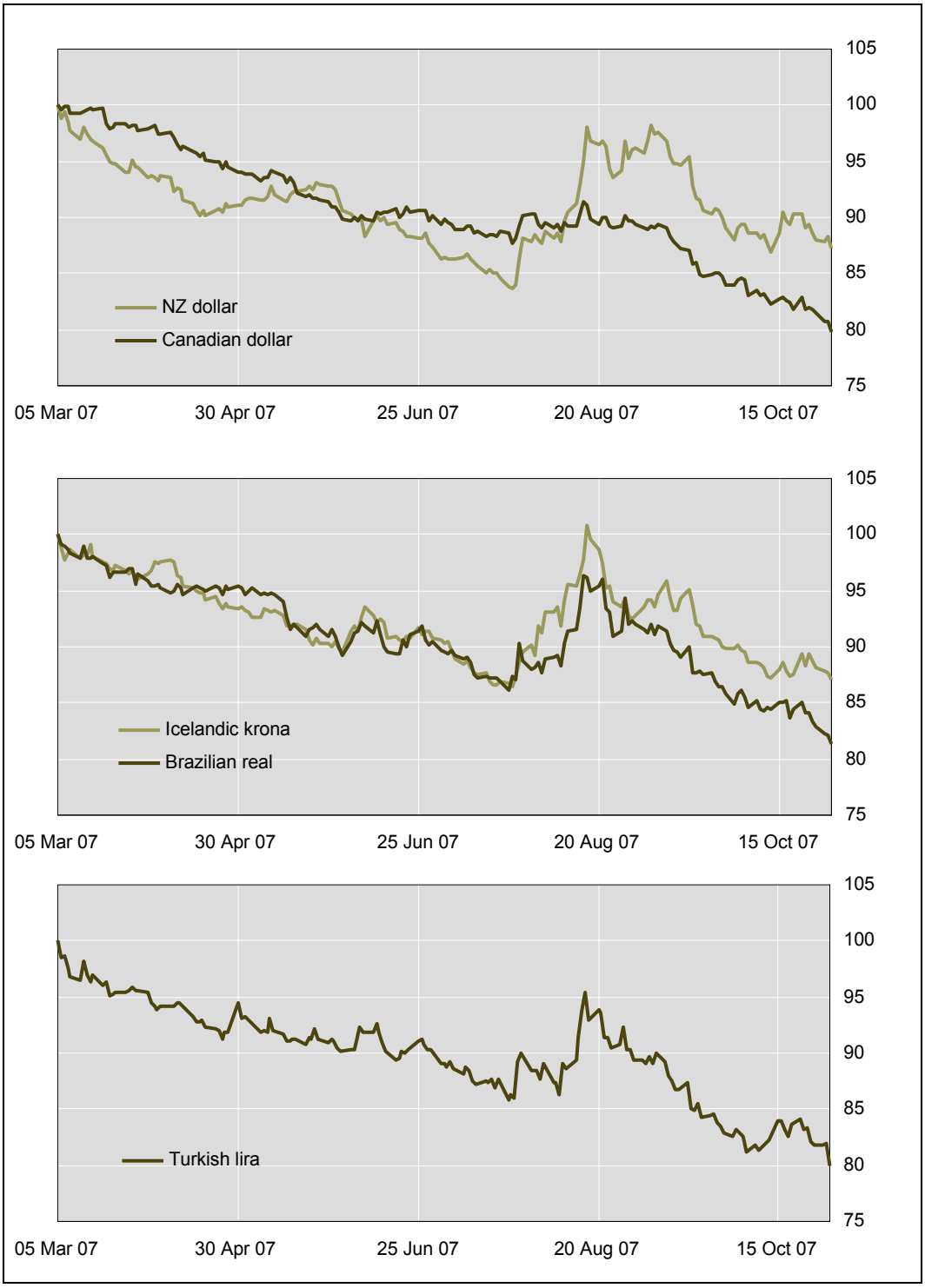
In currency per US dollar



Source: Bloomberg.

Spot exchange rates (5 Mar–30 Oct 2007)

5 March 2007 = 100; a rise in the index indicates depreciation against US dollar



Source: Bloomberg.

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Impact of financial market developments on the monetary transmission mechanism[36]

Sukudhew Singh, Ahmad Razi, Norhana Endut and Helmi Ramlee[37]

1. Introduction

The objective of this paper is to determine how the monetary transmission mechanism is affected by financial market developments. The study is motivated by the fact that the Malaysian financial system has undergone tremendous change in the last decade and that the pace of change is only likely to accelerate in the coming decade. Given that monetary policy works through its influence on prices in the financial system, some of these changes could have important implications for the way monetary policy changes are transmitted through the financial system. These changes could have important implications for the effectiveness of monetary policy.

We adopt two approaches in this paper. The first is to trawl the relevant literature and attempt to summarise the key findings regarding the implications of financial developments for monetary policy. Many of these studies are done for the financially developed countries, but by looking at their findings, we can gain important insights into the consequences of both changes that are already occurring in our financial systems, and those that are likely to occur in the future. The second approach used is an empirical study of how some types of financial developments could potentially influence the way in which changes in the policy rate are transmitted to various types of market interest rates.

The paper is organised in three parts. In the next section, we summarise the role of financial markets in the monetary transmission mechanism. In Section 3, we present the key findings from our survey of the literature. Section 4 describes the empirical study and its main findings, and we conclude with some thoughts on what is known about the impact of financial developments on monetary policy.

2. The role of financial markets in the monetary transmission mechanism

Financial markets are central to the conduct of monetary policy, as monetary policy is implemented largely through operations in these markets. The effectiveness of the transmission of monetary policy to the real economy hinges crucially on a set of parameters that are affected by the structure of the financial system; that is, the existence and degree of development of financial markets, and changes in these markets that affect their functioning.[38] Although economic theory has recognised this relation and even though this

[36] The views expressed herein are solely those of the authors and do not necessarily reflect the views of Bank Negara Malaysia. The authors would like to thank Kenneth Kuttner for his comments on the paper.

[37] The authors are all from the Monetary Assessment and Strategy Department of Bank Negara Malaysia.

[38] Krause and Rioja (2006) empirically analyse how financial development is related to monetary policy for 37 countries. Their results suggest that more developed financial markets significantly contribute towards explaining more efficient policy implementation (controlling for central bank independence, inflation targeting and membership in EMU).

issue has been debated in various forums,[39] empirical studies examining the ramifications of financial market developments for monetary transmission remain scant.

The five main channels in the monetary transmission mechanism literature are the interest rate or money channel, the credit channel, the exchange rate channel, the asset price or wealth channel and the most recent addition to the literature, the expectations channel.

The transmission of monetary policy through the interest rate mechanism has been a standard feature in the economics literature for the last seven decades, as proposed in the basic Keynesian model. This channel operates through its impact on the cost of capital, affecting both businesses' and households' investments and spending decisions. Taylor (1995) takes the position that there are strong interest rate effects on consumer and investment spending, and hence a strong interest rate channel of monetary policy.

The role of credit channels arises from the problem of asymmetric information and costly enforcement of contracts, which creates agency problems in financial markets. Because of this, banks are viewed as playing a special role in the financial system, and hence give rise to the importance of the credit markets in transmitting monetary policy. Two important channels under the credit view are the bank lending channel and the balance sheet channel. The bank lending channel stands on two premises. The first of these is that banks are resource-constrained in that monetary tightening can effectively influence their supply of credit to the markets. The second is that some borrowers are bank-dependent as they cannot easily access financing from the capital markets, possibly because of their size. The balance sheet channel operates through the financial health (or net worth) of borrowers. From the lenders' point of view, lower net worth[40] of borrowers implies a greater problem in adverse selection and moral hazard and these affect the supply of financing. Based on the borrowers' perspective, a reduction in the value of their financial assets signals the possibility of impending financial distress, which reduces their desire to spend.

With growing openness of an economy, the exchange rate may also play an important role in imparting monetary policy changes through its impact on net exports and aggregate demand. Thus, the exchange rate channel of transmission must also be considered in the case of an open economy. In addition, other asset prices such as equity prices and real estate prices[41] could potentially play a role in the transmission of monetary policy through the Tobin's Q effect on investments, as well as the wealth effects on consumption.

Parallel to central banks' move of adopting a single interest rate as the policy interest rate to signal monetary policy changes, increasing attention is now also being paid to the expectations channel of monetary policy. This is because changes in official interest rates can influence expectations about the future course of real activity in the economy.

3. Financial market developments and the monetary transmission mechanism

This section of the paper discusses different types of financial market developments, their theoretical underpinnings, and empirical evidence in relation to monetary transmission. Chart 1 provides an overview of some of the main types of developments. Topics that have a red tick mark next to them are the ones that are addressed in this paper.

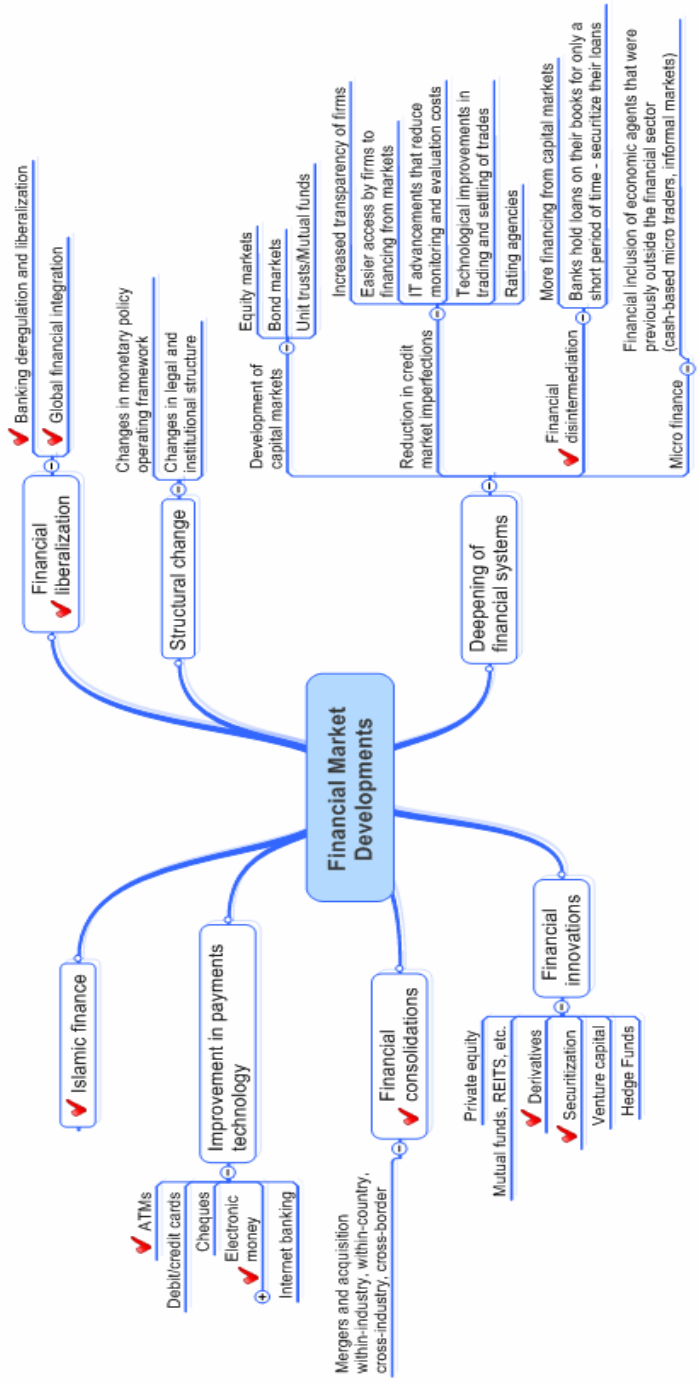
[39] An example is the conference on "Financial Innovation and Monetary Transmission" held at the Federal Reserve Bank of New York in April 2001.

[40] An increase in the interest rate reduces the value of collateral and other asset prices of borrowers, thus reducing net worth.

[41] Meltzer (1995) argues that changes in monetary policy in the 1980s and 1990s in Japan had an important impact on the economy through their effect on land and property values.

Chart 1

Overview of financial market developments



3.1 Financial liberalisation

While there is continued debate on the extent, speed and sequencing of financial liberalisation, there seems to be a consensus that a more liberalised financial system is desirable and leads to greater efficiency of financial intermediation. Consequently, the trend in many Asian economies has been towards increased liberalisation of financial systems in terms of reductions in constraints on price setting as well as on the participation of new players. In line with the increasing openness of Asian economies, over time, their financial systems have also become increasingly linked to the global financial system and are consequently being increasingly influenced by developments in other financial systems.

3.1.1 Interest rate deregulation

The most important aspect of financial liberalisation from the perspective of the transmission of monetary policy is the deregulation of interest rates. In Canada and Germany, interest rate liberalisation took place as early as 1967. The removal of deposit interest rate ceilings in the United States began with the introduction of the Monetary Control Act of 1980. Likewise in Australia, deposit interest rate ceilings were completely abolished in the early 1980s. In the case of the East Asian countries, the process of interest rate liberalisation was started in the 1970s and has continued into the current decade.

In principle, the removal of prescribed interest rates and interest rate ceilings allows policy rates to be transmitted to retail interest rates more quickly and to a larger degree, increasing the role of the interest rate channel. In the case of the United States, for example, Sellon (2002) argues that the impact of monetary policy on spending tended to occur more through credit availability i.e. the credit channel rather than through the interest rate channel during the time when interest rate ceilings were in effect. He shows that spending, particularly in the housing sector, was affected more by reduced credit availability than by higher interest rates prior to the deregulation of interest rates. Based on these arguments, Sellon then hypothesises that the principal consequence of the removal of deposit rate ceilings in the United States is that the interest rate channel is now likely to be a more important part of the monetary transmission mechanism.

Financial liberalisation promoted the emergence of new financial products[42] and this gave rise to problems of measuring money, creating problems in estimating a stable money demand function. A stable money demand model is essential for the functioning of the interest rate/money channel as it helps to ensure that the pass-through is predictable, stable and efficient. Instability in the money demand models of most countries, plagued with the measurement problems of monetary aggregates, shifted central banks' focus from targeting money supply to targeting a specific interest rate. It is common practice nowadays for the central bank's policy stance to be encapsulated in a policy interest rate and for changes in policy stance to be communicated by changes in the policy rate. This development has led to other questions, such as the extent and speed at which policy rate changes are reflected in retail interest rates in the financial system. We examine exactly this question in the second part of this paper.

Cottarelli and Kourelis (1994) empirically examine the pass-through of money market rates to bank lending rates for 31 industrial and developing countries. They assess whether changes in pass-through can be explained by changes in the financial structure which include, among others, the degree of competition within the banking system as well as between banks and other intermediaries, and the existence of constraints on capital movements. Their results suggest that lending rates in most countries are strongly influenced by several factors: first, the degree of competition and the existence of any constraints on competition among banks, such as the existence of barriers to entry. They find that very concentrated markets (measured by the market share of the five largest banks) behave like competitive markets as

[42] The impact of financial innovation on monetary transmission is discussed in a later section.

long as they are subject to entry threat. Second, lending rates appear to be less flexible in bank-based banking systems. Third, exchange controls reduce competitive pressures on the banking system and result in greater stickiness in lending rates and finally, the development of markets for securities enhances the flexibility of lending rates.

Financial liberalisation that facilitates greater competition, such as the removal of geographic barriers or product restrictions, will have an impact on the pricing of loans and financial services as well as an effect on how lending rates respond to changes in monetary policy. Studies[43] undertaken for the Euro Area countries by various authors strongly suggest that greater competition within the banking system, as well as from the capital markets, results in faster pass-through.

3.1.2 Capital account liberalisation

In recent years, increased capital account liberalisation has brought about greater cross-border capital flows. Financial sectors worldwide have not only witnessed greater volatility in exchange rates and liquidity arising from these flows, but have also experienced cross-border financial consolidations and financial market integration.[44] Greater financial market integration often induces an increase in market competition and this will have an impact on monetary transmission. In this case, de Bondt (2002, 2005) examines the pass-through of changes in the policy rate to bank deposits and lending rates in the Euro Area. Using the Error Correction Model (ECM) and Vector Autoregression (VAR), he finds a quicker retail interest rate pass-through after the introduction of a common monetary policy in 1999. Sander and Kleimeier (2004) also find that financial integration in the Euro Area has produced more competitive markets that improve the pass-through to deposit rates. Similar results are also found by Carlino and DeFina (1998), Heinemann and Schüler (2002), Kwapil and Scharler (2006), Sorensen and Werner (2006) and Chionis and Leon (2005).[45]

3.2 Financial disintermediation

Schmidt et al (1997) discuss the theoretical underpinnings of financial intermediation. According to them, based on theories by Townsend (1979), Diamond and Dybvig (1983), Diamond (1984) and others, banking institutions are a special type of intermediary that, under specific conditions, can solve specific information and incentive problems in the relationships between savers and borrowers better than other financial market players. This is the reason for the importance of banks as financial intermediaries, and it thus underscores banking institutions' role in transmitting monetary policy impulses. It also implies that changes in the nature of financial intermediation may have important implications for the operation of the monetary transmission mechanism.

Financial disintermediation implies a reduction in borrowers' dependency on the banking sector, and thus a decline in the role of the bank lending channel. A key development in recent years has been the rapid growth of the capital markets. One important consequence of the growing importance of these markets is that financial intermediation has increasingly shifted outside of the banking system as many borrowers and investors have switched to them from the banking sector. In short, the development of the capital markets has provided households and firms with alternative avenues to invest their savings and obtain their funding through the emergence of a broader range of investment and borrowing instruments, for

[43] For example, by Mojon (2000), de Bondt (2002), Sorensen and Werner (2006) and Gropp et al (2007). These studies not only examine the dynamic pass-through between market interest rates and retail rates in the Euro Area as a function of the degree of financial market competition but also analyse a host of other structural differences in the financial systems.

[44] For discussions on the impact of financial consolidation (cross-border and domestic) and derivatives trading on monetary transmission, see the following sub-section.

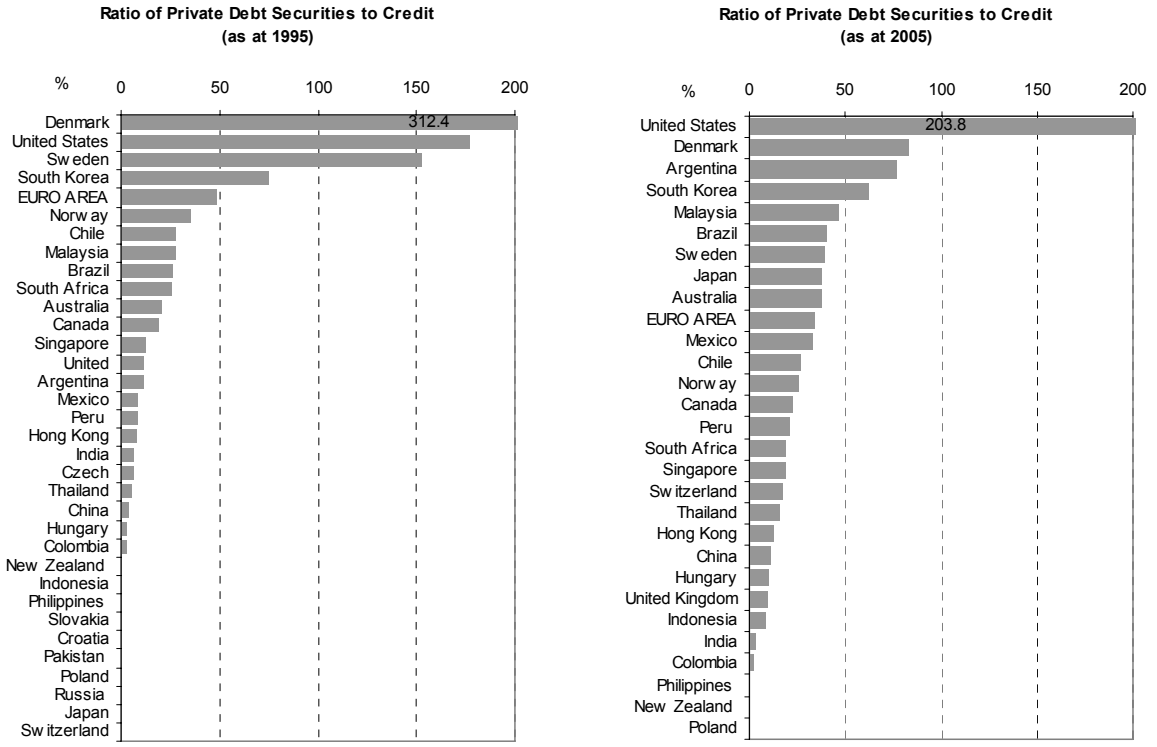
[45] Apart from Chionis and Leon (2005), who only analyse pass-through in Greece after EMU, the rest of these studies focus on pass-through for various groups of countries in the Euro Area.

example equities, various types of bonds and securities, and specialised investment instruments such as mutual funds.

Chart 2 suggests that the share of private debt securities (PDSs) has increased significantly in many countries over the last decade. In essence, there has been a general trend towards bank disintermediation, particularly in the United States and Australia. Nevertheless, there are countries (such as Denmark, Sweden and Canada) where bank loans continue to be an important source of financing.

Chart 2

Ratio of private debt securities to credit



Source: BIS, IMF International Financial Statistics and authors' own calculation.

It is possible that because access to the capital markets for small firms may be limited, banking institutions will continue to be the main providers of loans to the medium-sized and small enterprises sector. To the extent that this sector remains large in an economy, the bank lending channel may continue to be a potent channel of transmission.

Sellon (2002) hypothesises that, in the case of the United States, changes in lending rates in recent years are less likely to affect large corporations and more likely to influence smaller businesses and consumers when compared to a few years ago. Morsink and Bayoumi (2001) investigate the role of financial intermediation on monetary transmission in Japan. They find that bank lending continued to exert an important influence on financial intermediation in Japan for the period 1980–98. The authors attribute their results to the lack of alternative sources of borrowing for much of the non-financial private sector because neither the securities market nor lending by government financial institutions provided a significant offset to changes in bank loans. Generally, any development that reduces credit market imperfections, such as increased transparency of firms, rules that allow easier access by firms to financing from capital markets and technological improvements in trading can

improve market access and thus potentially reduce the importance of the bank lending channel.

For banking institutions, the greater role of capital markets also facilitates the shift from the banks' own traditional interest-based activities, involving mobilising funds through deposits and lending out these funds, towards other fee-based activities. Most importantly, the development of capital markets has provided an alternative source of funding for banks, hence reducing the constraints on the availability of loanable funds. It is therefore possible that the bank lending channel, which stands on the premise of resource-constrained banks, has become less influential. The ramifications of greater financial disintermediation for the credit channel for different countries thus remains an empirical question and may vary considerably from country to country and over time, depending on the depth and breadth of the development of the capital markets as well as the structure of borrowers in the economy, i.e. the composition in terms of small and large firms.

In fact, parallel changes in the profile of the household sector also have implications for the relative importance of different transmission channels. Mojon (2000) examines the balance sheet structure of non-financial agents and how it affects the sensitivity of interest income and payments and of wealth to changes in money market rates and thus their implications for the interest rate channel in Germany, Spain, France and Italy. He finds that varying financial structure is eminent in inducing the differences in the strength of the interest rate channel. A study of the OECD countries by Mylonas et al (2000) shows that there is a shift in financial wealth out of bank deposits into institutions such as mutual funds, pension funds and direct holdings of bonds and equities. The study postulates that the possible implication of such financial disintermediation is that a larger fraction of total wealth may now be more sensitive to market movements in general and vulnerable to abrupt shifts in valuations. If so, these developments raise the potential for monetary policy to affect real variables through the wealth channel.

3.3 Financial innovations

Accompanying the development of the capital markets is the increase in innovations in the financial sector. Tufano (2002) broadly categorises financial innovations into two types, product and process innovations. Product innovation can be illustrated by corporate securities or derivative contracts, while process innovation can be demonstrated by new means of distributing securities, processing transactions or payment system technologies.[46]

Securitisation and the introduction of derivative instruments have been happening for the last three decades. However, only in recent years have these markets grown in size and become vastly more complex. Securitisation enables the transformation of illiquid financial assets into highly liquid, marketable capital market assets. More specifically, it enables financial institutions to repackage and off-load their loans in the form of bonds, hence making their lending activities less constrained and ultimately more attuned to market conditions. Furthermore, banks' fee-based activities, which include simultaneous securitisation and issuance of bonds, have led the interest rate payable by the non-financial sector to be closely related and sensitive to prevailing market interest rates.

Large-scale usage of derivative instruments has become a central feature of financial markets globally and activity in those instruments has been growing. Derivatives are used for hedging and the transfer of specific risks of an underlying security among economic agents. They can also generate high leverage, thereby raising the volume of transactions and reducing the costs of capital. In addition, derivatives also make it easier to arbitrage between different types of assets, i.e. increasing the substitutability between assets. Based on their study of the OECD countries using data from the BIS, Mylonas et al (2000) show that there is

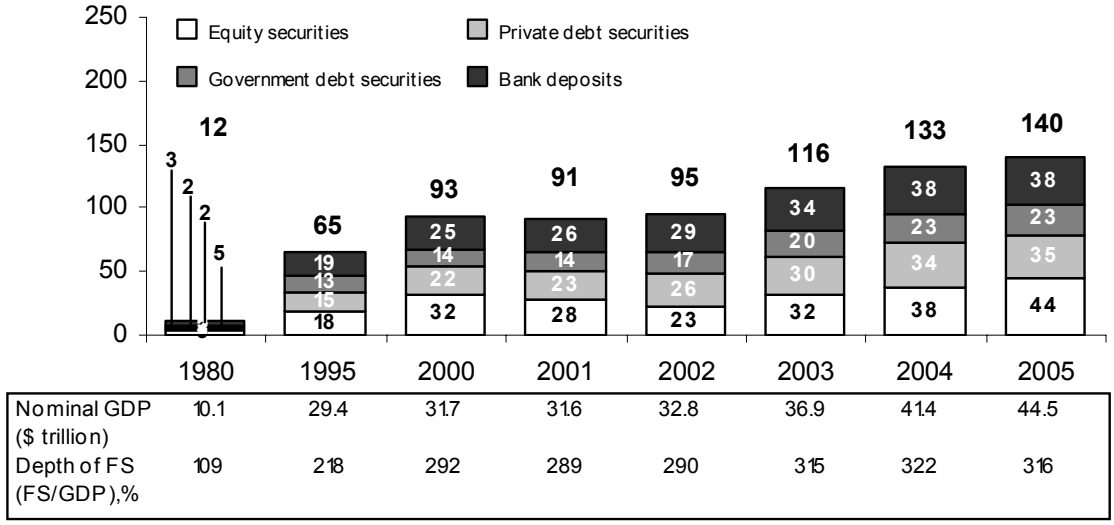
[46] The impact of payment system technologies is discussed in a later section.

evidence of rapid growth of the mortgage-backed securities (MBS) market and the over-the-counter (OTC) market for interest rate derivatives.

In Chart 3, the growth rates of equity, private debt securities and government debt securities are used as measures of financial innovation while traditional banking is represented by bank deposits. The growth in equities and securities was twice that of bank deposits from 1980 to 1995 (growth of 657 percent over the 15-year period compared to 380 percent growth of bank deposits). The IMF's *World Economic Outlook* in September 2006 also reported significant increases in asset-backed securities (ABSs), banks' non-interest income and bank liabilities vis-à-vis non-bank financial institutions over the recent decade.[47]

Chart 3

Global financial assets



	1980	1995	2000	2001	2002	2003	2004	2005
Nominal GDP ($ trillion)	10.1	29.4	31.7	31.6	32.8	36.9	41.4	44.5
Depth of FS (FS/GDP),%	109	218	292	289	290	315	322	316

Source: McKinsey Global Institute Global Financial Stock Database

The greater use of derivatives has two important implications for monetary transmission. First, it may improve transmission by extending the impact of changes in policy rates from short-term interest rates to the prices of assets in other markets as derivatives increase asset substitutability across financial markets. Indeed, based on an empirical assessment using data from the United States, Germany and Japan, Cohen (1996) suggests that derivatives accelerate the incorporation of new information into asset prices, thus facilitating greater asset substitutions. Furthermore, interest rate option contracts based on government securities, for example, can be used to protect against a change in the interest rate on a corporate security. This practice increases the link between the government and corporate securities markets, thereby strengthening the relationship between short-term and long-term rates. As such, Mylonas et al (2000) argue that derivative instruments are another reason for the increased sensitivity of asset prices to monetary policy actions, increasing the degree of the pass-through of changes in policy rates to the rates of return on various financial assets.

[47] Alternative investment vehicles, such as venture capital, are another example of financial innovation. According to Gompers and Lerner (1998) the growth in venture capital has been assisted by the rapid development in financial structures over the last two decades and the increasing importance of institutional investors as suppliers of venture capital financing.

A second implication of the greater use of derivatives is that it may help create a less abrupt or extreme financial market reaction to monetary policy changes because these instruments are designed to help insulate firms, at least temporarily, from unexpected changes in their revenues and debt-servicing costs. However, this remains a conjecture as the hypothesis is rather difficult to test empirically.

Vrolijk (1997) analyses the effect of incorporating the derivatives markets in examining the channels of monetary policy transmission. He argues that theoretically, derivatives trading speeds up transmission to financial asset prices, but changes in transmission to the real economy are ambiguous. Table 1 summarises the theoretical underpinnings of the impact of financial innovations on the various channels of monetary policy transmission as proposed by Vrolijk.

However, in his empirical estimation, Vrolijk is unable to find statistically strong evidence of the impact of derivatives on the monetary transmission mechanism in the United Kingdom.

On the other hand, Gomez et al (2005) conclude that monetary policy has lost some effectiveness in influencing real variables in the short run, due to the partial dilution of the main monetary transmission channels, i.e. the credit channels, caused by the completion of financial markets that derivative instruments imply. The hypothesis is that, given greater securitisation, the traditional bank lending channel will become less important. However, Gomez et al's argument is based on the assumption that monetary policy operates primarily via the credit markets, and that securitisation has transformed these markets and rendered monetary policy less potent. By estimating a partial equilibrium model of firm investment behaviour, Fender (2000) derives similar conclusions to Gomez et al (2005). In addition, Loutskina and Strahan (2006) and Edwards and Mishkin (1995) also find evidence of the weakening of the bank lending channel with the advent of financial innovations such as derivative instruments and securitisation.

An empirical study by Estrella (2002) finds that securitisation affected the effectiveness of monetary policy in influencing real output in the United States. Specifically, while the sensitivity of mortgage rates is higher with higher securitisation, he finds that sensitivity of output to the federal funds rate declines with higher securitisation. Thus, he suggests that the transmission of policy through the mortgage markets occurs primarily through changes in liquidity and the supply of intermediated credit, hence the credit channel, instead of the interest rate channel.

Table 1

Financial innovations and the monetary transmission mechanism

Channels	Impact of financial innovations
Interest rate channel Overall impact is marginal. Thus, financial innovation does not weaken the interest rate channel.	***Substitution effect*** ↑ IR → Agents substitute saving for borrowing and ↓ Investment Derivatives enable IR (funding cost) to be hedged but future needs of investment cannot be easily hedged. **Overall impact on substitution effect is small.**
	Income effect ↑ IR → ↑ interest rate sensitive payments & receipts →↓ spending. Derivatives enable agents to hedge interest rate sensitive payments and receipts exposures → MP has little impact via IR channel, i.e. IR channel weakens. But risk is now being transferred from hedged to unhedged agents, who will have double negative income effect. However, as the unhedged agents have lower marginal propensity to consume, the total income effect is now lower. **Overall impact on income effect is ambiguous.**
	Wealth effect Derivatives allow hedging on equities and properties. Hedging for equities is more common, but is much more difficult for properties. **Overall impact on wealth effect is likely to be small.**
Credit channel Overall impact is significant, i.e. the credit channel weakens due to financial innovations.	***Bank lending effect (channel)*** Derivatives allow hedging on long-term lending. Securitisation makes banks less constrained during MP tightening. **Overall impact is large, i.e. bank lending channel weakens due to innovations.**
	Balance sheet effect (channel) Agents can hedge against declines in net worth due to asset price changes – collateral values unaffected. **Overall impact is large, i.e. balance sheet channel weakens due to innovations.**
Exchange rate channel Overall impact is to make the ER channel more potent.	***Net exports effect*** ↑ IR → ↑ Inflows → ↑ Nominal ER (appreciate) → ↓ Net exports Nominal ER changes can easily be hedged, but not real ER changes, especially if they are due to changes in relative prices. **Overall impact may be little, i.e. exchange rate channel remains potent.**
	Interest rate parity effect Increased derivatives usage makes arbitrage trading across currency pairs easier and less expensive, encouraging increased arbitrage activity→ ↑ international capital flows following IR changes (due to MP) → ↑ ER changes → ↑ speed at which real import and export prices change → change real economy sooner. **Overall impact is that the exchange rate channel becomes more potent.**

Source: Authors' summary.

The issue of mortgage securitisation has attracted extensive research because of its implication for monetary transmission via the residential sector.[48] McCarthy and Peach (2002) assess the possible changes in monetary transmission to this sector as a result of liberalisation of the sector and the introduction of mortgage securitisation. They find that mortgage securities reduce the housing sector's response to monetary policy. Aoki et al (2002) suggest that the link between house prices and consumption in the UK may have changed due to financial innovations such as mortgage equity, based on the financial accelerator model. Their model suggests that, because of the existence of mortgage equity, consumption responds more to monetary changes but housing variables and collateral values tend to respond less. Kuttner and Mosser (2002) provide an excellent summary of some of the studies with regard to financial innovations and monetary transmission.

Overall, the impact of financial innovations on monetary transmission remains contentious. Monetary policy may be powerful through its effect on asset values, which reinforce the direct impact on aggregate demand through the interest rate and wealth channels. However, monetary policy may take longer to have an influence on the economy, as wealth effects take longer to play out. At the same time, financial innovations that lead to the deepening of credit markets by improving the markets' liquidity would produce a market less susceptible to the impact of monetary policy changes through the credit channel.

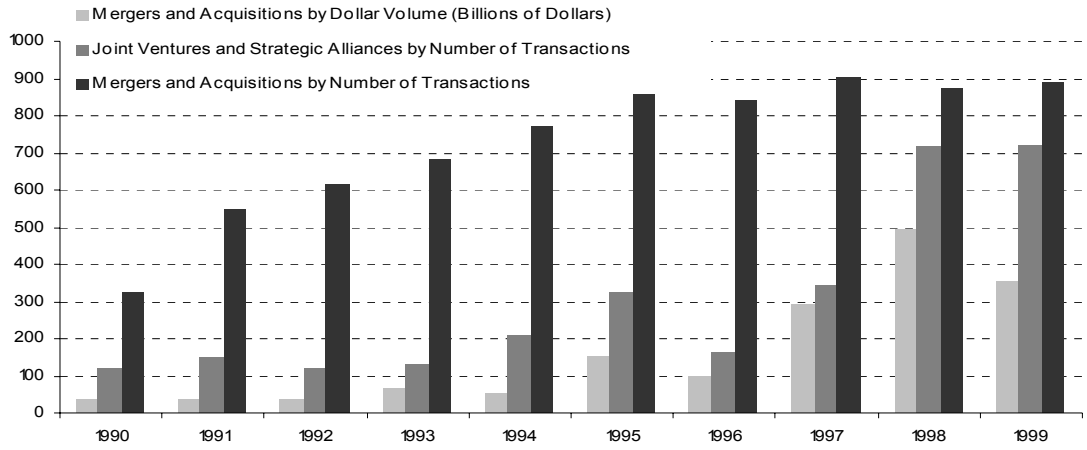
3.4 Financial consolidations

The 1990s saw a strong wave of financial consolidation in financial sectors across the globe (Chart 4). Recent financial consolidation has been driven mainly by technological factors, deregulation and globalisation, as well as by the responses formulated by policymakers to resolve weaknesses in their financial systems. Greater financial consolidation might change the economic and financial environment in which monetary policy decisions are made, and thus it could also affect policy transmission.

[48] Certainly, changes in the residential sector are not only driven by financial innovations such as mortgage securitisation and equity. Other factors such as fundamental restructuring and liberalisation of the sector are also playing a significant role in its transformation.

Chart 4

Financial sector consolidation in the 1990s



Source: BIS

Financial consolidation may lead to a decreasing number of counterparties for monetary operations, thus reducing competition. The degree of pass-through is reduced if liquidity is reduced or volatility is increased in the interbank market due to the lower number of participants. Moreover, financial firms in a less competitive financial sector generally have greater power of discretion in terms of adjusting prices to changes in costs. Empirical studies by Hannan and Berger (1991) and Neumark and Sharpe (1992) support this view, as they find that interest rate rigidity is significantly greater in markets characterised by higher levels of concentration.

However, if financial consolidation led to the creation of large and strong banks, the resulting outcome would differ because larger institutions, often operating in several markets, may promote a faster arbitrage of interest rate changes across markets and assets, hence resulting in an improvement in the degree and speed of pass-through. As shown by Cottarelli and Kourelis (1994), the existence of large and strong banks operating in a competitive environment enhances pass-through. Therefore, the impact of financial consolidation on the pass-through of the policy interest rate to money market and retail interest rates is highly dependent on the competitive environment it creates. If it leads to increased competition, then pass-through is more efficient.

The creation of large and strong banks from the consolidation exercise may dampen the bank lending channel. Large and newly merged banks often have better access to alternative sources of funds because of lower information costs, which implies that their lending activities will be less constrained by monetary policy actions. In addition, if the consolidation process reduces small banks' share in the industry, then the effect of a contractionary monetary policy on the supply of bank loans is likely to be reduced, further weakening the credit channel.

The Group of Ten (2001) undertook a comprehensive study on financial sector consolidation which included the effect of consolidation on monetary policy. The report concludes that financial consolidation imparts negligible effects on monetary policy. The report also recognises the difficulty in assessing the independent impact of consolidation on interest rate pass-through and the relative importance of channels, as in many countries consolidation is

accompanied by other financial market changes such as the introduction of new technology, the removal of barriers to entry and improved access to alternative sources of finance. English (2002) provides an excellent summary of the Group of Ten's report.

In the credit channel view of the transmission mechanism, collateral plays a crucial role in the lending process.[49] It is, however, unclear whether consolidation will improve or worsen the asymmetric information problems between lenders and borrowers which underscore the importance of collateral. If larger and well capitalised banks can afford new technologies to assess borrower risk, thereby leading to more efficient evaluation of credit risks, then less collateral will be needed, thus reducing the role of the balance sheet channel in transmitting policy impulses. On the other hand, if a large multinational bank acquires a small local bank, there may be a loss of local knowledge, therefore necessitating greater use of collateral. This enhances the role of the balance sheet channel.

3.5 Payment instrument technology

Financial markets have undergone rapid technological change over the last two decades, and nowhere is this more obvious than in the emergence of new payment technologies. The existence of Automated Teller Machines (ATMs) and electronic money (e-money) economises holdings of cash, while cheques and debit and credit cards represent alternative and more convenient modes of payment that affect the velocity of money. Arnone and Bandiera (2004) discuss the issues pertaining to electronic money, central banks' operations and monetary policy effectiveness. They conclude that as long as central banks continue to operate and retain control over short-term interest rates and money supply is used only as an information variable, the impact of digital money on monetary transmission is unlikely to be of concern.

The usage of credit cards allows greater consumption smoothing and to some extent boosts spending. To the extent that the pass-through to credit card rates is large and quick, the impact of monetary policy actions on consumption and spending will be significant. On the other hand, as credit cards provide a form of financing, akin to a personal loan, interest rate changes due to monetary policy will have a lesser income effect on households as credit cards can be used to cushion this impact.

Hawkins (2001) postulates that electronic money, finance, broking and trading affect the behaviour of agents in that they encourage greater consumption and investment. For example, the lower transaction costs resulting from the introduction of novel payment technologies may induce small investors to invest directly in the equity markets, thus accentuating the role of the wealth channel in transmitting monetary impulses. With electronic finance, previously constrained firms may be able to access a wider range of potential lenders including those outside the banking system, thus weakening the bank lending channel. Furthermore, the link between real activity and interest rate changes may be severed if hedging against exchange rate and interest rate fluctuations becomes easier and cheaper because of novel technology. Nevertheless, as these developments are relatively recent, there is a dearth of empirical studies examining these issues, and thus the above arguments remain conjectural.

3.6 Islamic finance

In Malaysia at least, the growth of the Islamic financial system could have implications for the conduct of monetary policy. There is evidence of some financial disintermediation from the

[49] Collateral is not an issue in the conventional interest rate view of the transmission mechanism since enforcement on debt contracts is assumed to be costless. Conversely, if enforcement is costly, then lenders will ask for collateral in order to give loans, and this will result in some borrowers being constrained by the value of the collateral that they can provide. If this is the case, a policy contraction will reduce the value of collateral, and the borrowers that have to provide collateral will not be able to borrow as much.

conventional to the Islamic segment of the financial sector. In principle, the structure of Islamic financing requires the sharing of risks and profits in some pre-agreed ratios, leading to a significantly different method of determining returns within the Islamic financial system. This introduces possible issues regarding the transmission of policy rates to market rates.

It is possible that Islamic loans may be priced higher or lower than their conventional counterparts depending on their structure. Although Islamic deposits are expected to provide a rate of return that is somewhat comparable to conventional deposits, increases in interest rates could result in a lowering of the margins between the rate of return on Islamic loans and the cost of Islamic deposits. Although Islamic banks do utilise their profit equalisation reserves, which are built up to smooth out the fluctuations in their margins by helping them to pay depositors when the rates of return on deposits are rising, the reserves can be depleted if policy rates continue to increase, hence affecting their margins. As a result, to manage this risk, Islamic banks' pricing of loans could be higher than that of their conventional counterparts, although the differential may again be determined by the structure of risk and return sharing, and also constrained by competitive pressures. The implication is that the impact of monetary changes could be magnified or diluted for Islamic financial institutions relative to conventional financial institutions.

A study by Bank Negara Malaysia in 2006 suggests that the pass-through from policy rates to the Islamic money market is fast and sizeable and consistent with those of conventional estimates. In addition, the study finds that profit rates follow conventional money market rates closely, reflecting the evidence of arbitraging between the two markets. As such, as long as there is institutional arbitraging between the two markets, the transmission of monetary policy will be equally effective through the Islamic and conventional financial sectors.

3.7 Summary of main findings

Table 2 attempts to summarise the main findings from the literature survey.

Table 2

Summary of key findings

Financial Market Developments	Consequences on Financial System	Impact on Monetary Transmission Mechanism[1]	Impact on IR Pass-through[2]
Financial Liberalisation	Promotes greater competition		
Interest rate deregulation	Leads to more flexible and market-determined interest rates	IRC ↑ BLC ↓	Faster
Capital account liberalisation	Leads to greater financial market integration	Makes foreign interest rates more important – capital flows	Could make domestic monetary policy less effective
Financial Disintermediation		IRC ↑ if non-financial agents hold more interest-sensitive assets in their balance sheets (bonds and equity)	Faster and larger
Development of capital markets	Move away from bank-based financial system	BLC ↓; but BLC ↑ if number of smaller firms is large APC ↑ if non-financial agents hold more interest-sensitive assets in their balance sheets	
Financial Innovation		IRC unaffected BLC ↓ BSC ↓	Faster
Securitisation	Banks are less resource-constrained due to ability to securitise their assets	APC ↑	
Derivatives	Allows economic agents to hedge against price changes		

For footnotes, see the end of the table.

Table 2 (cont)

Summary of key findings

Financial Market Developments	Consequences on Financial System	Impact on Monetary Transmission Mechanism[1]	Impact on IR Pass-through[2]
Financial Consolidation	Produces higher concentration ratio If accompanied by reduction in barriers to entry – ↑ competition	BLC ↓ BSC ↑ if larger banks have efficient credit risk evaluation (rely less on collateral); but BSC ↓ if a large multinational bank acquires a small local bank and loses the local knowledge, hence requiring greater use of collateral	Faster if consolidation leads to the creation of large and strong banks (promotes faster interest rate arbitrage) Slower if liquidity is reduced due to the smaller number of participants in the interbank market
Payment Instrument Technology	Reduces the use of cash as a mode of transaction ("cashless" society)	IRC ↓ BLC ↓ APC ↑	
Islamic Finance	Generates competition to conventional financial instruments and services	IRC unaffected (expected to weaken) BLC unaffected	Pass-through from policy rate to Islamic money market rate fast and large

[1] Transmission channels are defined as **IRC** = Interest rate/money channel; **BLC** = Bank lending channel; **BSC** = Balance sheet channel; **APC** = Asset price (wealth) channel. [2] Interest rate pass-through = transmission of policy interest rate to market interest rates.

Source: Authors' summary.

4. Financial market developments and interest rate pass-through

Interest rate pass-through from the policy rate to retail bank deposit and lending rates along with other short-term paper rates and longer-term bond yields is certainly an important aspect of the monetary transmission mechanism, as it partly determines the effectiveness of monetary policy in affecting aggregate demand and inflation. A faster and stronger pass-through implies that monetary policy is becoming more effective in influencing the cost of funds, while a slower and weaker pass-through would mean that monetary policy is becoming less effective in this regard, and hence might become less effective in influencing aggregate demand.[50]

The question that we are trying to answer is whether financial developments have had any discernible impact on the monetary transmission mechanism by changing the interest rate pass-through. We first estimate some interest rate pass-through figures for developed and Asian countries and then provide some assessment of the extent to which financial market

[50] The final effect on aggregate demand and inflation, however, remains an open question that is not addressed by this paper. The final effect of policy rate changes might become stronger or weaker depending on the changes in the sensitivity of aggregate demand to various market rates as well as the sensitivity of inflation to changes in aggregate demand.

developments may account for the differences in the speed and magnitude of this pass-through across these countries.

4.1 Findings of previous studies

One of the first empirical studies on interest rate pass-through was undertaken by Cottarelli and Kourelis (1994). The authors investigated differences in the size of the immediate and long-run pass-through across developed and developing countries, and the factors that would explain the differences in that pass-through. The authors suggest that the differences in pass-through could be due to differences in financial structure. The degrees of competition in the banking system, the extent of money market development, private-public ownership of banking institutions and barriers to foreign competition were among the possible explanations for the differences in interest rate pass-through. The authors also included per capita GDP and interpreted it as a proxy for financial market development, and attributed it as another possible explanation for differences in interest rate pass-through. There was, however, no obvious pattern whereby developed countries with higher per capita GDP had a speedier and stronger pass-through. Borio and Fritz (1995) studied the response of short-term bank lending rates to policy rates among the advanced countries and also found that there were significant differences in the results among countries in terms of the speed of adjustment, but they did not attempt to explain the reason for these differences in pass-through.

Since then, studies of interest rate pass-through have been undertaken by a number of authors. However, most studies have attempted to investigate only the pass-through to retail bank deposit and lending rates, and not the pass-through to short-term paper and long-term bond yields. In addition, the bulk of studies were undertaken for countries in the Euro Area. The main interest of these studies was to analyse the extent of the differences in the speed and magnitude of pass-through across countries in the Euro Area, and to determine if there was uneven transmission of policy rate changes across these countries following the adoption of the single monetary policy. The general findings of these studies were that there were significant differences in the speed and magnitude of pass-through in Euro Area countries, and most authors tended to associate these differences to the differences in the structure of the banking and financial systems. Mojon (2000) provided evidence that the differences in pass-through could be partly explained by differences in the degree of competition in the banking system and disintermediation through the development of the short-term securities market. De Bondt (2002) found a quicker retail interest rate pass-through process since the introduction of the Euro. On the other hand, Sorensen and Werner (2006) attributed the large degree of heterogeneity for both long-term pass-through and the speed of adjustment across Euro Area countries to the differences in the degree of competition in banking sectors across these countries. A more recent study by Gropp et al (2007) has provided further evidence of the importance of differences in competition in the banking system as an explanation for differences in pass-through among Euro Area countries. The authors also provided evidence that greater competition within and between banking systems, as well as the enlargement of bond and stock markets, would lead to speedier pass-through.

As part of their studies, some authors have also included the US as a benchmark country with a market-based financial system as opposed to the bank-based financial system in Euro Area countries. Kwapil and Scharler (2006) reviewed the empirical studies by various authors for the US and Euro Area, and found that the adjustment of retail bank deposit and lending rates was not instantaneous and was relatively smaller in Euro Area countries compared with the US. Only about half of the adjustment took place in the immediate period, and the long-run pass-through was also not complete. In contrast, the US had a high pass-through of almost 75 percent in the immediate period, and a nearly complete pass-through in the long run. In a non-empirical paper, Sellon (2002) argued that changes in the US financial system over the past three decades have led to faster and larger interest rate pass-through. He

pointed out several key developments that could have led to faster and larger pass-through. These include the removal of deposit rate ceilings and other geographical and product line barriers, the trend towards consolidation within and across financial services industries, the emergence and greater role of money market mutual funds and greater transaction volumes with the growth of mortgage-backed securities, and disintermediation from the banking system to the capital market as large corporations have started to meet their funding needs through the capital market. Estrella (2002) examined the impact of mortgage securitisation (as a ratio to total home mortgages) and found that mortgage securitisation increased the size of the pass-through of the fed funds rate to mortgage rates.[51]

There appears to be no study so far to investigate the nature of interest rate pass-through in Asian countries, especially in terms of trying to compare the differences between Asian countries as well as between Asian countries and developed countries with more mature financial systems. An exception here is Archer (2006). The author estimated and updated the de Brouwer (1995) estimates of pass-through from money market to lending rates across three different time periods (1990–95, 1995–99 and 2000–05). The study indicated that pass-through was already strong in the 1990s for developed countries, but became stronger and speedier from 2000 onwards. For Asian countries, pass-through was found to be stronger in the Philippines but weaker for Indonesia. No conclusion could be drawn for Malaysia and Thailand due to a breakdown in the estimated relationships for these two countries. The author, however, did not attempt to investigate possible explanations for the differences in interest rate pass-through between developed and Asian countries.

4.2 Empirical methodology

To assess the importance of financial market developments in influencing the pass-through from changes in the policy rate to bank retail rates and other market interest rates, we estimate differences in the nature of interest rate pass-through between developed industrial countries and developing Asian countries. The estimates of interest rate pass-through are then compared with various measures of financial market developments using simple cross-country correlation analysis to gauge the strength of the association between interest rate pass-through and various measures of financial developments.

In undertaking these estimations, we adopt the standard two-step Engle-Granger ECM approach. That is, in the first step, we estimate a long-run relationship between the market rate of interest and the policy rate:

$$i_t = \gamma^* + \beta^* p_t + \varepsilon_t$$

where i is the market rate of interest – retail bank deposit and lending rates, the short-term paper rate (proxied by the treasury bill rate) and the long-term bond rate (proxied by government bond rates) and p is the policy rate or short-term money market rate (as a proxy for the policy rate).

In the second step, we then estimate the following short-run model incorporating the error correction term, i.e. the lag residual from the above long-run equation:[52]

$$\Delta i_t = \gamma + \alpha_1 \Delta i_{t-1} + \alpha_2 \Delta i_{t-2} + \beta_0 \Delta p_t + \beta_1 \Delta p_{t-1} + \beta_2 \Delta p_{t-2} + \delta \hat{\varepsilon}_{t-1} + \eta_t$$

[51] The author, however, found that mortgage securitisation has a negative impact on the effect of policy rate change on the output gap. He attributed this to the fact that mortgage securitisation increased the liquidity and supply of mortgage financing and resulted in a lower impact of interest rates on output.

[52] We initially estimated a more general model, i.e. with greater lag length. However, we finally chose to estimate an error correction mechanism with lag 2 as we found that lag 3 and above are generally not significant for most countries.

In the above two equations, the immediate impact or pass-through is represented by β_0 and the "speed of adjustment" towards the long-run relationship is represented by δ. The long-run pass-through is represented by β^*. These are the three coefficients that we are interested in for our assessment of the effectiveness of the policy rate in influencing market interest rates.

Most empirical studies by other authors investigating interest rate pass-through have employed the ECM methodology. However, the alternative approach is to model interest rate pass-through based on the expectations hypothesis – that is, to differentiate changes in the policy rate into anticipated and unanticipated policy rate changes as advocated by Kuttner (2001). Kuttner proxied the ***anticipated*** policy rate change using the difference between the *previous period fed funds futures rate* and the *previous period spot fed funds rate* and the ***unanticipated*** policy rate change as the difference between the *current period spot fed funds rate* and the *previous period fed funds futures rate*. The author found that short-term paper rates in the US responded almost one-to-one to unanticipated policy rate change but not to anticipated policy rate change. Similar results were found for long-term bond rates although the pass-through from unanticipated policy rate change is less than one-to-one.

While a similar approach would clearly enrich the present study by allowing analysis of the impact of financial developments on the pass-through of anticipated and unanticipated policy rate changes, this approach is not possible for our study due to unavailability of long time series of short-term futures rates for most of the countries in our sample. In addition, overnight or short-term interbank rates were generally volatile in the early part of the sample period and most Asian countries have only recently adopted a monetary policy operating framework that centres on a policy rate.[53]

Before discussing our results, a few caveats are in order. First, the above equations presume that aside from the policy rate, there are no other variables that would explain the movement of market interest rates. We had initially included two additional control variables – annual inflation rate and the growth rate of the industrial production index – but we found that these two variables were generally not statistically significant. Second, for most industrialised countries, we have been able to compile data on the actual announced policy rates. However, policy rates were only adopted recently in some countries, especially Asian countries. To the extent that we employ the short-term money market rate as the proxy for the policy rate, it is assumed that there is a very close one-to-one relationship between the money market rate and policy rate. While this is generally the case in recent periods, the conduct of monetary policy in the early 1980s might not have used the same tools as those currently employed by central banks. The level of volatility of money market rates was generally higher in the 1980s compared with the period since the early 1990s. Third, as much as the availability of data permits, efforts have been made to ensure consistency in the compilation of interest rate time series, especially those for lending rates.[54] The preferred lending rate is the one associated with the prime rate offered to the best customers on new loans, instead of the average lending rate on outstanding loans.

4.3 Results

On the whole, there is evidence of significant differences in the nature of the pass-through of policy rates to both retail bank deposit and lending rates, as well as to short- and long-term

[53] During our estimations, we have also tried to include lead observations of the policy rate as one of the possible explanatory variables to take into account the possibility that market interest rates react to expected policy rate changes (proxied by lead period policy rate) rather than the current level of the policy rate. However, we do not find the lead policy rate to be a statistically significant explanatory variable.

[54] Appendix III gives detailed sources of data and plots policy rates, deposit and lending rates, and short-term paper and long-term bond rates for the advanced and Asian countries used in the estimations.

bond rates across both the financially advanced countries and the Asian countries in our sample.[55]

Table 3 and Charts 5 and 6 summarise the results for the sample:

- In the case of all the interest rates considered here, the pass-through in both the immediate period and the long run is higher in the developed countries than in the Asian countries.
- The speed of adjustment towards the long-run impact is also faster in developed countries, with the cumulative pass-through after three months being almost as high as its long-run level. This is clearly not the case with the Asian countries, which have a slower pace of transmission of policy rate changes to market interest rates.
- The gap between these two groups of countries is wider for immediate pass-through and much smaller in the long run. So while monetary policy changes are transmitted to market rates much more quickly in the developed countries, over the longer term, changes in monetary policy in the Asian economies do filter through to market interest rates to quite a significantly high level.
- Among the developed economies, the UK has the highest and fastest pass-through, while Germany has the lowest.
- Among the Asian economies, pass-through is generally larger and faster in Korea and Malaysia, but much lower and slower for the Philippines, Thailand and Indonesia.
- Among the different types of market rates, pass-through is largest and fastest for short-term paper rates followed by deposit rates. This is true for both groups of countries. However, in the case of the developed economies, lending rates come third and long-term paper rates are last. In the Asian economies, the reverse is true.

Notably, long-run pass-through is less than one, especially among the Asian countries. This is a result not unique to this study, as studies by other authors have also found interest rate pass-through to be incomplete. This is a puzzle, as it appears to indicate that a permanent one percent decline in policy rates would not be accompanied by an equivalent permanent fall in market interest rates.

There are a few possible reasons why this might be the case. First, during the earlier part of the sample period (1987–2006), many of the Asian countries still had some form of interest rate controls that could have made deposit and lending rates not fully responsive to changes in policy rates. Second, in the aftermath of the Asian financial crisis, despite the decline in policy rates, banks may not have significantly lowered their lending rates to compensate for the increased risks of defaults, or even to rebuild their eroded capital base. A third reason could be the fact that unlike their more developed counterparts, the Asian economies are characterised by a situation of surplus liquidity which, if not fully sterilised, could lead to discrepancies between market rates and policy rates.

[55] We term the UK, Australia, Canada, the US and Germany as the financially advanced countries and Korea, Malaysia, the Philippines, Thailand and Indonesia as the Asian countries.

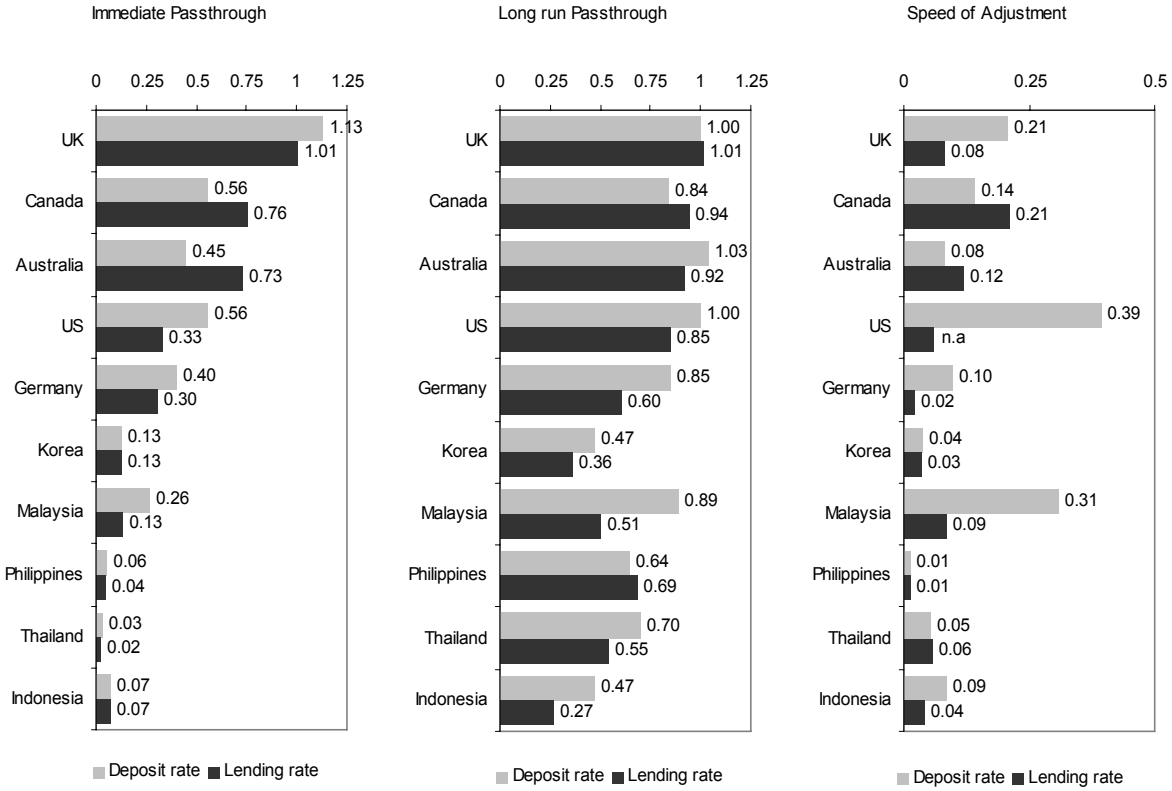
Table 3

Summary of estimation results

		Deposit Rate	Lending Rate	Short-term Paper	Long-term Paper
Developed Countries	Immediate Pass-through	0.40–1.13	0.30–1.01	0.43–1.16	0.15–0.60
	After 3 months	0.78–1.10	0.57–0.99	0.85–1.02	0.19–0.56
	Long-run Pass-through	0.84–1.03	0.60–1.01	0.88–1.00	0.65–0.83
Asian Countries	Immediate Pass-through	0.03–0.26	0.02–0.13	0.10–0.45	0.01–0.19
	After 3 months	0.10–0.72	0.15–0.40	0.20–0.67	0.05–0.37
	Long-run Pass-through	0.47–0.89	0.27–0.69	0.72–0.82	0.37–0.72

Chart 5

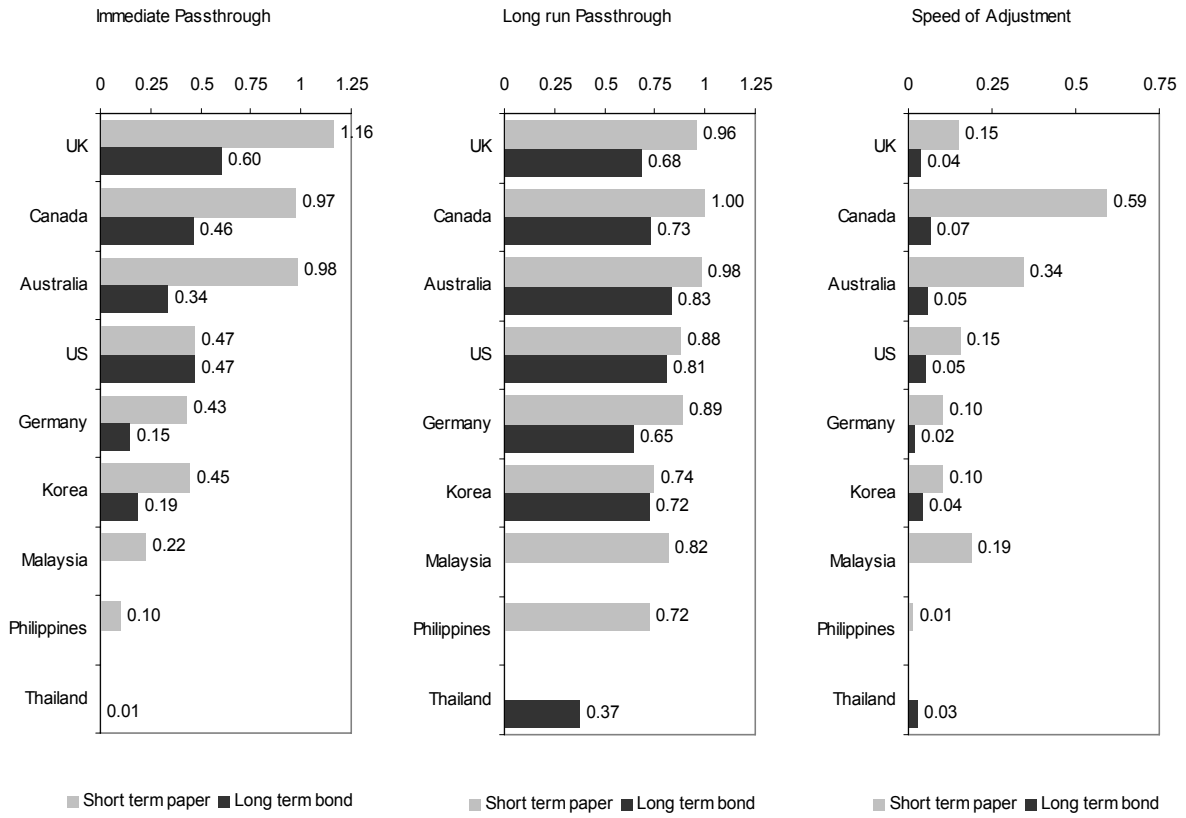
Estimated immediate and long-run pass-through and speed of adjustment of deposit and lending rates



Source: Authors' estimates.

Chart 6

Estimated immediate and long-run pass-through and speed of adjustment of short-term and long-term bond rates



Source: Authors' estimates.

The incomplete pass-through could also reflect the state of development of the financial systems in these countries. A lack of alternative sources of financing as well as the significant presence of relationship banking may have made it difficult for bank customers to switch banks and thereby allowed the pricing of bank loans to be less sensitive to changes in policy rates. Similarly, banks might be able to continue offering lower deposit rates to customers if the customers do not have alternative saving instruments or when competition for deposits among banks is limited. From a broader perspective, the differences in the nature of interest rate pass-through across the developed and Asian countries must certainly reflect differences in the nature of the financial markets. The degree of competition within the banking system, as well as with non-bank financial institutions, and the size and composition of financial systems could have an important impact on the speed and size of interest rate pass-through. We provide some results on this in the following pages.

In looking at explanations for the differences in pass-through between the two groups of countries, particularly in the immediate period, one factor could be differences in the level of competition. Interest rate liberalisation and free competition among banks was a feature of financial systems in the developed economies during the sample period used for this study.[56]

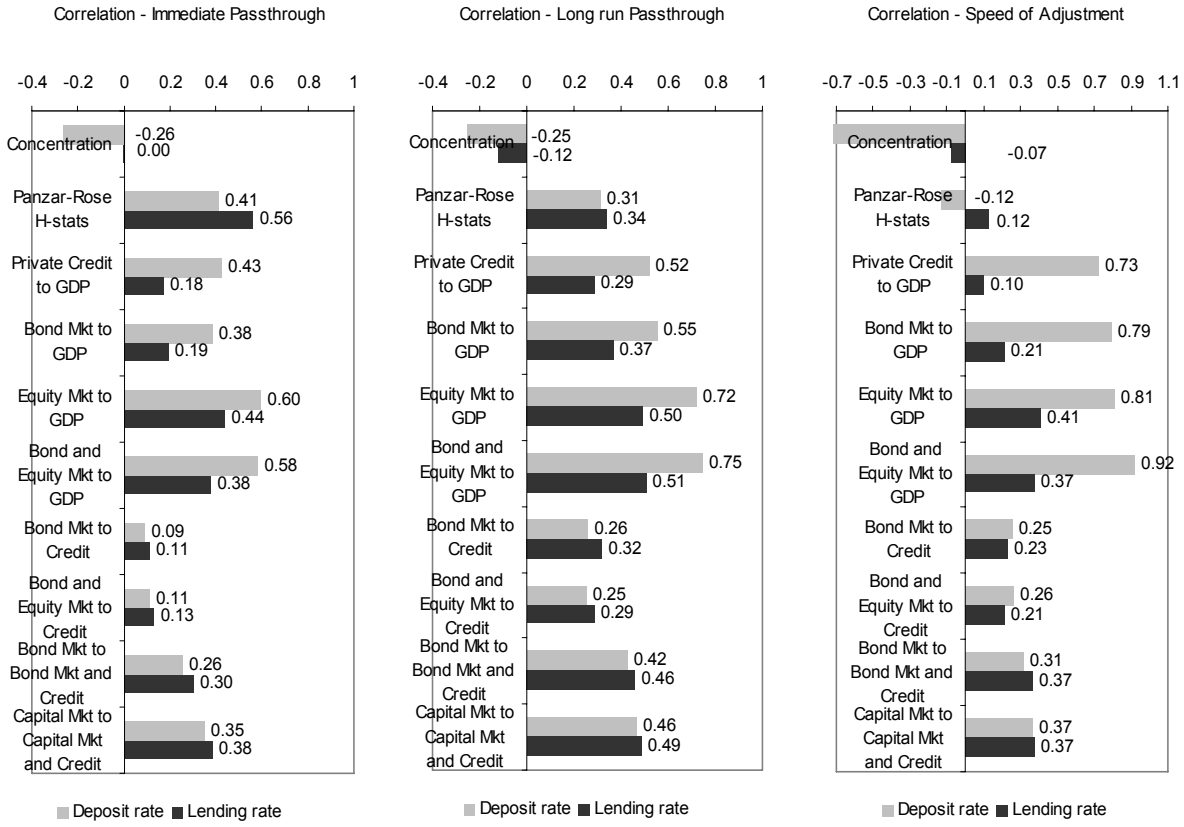
[56] Monetary reforms were introduced in the UK in 1981–82 which involved the removal of the so-called Corset (special deposit requirement that was actively employed to control the expansion of the monetary base) and the establishment of a system of market-determined interest rates. In the US, regulation-Q and the inter-state branching restriction were removed in the early 1980s. Australia began to remove ceilings on lending rates as early as 1972 and had removed them completely by 1986.

This was not the case with the Asian economies. Many undertook sustained interest rate liberalisation starting only in the mid 1990s.

One of the standard measures of the degree of market competition is the concentration ratio (CR_k), where k is the number of institutions. Based on CR_3, there appear to be some differences between the degrees of market concentration of the financially developed and Asian countries (Table 4). There appears to be a negative correlation between interest rate pass-through and banking concentration (Chart 7), suggesting higher banking concentration does reduce interest rate pass-through. However, the size of correlation is relatively small.

Chart 7

Correlation between pass-through to deposit and lending rates and measures of competitiveness and financial market developments



Source: Authors' estimates.

Table 4

Measures of competitiveness, size and composition of financial market

	Competitiveness		Size of Financial Market[1]				Composition of Financial Market			
	Con-centra-tion[1]	Panzar-Rosse H-stats[2]	Private Credit to GDP	Bond Mkt to GDP	Equity Mkt to GDP	Bond and Equity Mkt to GDP	Bond Mkt to Credit	Bond and Equity Mkt to Credit	Bond Mkt to Bond Mkt and Credit	Capital Mkt to Capital Mkt and Credit
UK	0.50	0.84	1.26	0.48	1.43	1.91	0.38	0.28	1.51	0.60
Canada	0.56	0.60	0.97	0.81	0.91	1.72	0.84	0.46	1.78	0.64
Australia	0.64	0.98	0.81	0.48	0.88	1.36	0.59	0.37	1.68	0.63
US	0.30	0.52	1.87	1.46	1.24	2.71	0.78	0.44	1.45	0.59
Germany	0.68	0.69	1.10	0.81	0.42	1.23	0.74	0.42	1.12	0.53
Korea	0.49	0.68	1.21	0.55	0.43	0.99	0.46	0.31	0.82	0.45
Malaysia	0.47	0.66	1.29	0.79	1.77	2.56	0.62	0.38	1.99	0.67
Philippines	0.64	0.70	0.41	0.33	0.50	0.83	0.80	0.45	2.04	0.67
Thailand	0.53	0.35	1.20	0.23	0.53	0.77	0.19	0.16	0.64	0.39
Indonesia	0.61	0.66	0.33	0.16	0.25	0.41	0.48	0.32	1.22	0.55

[1] Data on concentration and various measures of size of financial market are from Beck et al (1999). Composition of financial market data are derived through ratios using data on financial market size. All data represent average values for 1994–2005. [2] Panzar-Rosse H-stats are taken from Claessens and Laeven (2004), except for Korea (Bikker and Haaf (2002)) and Thailand (Laeven (2005)).

The other – and often preferred – measure of market competition is the Panzar-Rosse H-statistic, which measures the degree of monopolistic structure of the market by assessing the impact of factor input prices on revenue.[57] Based on Panzar-Rosse H-statistics, banking systems in the financially advanced countries seem to be more competitive than in Asian countries. The correlations with the policy rate pass-through to deposit and lending rates are also positive, suggesting that pass-through is higher and faster in countries with greater competition.

The other factor that could also influence the degree of interest rate pass-through is the size of financial markets. The presence of alternative channels of intermediation – namely bond and equity markets – offers opportunity for both savers and borrowers to access savings and financing instruments directly from the markets. Savers in this environment, through mutual and hedge funds as well as pension and insurance funds, would gain access to alternative investment instruments that would enable them to possibly earn higher returns on their savings. Banking institutions would then need to compete for their deposits by offering competitive deposit rates. This would lead to greater sensitivity of deposit rates to underlying market interest rates and policy rates. Likewise, corporations would also gain access to alternative ways of raising financing. Banking institutions would therefore need to offer credit to borrowers at more competitive lending rates. The greater the size of bond and equity markets, the greater is the breadth and depth of these markets. Indeed, the size of the

[57] A number of authors have computed cross-country Panzar-Rosse H-statistics as part of their studies on banking market structure to understand factors determining bank competitiveness, growth and development. The computed H-statistics, however, differ across studies. In general, most empirical studies tend to suggest competition is higher in financially advanced countries compared to developing countries. See for example Bikker and Haaf (2002), Claessens and Laeven (2004) and Laeven (2005).

correlations between pass-through from the policy rate to retail rates and various measures of the size of financial markets are positive, and particularly strong for deposit rates.

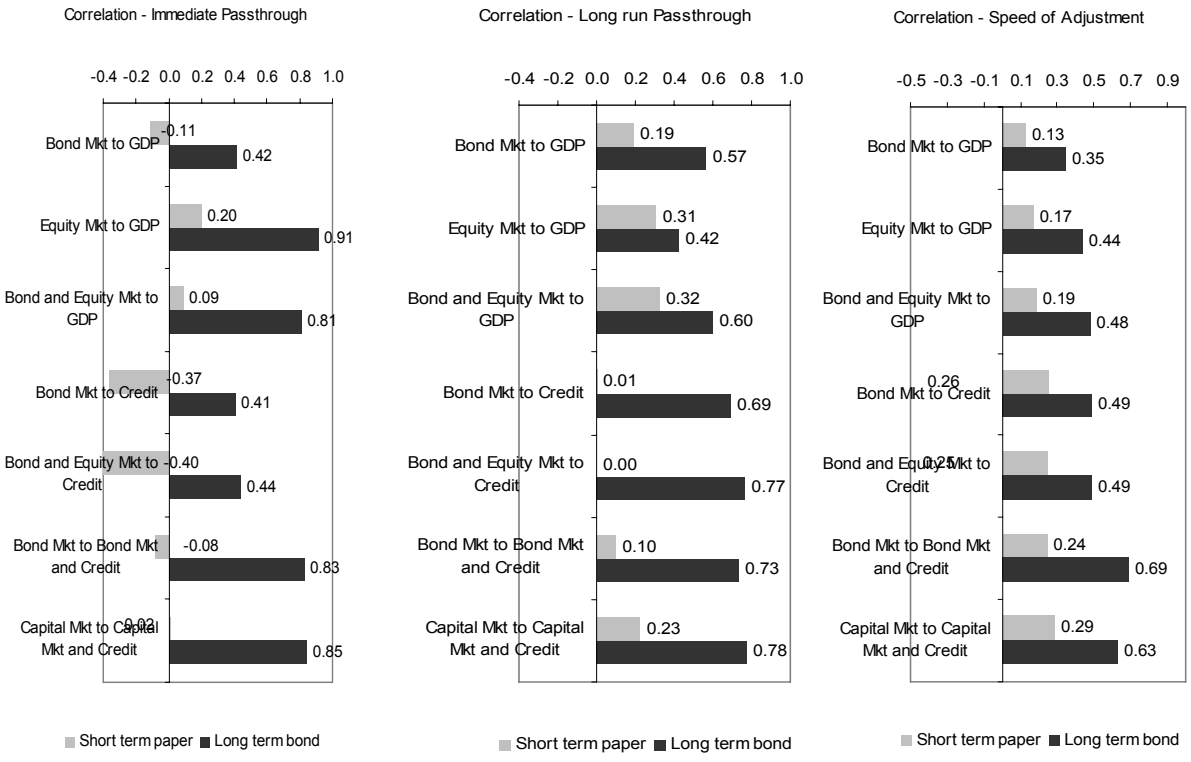
The other aspect that ought to also influence the degree of interest rate pass-through would be the composition of financial markets – the relative share between traditional bank lending and capital market activity. Correlations between interest rate pass-through to deposit and lending rates and the various measures of the composition of financial markets are also positive although the degree of correlation is somewhat lower compared with correlations involving the size of financial market.

On the whole, the evidence suggests that the degree of pass-through from policy rates to both deposit and lending rates appears to positively correlate with the degree of competitiveness and the size and composition of financial markets. That is, countries with a greater degree of market competition, larger financial markets and a higher share of bond and equity markets relative to credit markets should experience stronger and faster policy rate pass-through to both deposit and lending rates.

In Chart 8, we present the results of the correlation between pass-through to short-term and long-term bond rates, and measures of financial developments. The correlation analysis reveals differences in the interactions between the degree of pass-through for short-term paper rates and long-term bond rates. There appear to be only weak positive or negative correlations between the pass-through to short-term paper rates and the various measures of the size and composition of financial markets. Only the size of bond and equity markets appears to matter for pass-through to short-term paper rates and then only for long-run pass-through and not for immediate pass-through. There appear to be other important factors that determine the nature of pass-through to short-term paper rates. This might reflect differences in the micro-structure of the short-term paper market, such as the tendering and auctioning practices.

Chart 8

Correlation between pass-through to short-term and long-term bond rates and measures of competitiveness and financial market developments



Source: Authors' estimates.

In contrast, the degree of pass-through to long-term bond rates is strongly and positively correlated with measures of the size and composition of the financial market. The size of the correlations seems to indicate that the size of bond and equity markets has an important influence on the size of immediate and long-run pass-through, as well as the speed of adjustment of long-term bond rates.

4.4 Rolling regression

When looking at the entire period, we cannot exclude the possibility that some structural change or changes in the policy framework could have fundamentally affected the nature of interest rate pass-through over time, especially for the Asian countries. In order to investigate this possibility, we estimated a rolling regression with a 10-year window using data from 1980–2006. Appendix II plots the rolling regression results for the immediate and long-run pass-through and the speed of adjustment of market rates to policy rate changes for the 10 countries in our sample.

The rolling regression results for the financially advanced countries indicate that, for deposit and lending rates, the nature of interest rate pass-through has changed for some countries. The degree of immediate pass-through was already high in the UK and Canada in the early 1990s. Pass-through in the UK is almost complete in the immediate period, while in Canada it is also nearly complete. Meanwhile, the size of immediate pass-through in the US and Australia shows an increasing trend over the last 16 years, although the size of immediate pass-through to deposit rates in Australia seems to have declined slightly in the recent period. Thus, the ability of monetary policy to influence the cost of borrowing from the banking system in the US and Australia appears to have become stronger. On the other hand, immediate pass-through in Germany appears to have declined for the lending rate, while remaining relatively stable for the deposit rate. Thus, the monetary policy impact to borrowers in Germany appears to be weakening.

For the Asian countries, the size of immediate pass-through as well as long-run pass-through appears to have increased, especially since the financial crisis in 1998 for Korea and to some extent for Malaysia. However, there seems to be little change for Thailand, Indonesia and the Philippines.

The results for short-term paper rates, however, are mixed. In the US, immediate pass-through to short-term paper rates is getting stronger, but this is declining in Germany (similar to deposit rate trends). However, for long-term bond rates, the rolling regression indicates that there are signs that the immediate pass-through to long-term bond rates has been weakening in recent periods for financially advanced countries. Thus, it appears that policy rate transmission to the long-term bond market has weakened for most financially advanced countries.

One of the possible reasons for lower immediate pass-through to long-term bond rates that is often suggested is that, with large free flow of capital, there is a strong correlation between long-term bond rates across countries. To investigate this possibility we re-estimated the rolling regression by including either US or UK long-term bond rates in the short-run equation (and either US or UK or Canada for US and UK). The estimation result is shown in Chart 9. The evidence seems to suggest that while there are some changes in size of immediate pass-through – a smaller size of immediate pass-through in all countries, except the UK – the size of the immediate pass-through still shows a declining trend over the rolling window. Thus, while the strong correlation between long-term rates across countries seems to reduce the size of immediate pass-through, the evidence still suggests a decline in immediate pass-through in recent periods.

Chart 9

Rolling regression result for interest rate pass-through to long-term bond rates

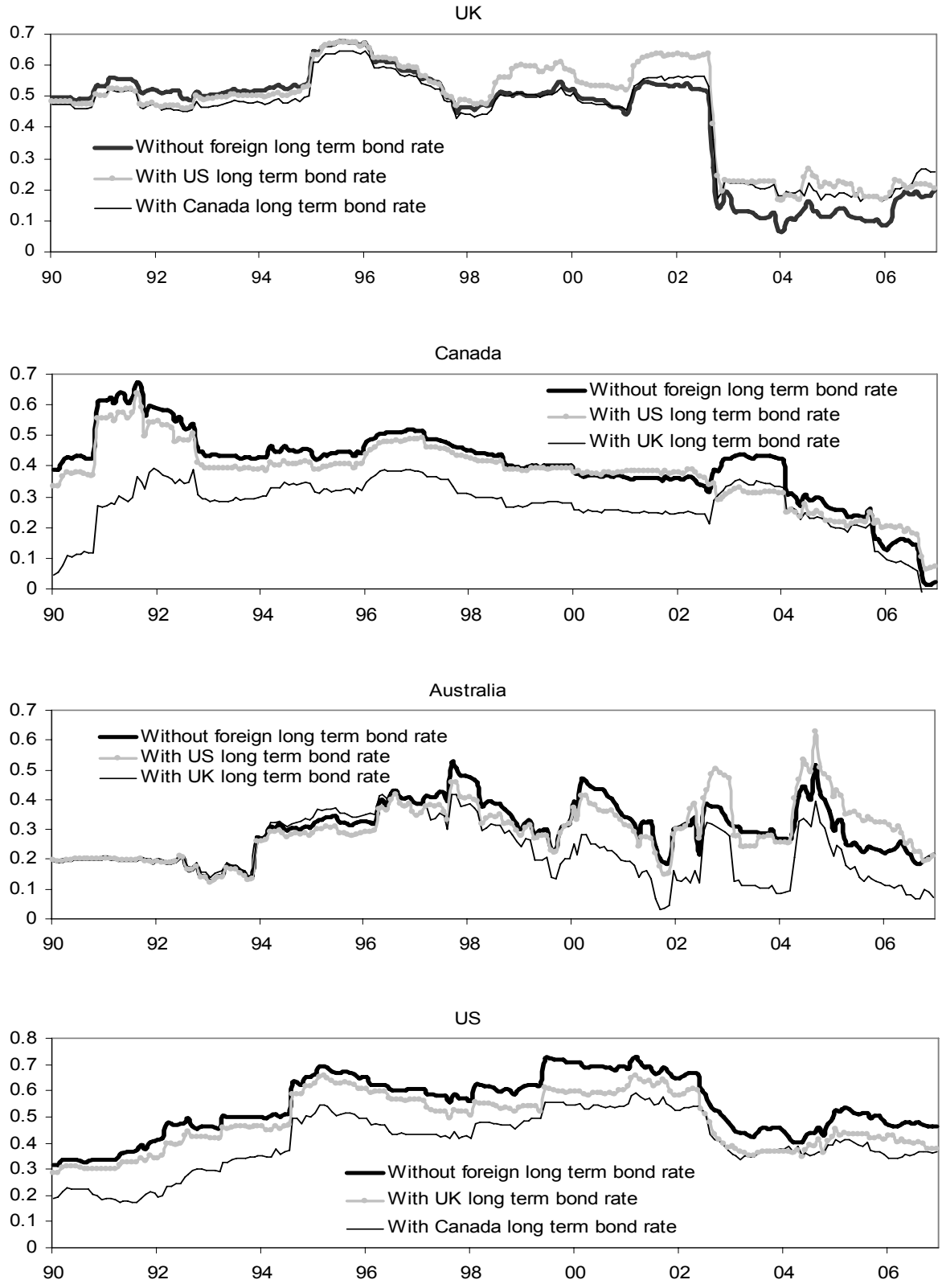
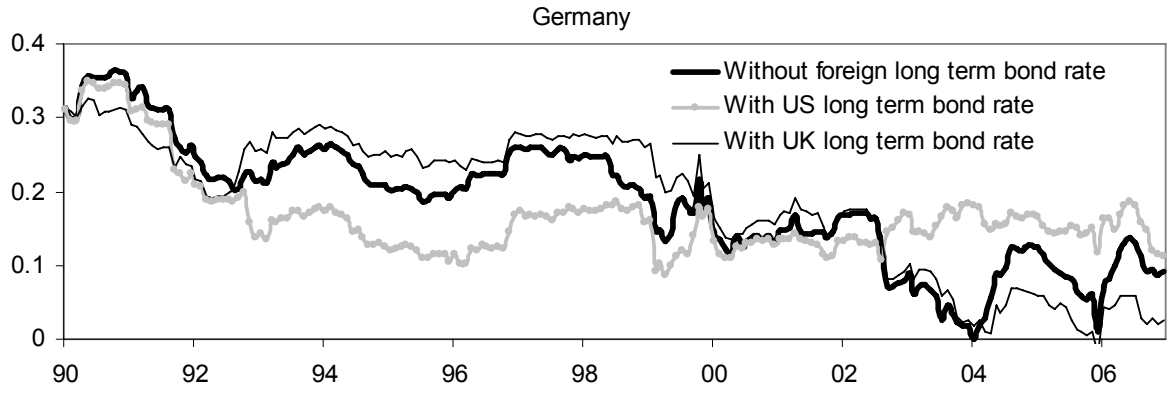


Chart 9 (cont)

Rolling regression result for interest rate pass-through to long-term bond rates



Source: Authors' estimates.

The other possible explanation that is often put forward is lower inflation expectations, with the success of many central banks in bringing down and anchoring inflation at lower levels since the mid 1990s. In an environment of stable and constant inflation expectations, responses to policy rate changes would be partial as increases or decreases in policy rates would be viewed as temporary and likely to revert back to average or normal levels. In other words, the size of immediate pass-through would be smaller than that under an environment of unstable inflation expectations. It is difficult, if not impossible, however, to directly test this hypothesis. Nonetheless, careful observation of the rolling regression results reveals that the "structural break" tends to occur in 2002. This coincides with the lapse of the year 1991 and 1992 in the rolling window. This seems to suggest that the size of the immediate pass-through is somehow being influenced by the level of inflation experienced during the period. The generally much lower and more stable inflation experienced by most advanced countries since the mid 1990s seems a probable and good explanation for the reduced size of the immediate pass-through effect to the long-term bond rate here.

4.5 Summary of empirical findings

Overall, the empirical findings suggest that interest rate pass-through in the financially developed countries is stronger – in terms of higher immediate and long-run pass-through as well as faster speed of adjustments – compared with that in the Asian countries. In other words, countries with more developed financial markets – in terms of higher levels of bank competitiveness and breadth and depth of bond and equity markets – will tend to have stronger interest rate pass-through. In addition, market-based financial systems also tend to be associated with stronger interest rate pass-through compared with bank-based financial systems.

Meanwhile, the rolling regression results suggest that the degree of interest rate pass-through to deposit and lending rates, and to some extent short-term paper rates, has also become stronger for a number of countries, notably the US and Australia among the financially developed countries, as well as Malaysia and Korea among the Asian countries. The nature of pass-through for other countries appears to remain unchanged. In Germany, however, the interest rate pass-through to retail bank rates and short-term paper rates appears to have declined in recent periods.

5. Conclusions

The effectiveness of monetary policy in affecting economic activity and inflation depends on the state of the financial system, and various financial developments can potentially change the way monetary policy is transmitted through the financial system. From our literature survey, we can conclude that most aspects of financial market developments tend to strengthen the interest rate channel. Only the advancement of payments technology, which enables consumption smoothing, weakens the importance of the interest rate channel. With respect to the bank lending channel, almost all aspects of financial market developments weaken the impact of monetary policy through this channel. However, having a large proportion of smaller firms in an economy with a relatively high dependence on bank financing may strengthen the role of this channel in transmitting monetary policy. As for the balance sheet channel, financial market developments appear to have a mixed impact. Meanwhile, the asset price or wealth effect channel strengthens with greater financial market development. In the case of interest rate pass-through, it can be concluded that financial market developments lead to faster and larger pass-through.

The findings of our empirical studies with respect to interest rate pass-through are in line with other studies. Financial market developments, in general, lead to stronger interest rate pass-through – in terms of both higher immediate and long-run pass-through and faster speed of adjustments. Our study on Asian countries together with developed countries suggests that Asian countries, which have a lower degree of financial market development compared with the financially advanced countries, also have lower interest rate pass-through. Looking ahead, therefore, our empirical findings together with other earlier studies suggest that interest rate pass-through will become much stronger in the near future with the current trend of changes and developments in the Asian financial landscapes. That is, the effectiveness of monetary policy in Asian countries is likely to increase in the future, at least in terms of its influence on cost of funds.

Appendix I:
Estimation results of study

**Estimation results –
interest rate pass-through to deposit rate**

1987–2006

	Long-run			Short-run							
	γ^*	β^*	Adj R^2	γ	α_1	α_2	β_0	β_1	β_2	δ	Adj R^2
UK	0.04	1.00	1.00	0.00	–0.17	–0.20	1.13	0.16	0.10	–0.21	0.87
	(0.03)	(0.00)		(0.01)	(0.07)	(0.06)	(0.03)	(0.08)	(0.06)	(0.06)	
Canada	–1.33	0.84	0.98	–0.01	–0.23	0.04	0.56	0.20	0.11	–0.14	0.61
	(0.06)	(0.01)		(0.01)	(0.06)	(0.06)	(0.03)	(0.05)	(0.05)	(0.04)	
Australia	–1.43	1.03	0.97	–0.01	0.13	–0.07	0.45	0.10	0.10	–0.08	0.40
	(0.09)	(0.01)		(0.02)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.03)	
US	0.15	1.00	0.99	0.00	0.17	0.05	0.56	0.16	0.00	–0.39	0.57
	(0.03)	(0.01)		(0.01)	(0.07)	(0.06)	(0.05)	(0.07)	(0.06)	(0.06)	
Germany	0.03	0.85	0.99	0.00	0.04	–0.04	0.40	0.29	0.07	–0.10	0.68
	(0.02)	(0.00)		(0.01)	(0.07)	(0.05)	(0.03)	(0.04)	(0.04)	(0.04)	
Korea	3.62	0.47	0.72	–0.01	0.24	0.05	0.13	0.07	0.04	–0.04	0.44
	(0.20)	(0.02)		(0.02)	(0.07)	(0.06)	(0.02)	(0.02)	(0.02)	(0.01)	
Malaysia	0.76	0.89	0.92	–0.01	0.31	0.04	0.26	–0.07	–0.08	–0.31	0.42
	(0.09)	(0.02)		(0.02)	(0.06)	(0.06)	(0.03)	(0.04)	(0.03)	(0.04)	
Philippines	–1.29	0.64	0.24	–0.03	–0.12	–0.04	0.06	0.02	0.02	–0.01	0.04
	(0.93)	(0.07)		(0.06)	(0.07)	(0.06)	(0.02)	(0.02)	(0.02)	(0.01)	
Thailand	2.50	0.70	0.70	–0.02	0.11	–0.03	0.03	0.08	0.06	–0.05	0.20
	(0.25)	(0.03)		(0.03)	(0.06)	(0.06)	(0.02)	(0.02)	(0.02)	(0.02)	
Indonesia	9.67	0.47	0.64	–0.01	0.18	0.17	0.07	0.05	0.09	–0.90	0.42
	(0.46)	(0.02)		(0.08)	(0.06)	(0.05)	(0.02)	(0.02)	(0.02)	(0.02)	

Source: Authors' estimates.

Estimation results – interest rate pass-through to lending rate

1987–2006

	Long-run			Short-run							
	γ^*	β^*	Adj R^2	γ	α_1	α_2	β_0	β_1	β_2	δ	Adj R^2
UK	0.04	1.01	1.00	0.00	–0.10	–0.21	1.01	0.09	0.21	–0.08	0.99
	(0.01)	(0.00)		(0.00)	(0.07)	(0.06)	(0.01)	(0.07)	(0.06)	(0.03)	
Canada	1.65	0.94	0.99	0.00	–0.14	–0.04	0.76	0.20	0.05	–0.21	0.74
	(0.04)	(0.01)		(0.01)	(0.07)	(0.06)	(0.03)	(0.07)	(0.06)	(0.05)	
Australia	4.03	0.92	0.99	0.00	–0.04	0.01	0.73	0.01	0.02	–0.12	0.73
	(0.05)	(0.01)		(0.01)	(0.06)	(0.06)	(0.04)	(0.06)	(0.06)	(0.03)	
US	3.48	0.85	0.95	0.01	–0.03	0.00	0.33	0.42	0.12	–0.06	0.65
	(0.07)	(0.01)		(0.01)	(0.06)	(0.05)	(0.04)	(0.04)	(0.05)	(0.02)	
Germany	7.33	0.60	0.78	0.01	0.04	–0.08	0.30	0.15	0.12	–0.02	0.44
	(0.11)	(0.02)		(0.01)	(0.06)	(0.06)	(0.04)	(0.04)	(0.04)	(0.01)	
Korea	5.60	0.36	0.57	–0.01	0.19	0.01	0.13	0.02	0.02	–0.03	0.29
	(0.22)	(0.02)		(0.02)	(0.07)	(0.07)	(0.02)	(0.02)	(0.02)	(0.01)	
Malaysia	5.18	0.51	0.68	–0.01	0.06	0.19	0.13	0.10	0.04	–0.09	0.32
	(0.12)	(0.02)		(0.01)	(0.06)	(0.06)	(0.02)	(0.03)	(0.02)	(0.02)	
Philippines	2.11	0.69	0.23	–0.03	–0.13	0.03	0.04	0.08	0.02	–0.01	0.07
	(1.03)	(0.08)		(0.07)	(0.07)	(0.06)	(0.02)	(0.02)	(0.02)	(0.01)	
Thailand	6.80	0.55	0.70	–0.01	0.20	0.13	0.02	0.01	0.02	–0.06	0.26
	(0.19)	(0.02)		(0.02)	(0.06)	(0.06)	(0.01)	(0.01)	(0.01)	(0.01)	
Indonesia	16.42	0.27	0.58	–0.01	0.13	0.26	0.07	0.04	0.01	–0.04	0.45
	(0.30)	(0.01)		(0.04)	(0.06)	(0.06)	(0.01)	(0.01)	(0.01)	(0.01)	

Source: Authors' estimates.

Estimation results –
interest rate pass-through to short-term paper rate

1987–2006

	Long-run			Short-run							
	γ^*	β^*	Adj R^2	γ	α_1	α_2	β_0	β_1	β_2	δ	Adj R^2
UK	0.03	0.96	0.99	0.00	–0.23	–0.16	1.16	0.09	0.09	–0.15	0.82
	(0.04)	(0.00)		(0.01)	(0.07)	(0.07)	(0.04)	(0.08)	(0.06)	(0.05)	
Canada	–0.27	1.00	0.99	0.00	–0.35	–0.13	0.97	0.26	0.17	–0.59	0.74
	(0.03)	(0.00)		(0.01)	(0.10)	(0.07)	(0.04)	(0.09)	(0.07)	(0.12)	
Australia	0.05	0.98	0.99	0.00	–0.11	–0.11	0.98	0.25	0.10	–0.34	0.46
	(0.07)	(0.01)		(0.02)	(0.11)	(0.09)	(0.10)	(0.11)	(0.08)	(0.10)	
US	0.24	0.88	0.99	0.00	0.07	–0.19	0.47	0.20	0.18	–0.15	0.55
	(0.04)	(0.01)		(0.01)	(0.07)	(0.07)	(0.04)	(0.05)	(0.05)	(0.04)	
Germany	0.27	0.89	0.96	0.00	0.03	0.06	0.43	0.35	0.05	–0.10	0.29
	(0.06)	(0.01)		(0.01)	(0.07)	(0.06)	(0.07)	(0.07)	(0.07)	(0.03)	
Korea	3.74	0.74	0.82	–0.03	0.05	–0.09	0.45	–0.04	0.01	–0.10	0.31
	(0.24)	(0.02)		(0.05)	(0.07)	(0.07)	(0.05)	(0.06)	(0.05)	(0.03)	
Malaysia	0.67	0.82	0.89	0.00	0.31	–0.10	0.22	0.08	0.01	–0.19	0.26
	(0.10)	(0.02)		(0.02)	(0.06)	(0.06)	(0.04)	(0.04)	(0.04)	(0.04)	
Philippines	–0.03	0.72	0.24	–0.02	0.06	–0.14	0.10	0.08	0.01	–0.01	0.13
	(1.05)	(0.08)		(0.08)	(0.07)	(0.06)	(0.02)	(0.02)	(0.02)	(0.01)	
Thailand[1]											
Indonesia[1]											

[1] Data not available.

Source: Authors' estimates.

Estimation results –
interest rate pass-through to long-term bond rate

1987–2006

	Long-run			Short-run							
	γ^*	β^*	Adj R^2	γ	α_1	α_2	β_0	β_1	β_2	δ	Adj R^2
UK	2.22	0.68	0.84	–0.01	0.30	–0.04	0.60	–0.40	–0.03	–0.04	0.36
	(0.15)	(0.02)		(0.02)	(0.07)	(0.06)	(0.07)	(0.08)	(0.07)	(0.02)	
Canada	2.16	0.73	0.88	–0.01	0.00	–0.04	0.46	–0.09	0.02	–0.07	0.23
	(0.12)	(0.02)		(0.02)	(0.07)	(0.07)	(0.05)	(0.06)	(0.06)	(0.03)	
Australia	1.55	0.83	0.91	–0.02	–0.05	0.01	0.34	0.03	–0.02	–0.05	0.03
	(0.14)	(0.02)		(0.03)	(0.07)	(0.07)	(0.12)	(0.12)	(0.10)	(0.03)	
US	1.66	0.81	0.87	0.00	0.36	–0.20	0.47	–0.03	–0.02	–0.05	0.28
	(0.11)	(0.02)		(0.02)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.03)	
Germany	2.66	0.65	0.78	–0.01	0.30	–0.02	0.15	0.03	–0.06	–0.02	0.09
	(0.11)	(0.02)		(0.01)	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.02)	
Korea	3.61	0.72	0.81	–0.02	0.13	–0.12	0.19	0.05	0.06	–0.04	0.22
	(0.24)	(0.02)		(0.03)	(0.06)	(0.06)	(0.03)	(0.03)	(0.03)	(0.02)	
Malaysia[1]											
Philippines[1]											
Thailand	5.63	0.37	0.54	–0.01	0.15	–0.03	0.01	0.00	0.00	–0.03	0.02
	(0.19)	(0.02)		(0.02)	(0.07)	(0.07)	(0.01)	(0.01)	(0.01)	(0.01)	
Indonesia[1]											

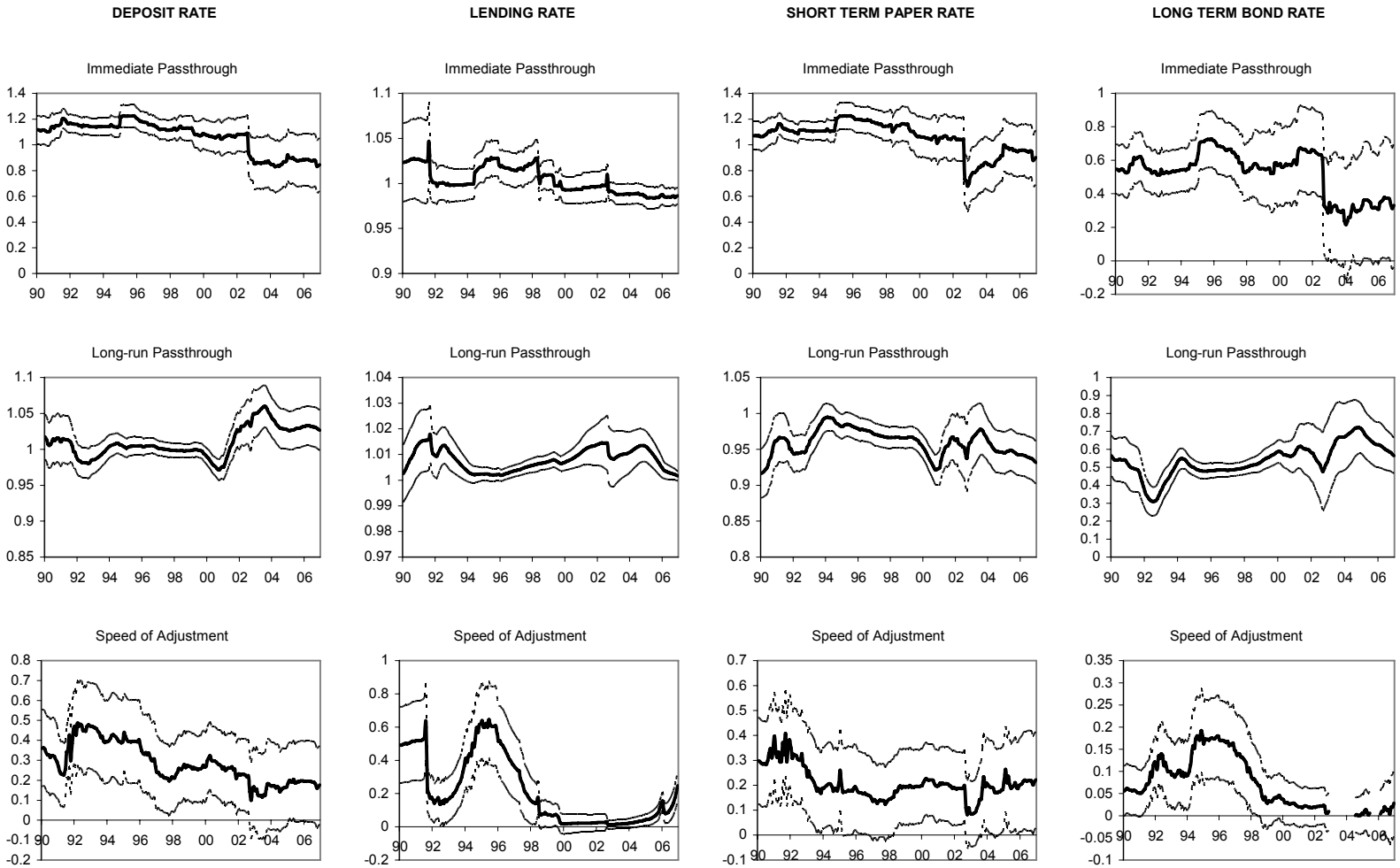
[1] Data not available.

Source: Authors' estimates.

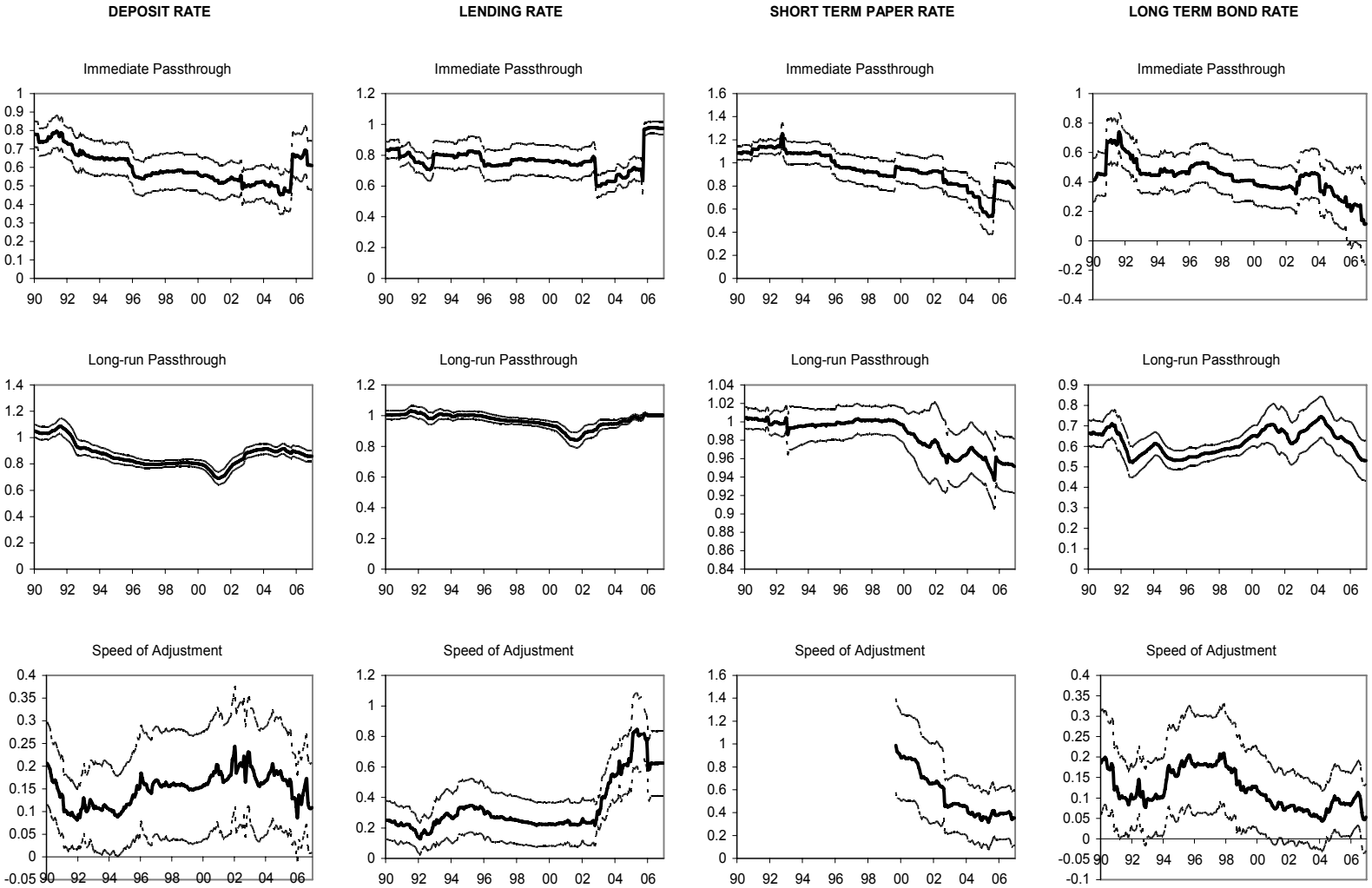
Appendix II:

Rolling Regression Result

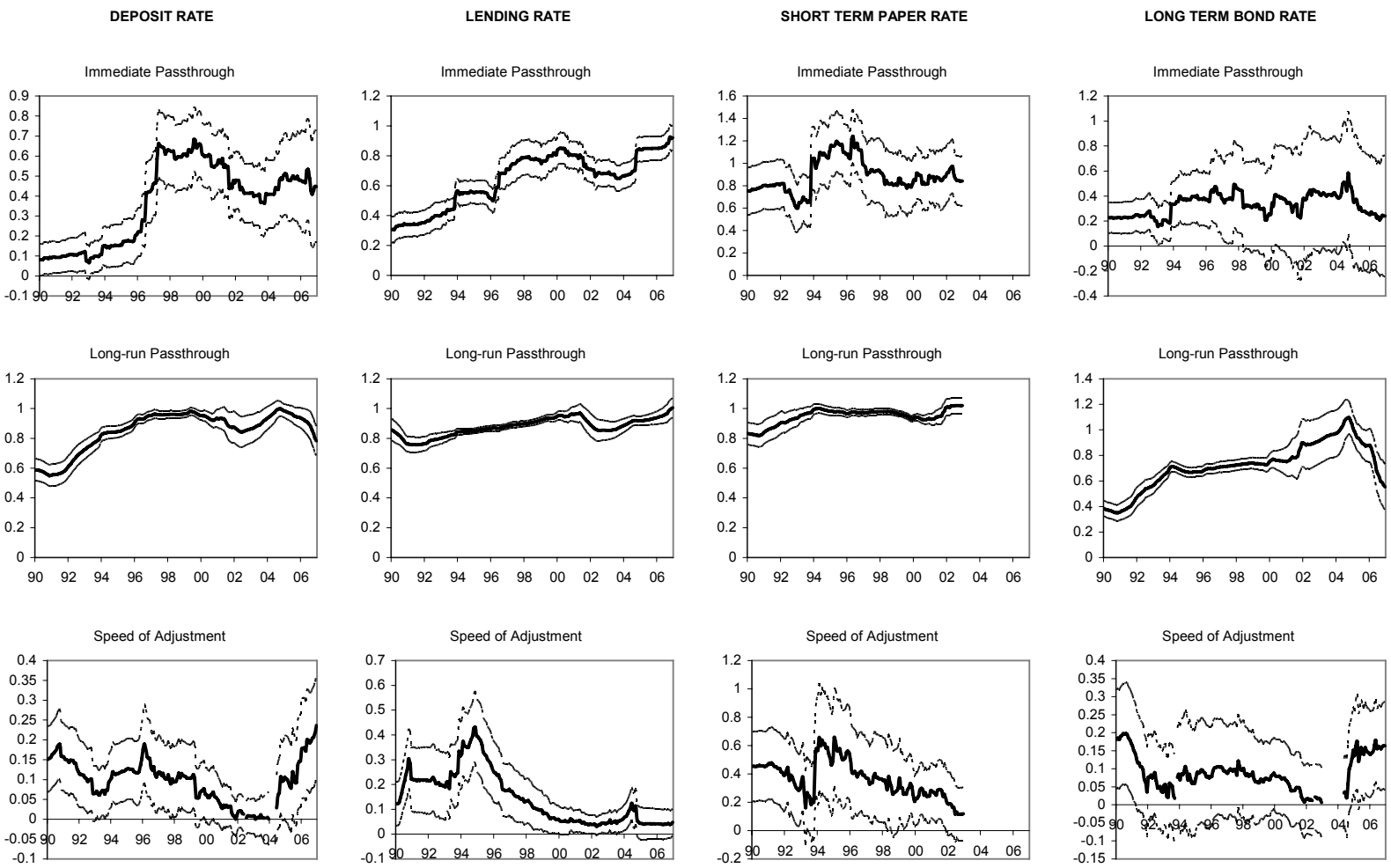
UK



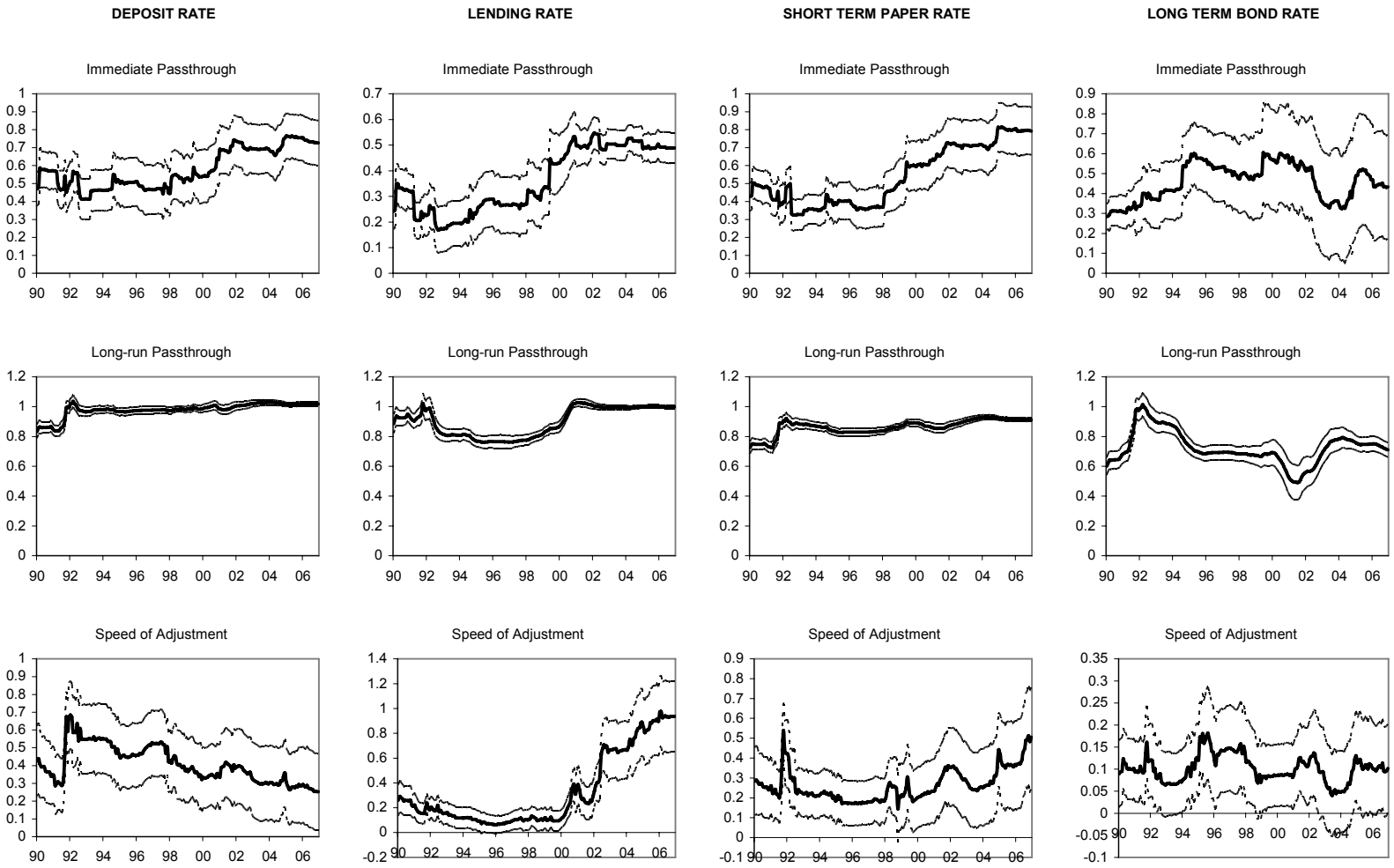
Canada


DEPOSIT RATE
LENDING RATE
SHORT TERM PAPER RATE
LONG TERM BOND RATE
Immediate Passthrough
Long-run Passthrough
Speed of Adjustment
90 92 94 96 98 00 02 04 06

Australia

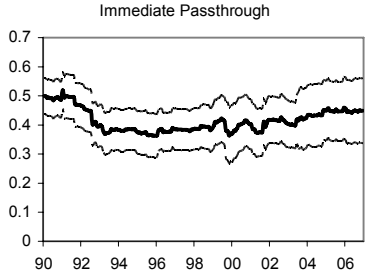

DEPOSIT RATE
LENDING RATE
SHORT TERM PAPER RATE
LONG TERM BOND RATE
Immediate Passthrough
Long-run Passthrough
Speed of Adjustment
90 92 94 96 98 00 02 04 06

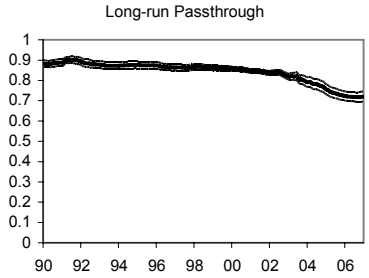
US

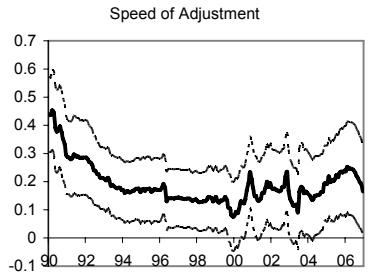

DEPOSIT RATE
LENDING RATE
SHORT TERM PAPER RATE
LONG TERM BOND RATE
Immediate Passthrough
Long-run Passthrough
Speed of Adjustment
90 92 94 96 98 00 02 04 06

Germany

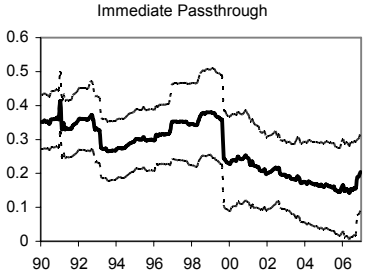
DEPOSIT RATE

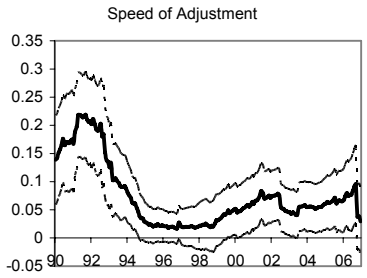




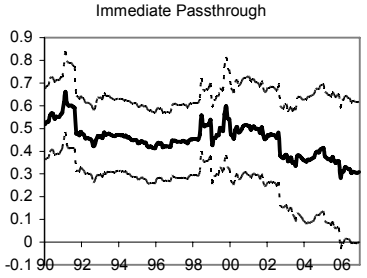


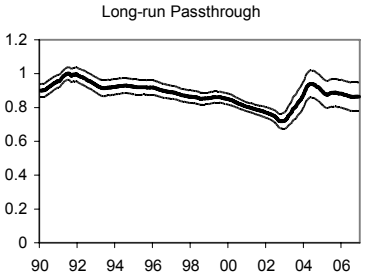
LENDING RATE

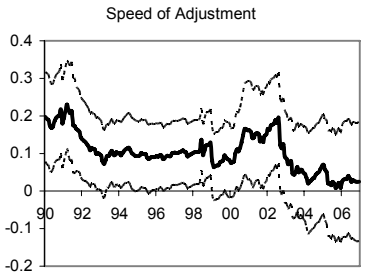




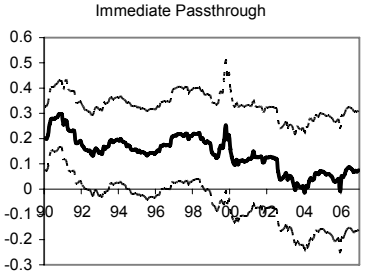
SHORT TERM PAPER RATE

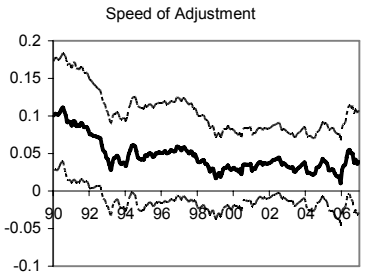




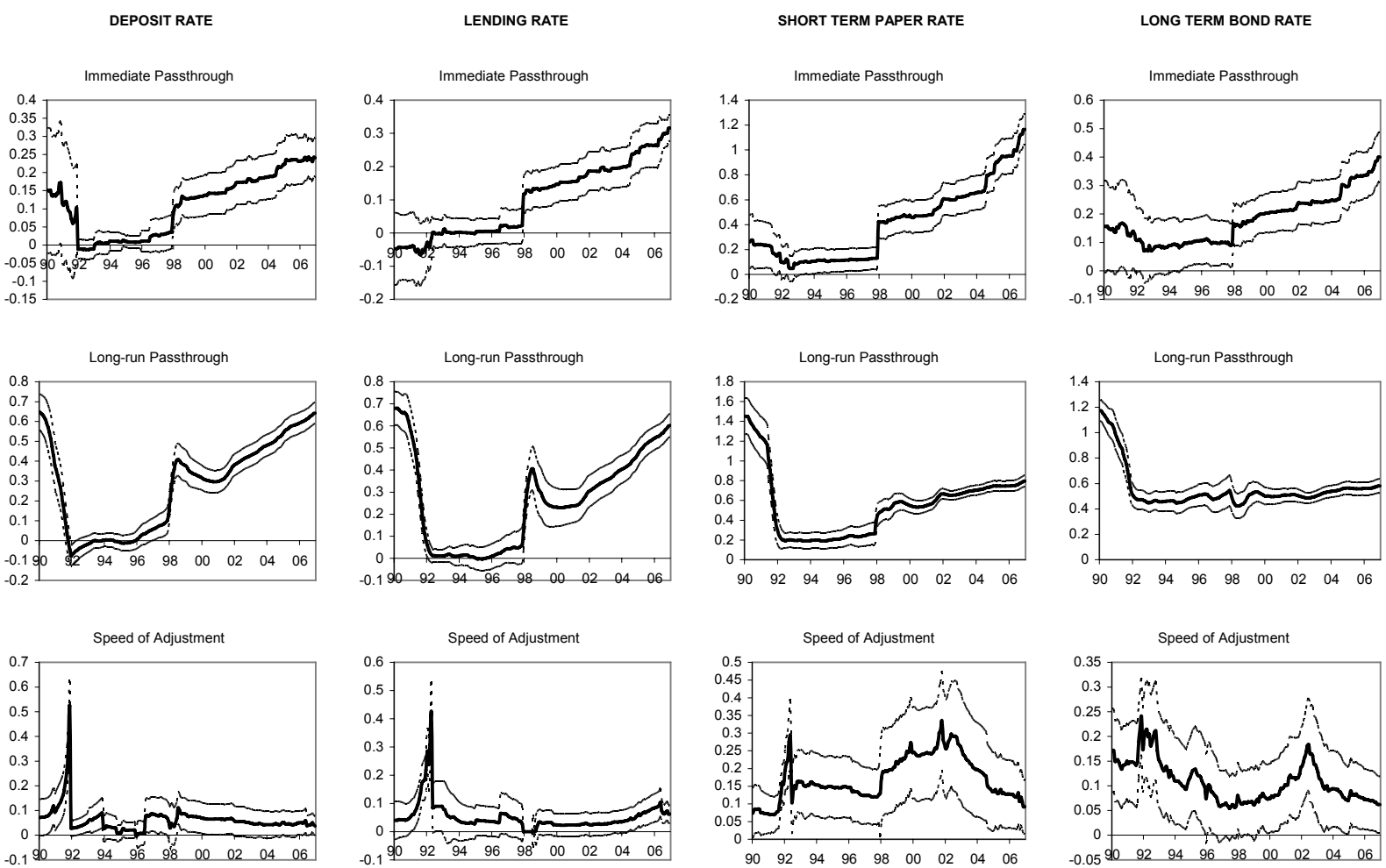


LONG TERM BOND RATE





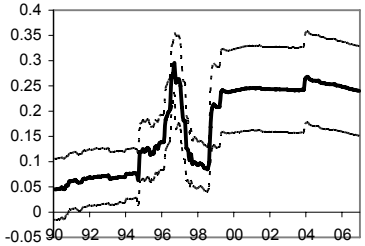
Korea


DEPOSIT RATE
LENDING RATE
SHORT TERM PAPER RATE
LONG TERM BOND RATE
Immediate Passthrough
Long-run Passthrough
Speed of Adjustment
90 92 94 96 98 00 02 04 06

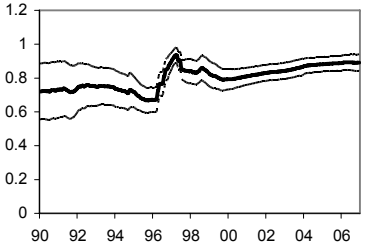
Malaysia

DEPOSIT RATE

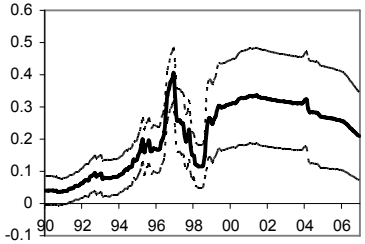
Immediate Passthrough



Long-run Passthrough

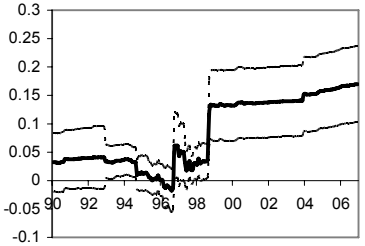


Speed of Adjustment

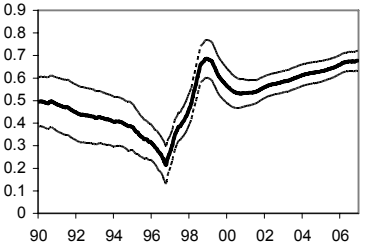


LENDING RATE

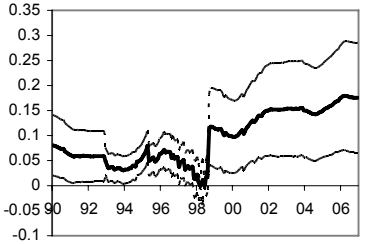
Immediate Passthrough



Long-run Passthrough

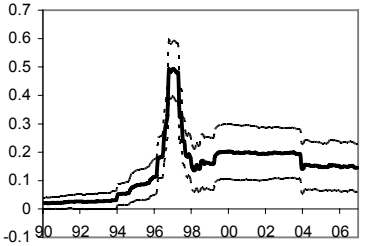


Speed of Adjustment

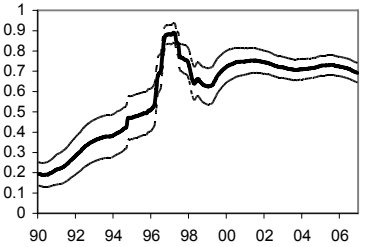


SHORT TERM PAPER RATE

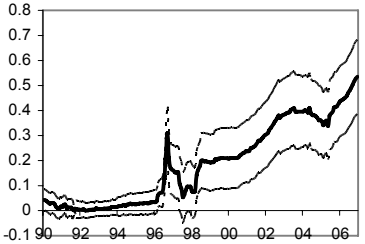
Immediate Passthrough



Long-run Passthrough



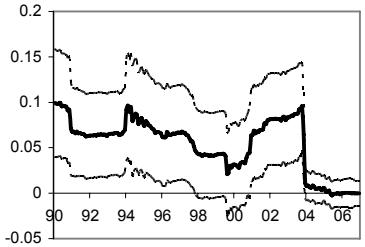
Speed of Adjustment



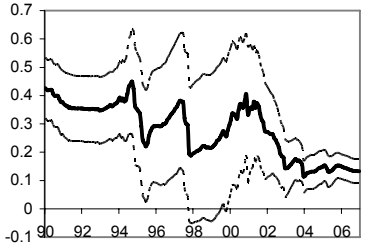
Philippines

DEPOSIT RATE

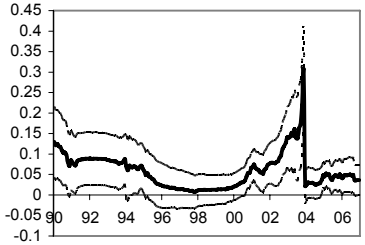
Immediate Passthrough



Long-run Passthrough

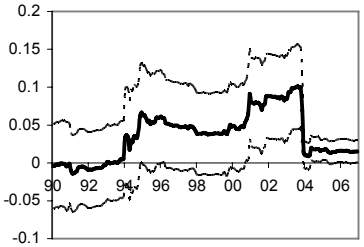


Speed of Adjustment

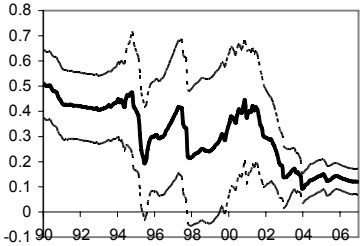


LENDING RATE

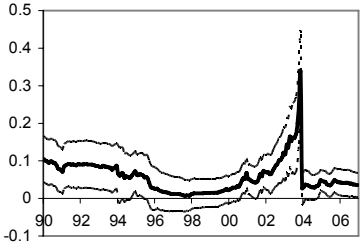
Immediate Passthrough



Long-run Passthrough

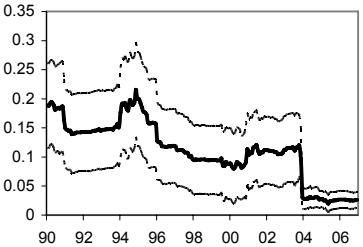


Speed of Adjustment

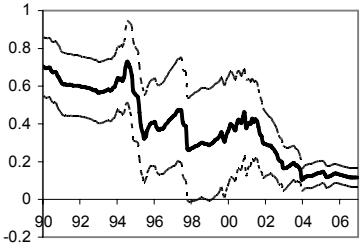


SHORT TERM PAPER RATE

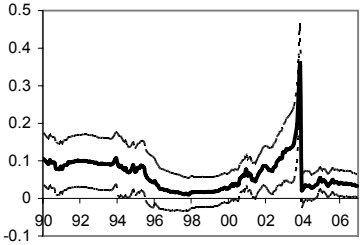
Immediate Passthrough



Long-run Passthrough



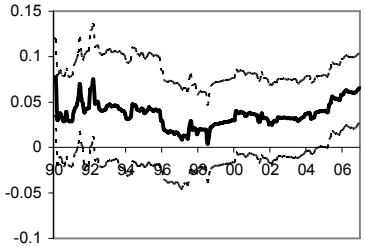
Speed of Adjustment



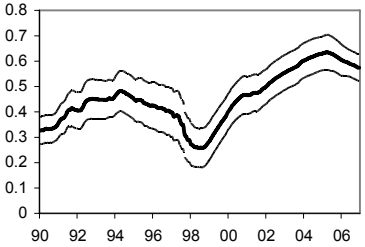
Thailand

DEPOSIT RATE

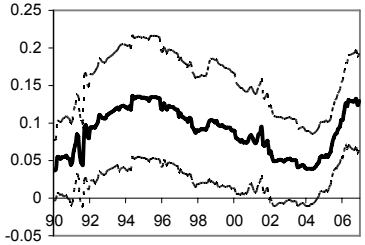
Immediate Passthrough



Long-run Passthrough

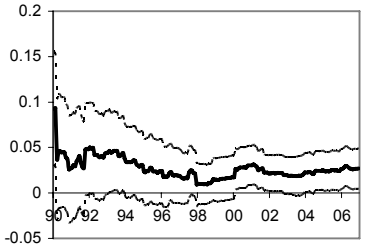


Speed of Adjustment

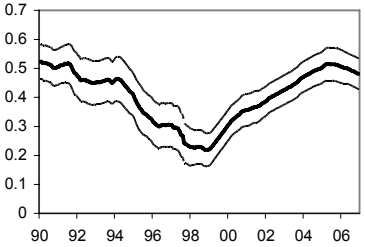


LENDING RATE

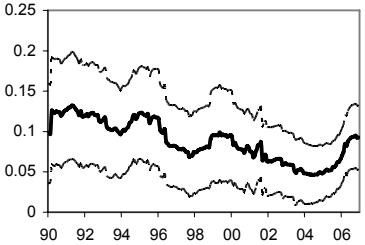
Immediate Passthrough



Long-run Passthrough

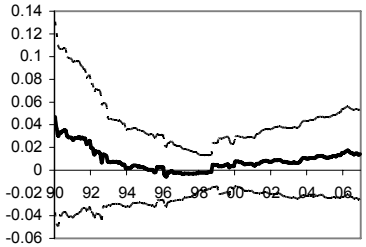


Speed of Adjustment

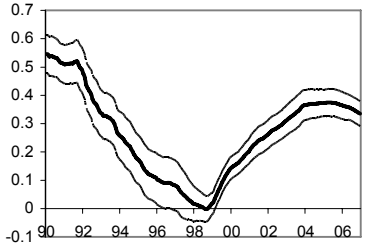


LONG TERM BOND RATE

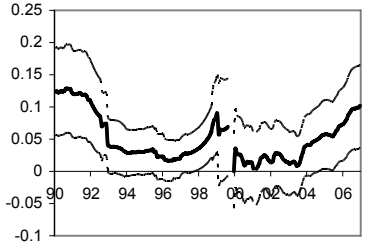
Immediate Passthrough

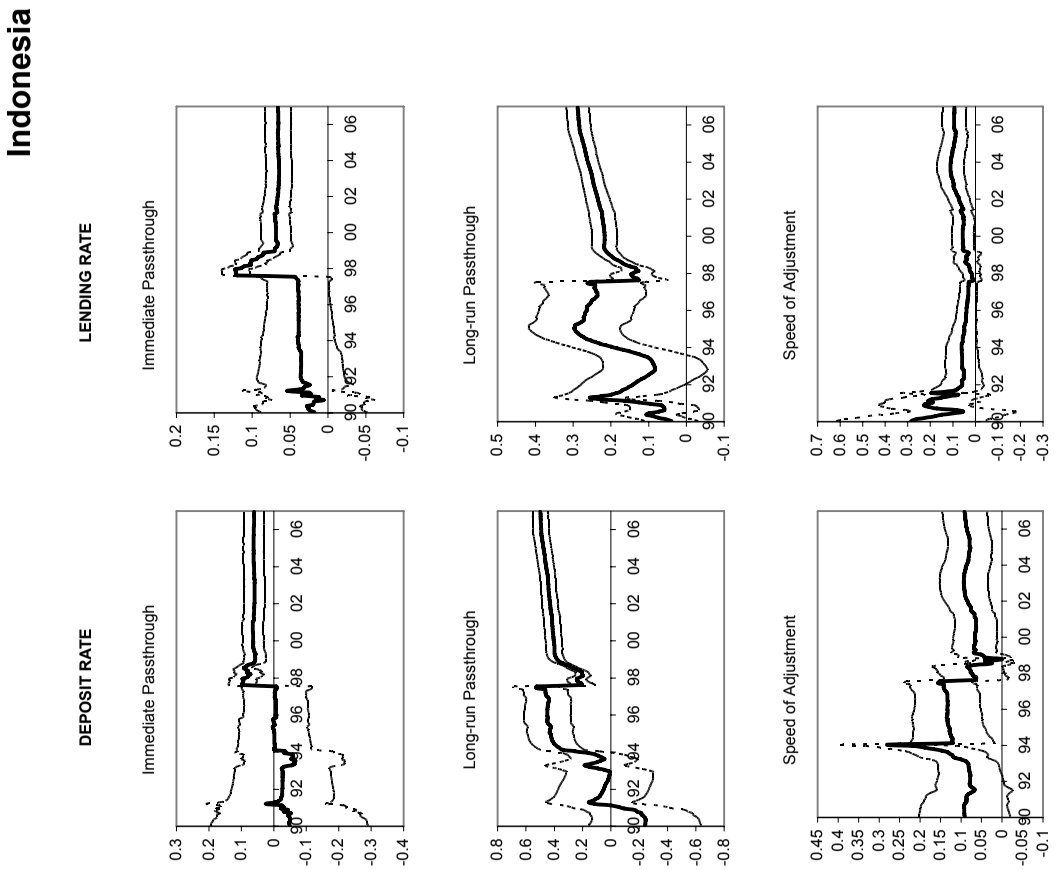


Long-run Passthrough



Speed of Adjustment




Indonesia
LENDING RATE
DEPOSIT RATE
Immediate Passthrough
Long-run Passthrough
Speed of Adjustment

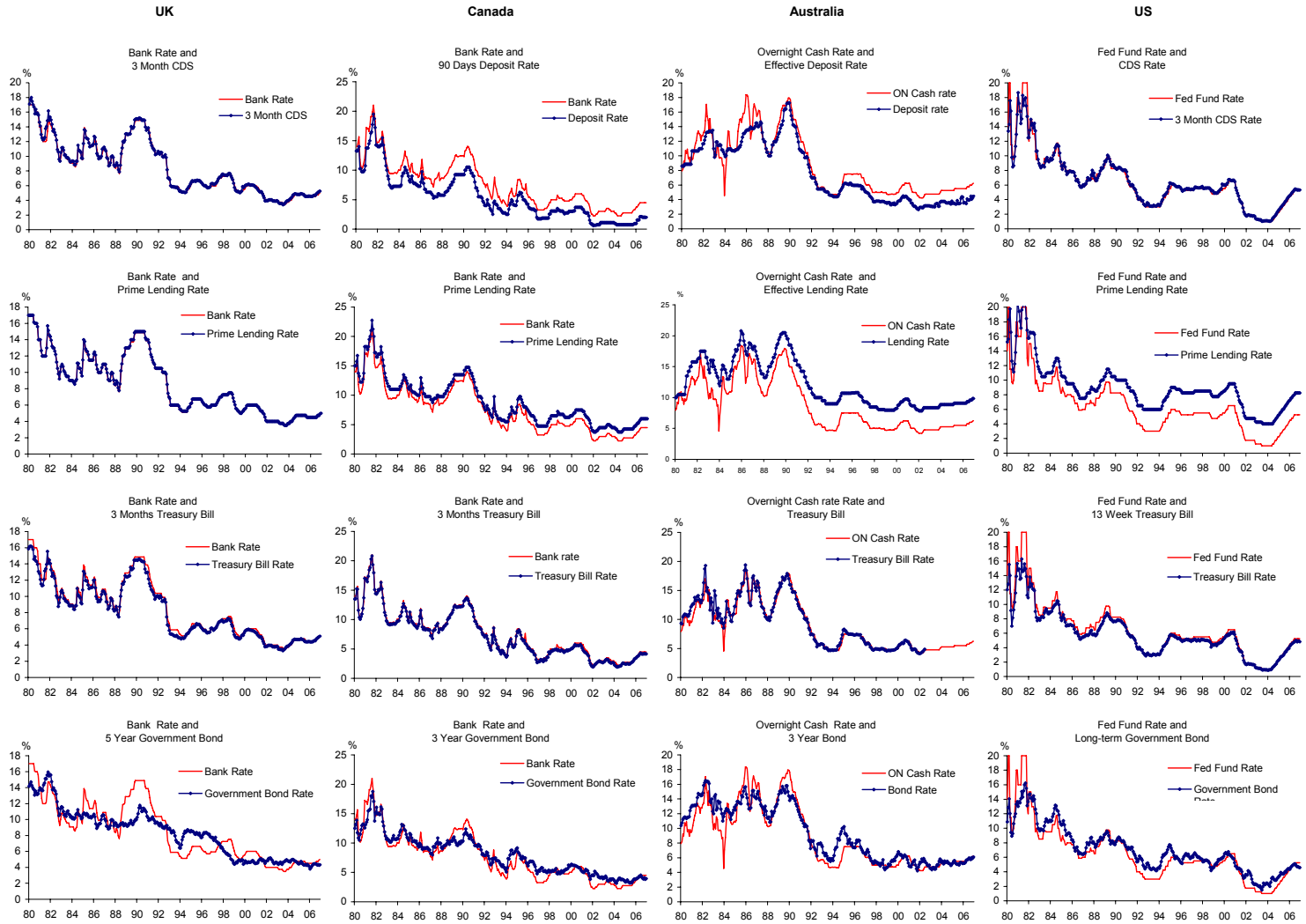
Appendix III: Sources and plots of data

Country	Data	Description	Source
UK	**Bank rate**	**Monthly average Bank official rate.**	**Bank of England**
	CDS	**Three-month certificate of deposit rate.**	**Bank of England**
	Prime lending rate	**Monthly average of base rate of four banks.**	**Bank of England**
	Treasury bill rate	**Tender rate at which 91-day bills are allotted.**	**IFS**
	Government bond rate	**Theoretical gross redemption bond yields computed from bonds issued at par with five years to maturity.**	**IFS**
Canada	**Bank rate**	**Rate at which the Bank of Canada is prepared to respond to requests of chartered banks for temporary advances and enter into purchase and resale agreements with money market dealers.**	**IFS**
	Deposit rate	**Rate offered by chartered banks on 90-day deposits in national currency.**	**IFS**
	Prime lending rate	**Rate charged on large business loans to their most creditworthy customers.**	**IFS**
	Treasury bill rate	**Weighted average of the yields on successful bids for three-month bills.**	**IFS**
	Government bond rate	**Average yield to maturity of government bonds with original maturity of three-five years.**	**IFS**
Australia	**Overnight Cash Rate**	**Weighted average rate of the interest rates at which banks have borrowed and lent exchange settlement funds during the day.**	**IFS**
	Deposit rate	**Average rate offered by major banks on three-month fixed deposits of 10,000 Australian dollars.**	**IFS**
	Lending rate	**Maximum rate charged by banks on loans to small and large businesses.**	**IFS**
	Treasury bill rate	**Weighted average yield on 13-week treasury notes allotted at last tender of month. Beginning in January 1995, estimated closing yield in the secondary market on 13-week treasury notes.**	**IFS**
	Government bond rate	**Yield on two-year Treasury bonds. Beginning in June 1981, assessed secondary market yield on two-year non-rebate bonds. Beginning in June 1992, assessed secondary market yield on three-year non-rebate bonds.**	**IFS**

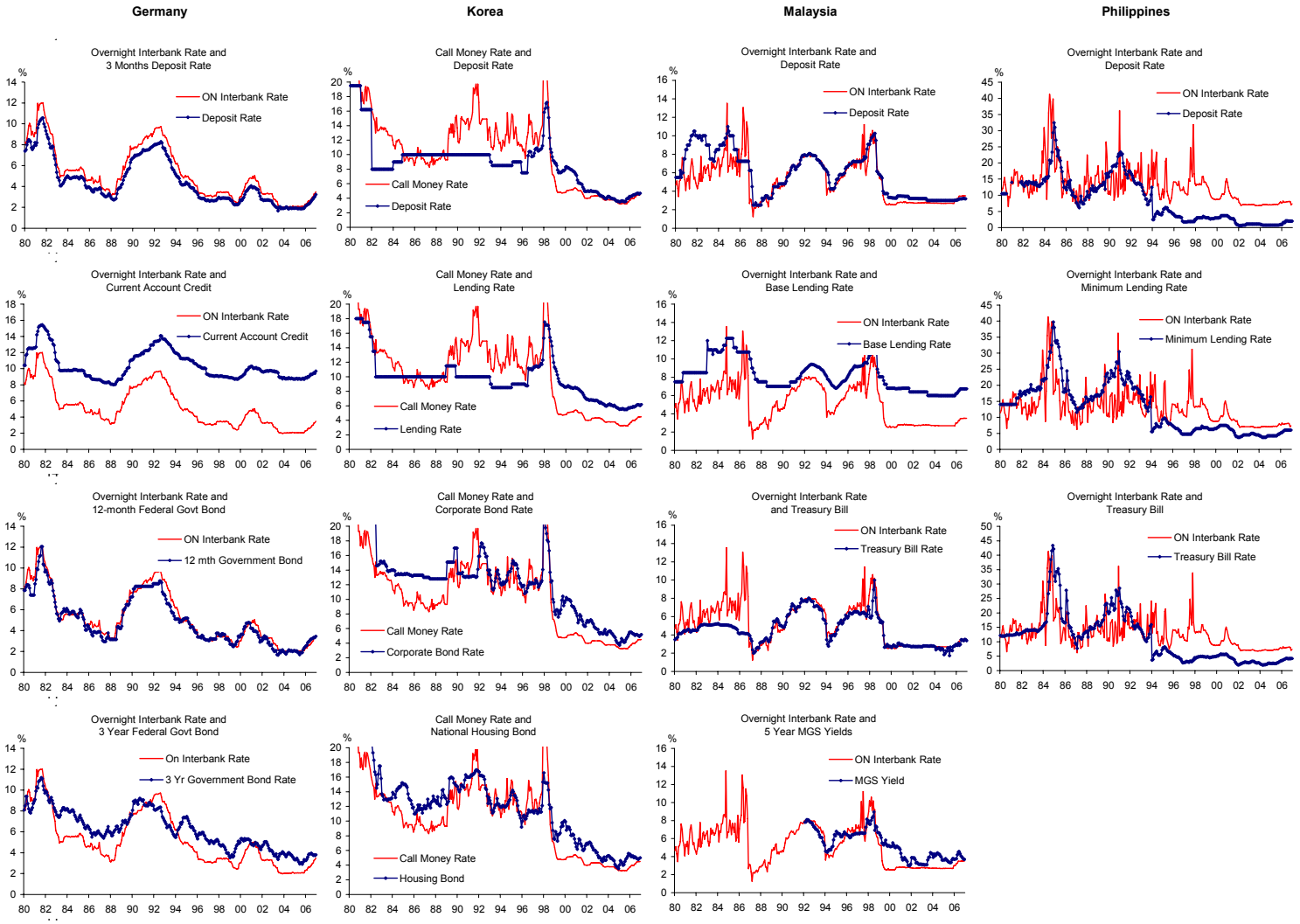
Country	Data	Description	Source
US	**Fed funds rate**	**Fed funds target rate.**	**Federal Reserve Board**
	CDS	**Average of dealer offering rates on nationally traded certificates of deposit.**	**IFS**
	Prime lending rate	**Average base rate charged by 23 banks on short-term business loans.**	**IFS**
	Treasury bill rate	**Weighted average yield on multiple-price auctions of 13-week treasury bills. Beginning on 28 October 1998, data are stop yields from uniform-price auctions.**	**IFS**
	Government bond rate	**Yield on actively traded treasury issues adjusted to three-year constant maturities.**	**IFS**
Germany	**Overnight interbank rate**	**Period averages of 10 daily average quotations for overnight credit.**	**IFS**
	Deposit rate	**Rate on three-month deposits in denominations of less than one million marks. From January 2003, rates on household deposits up to two years.**	**IFS**
	Current account credit rate	**Rate on current account credit in denominations of less than one million marks. From January 2003, rates on household loans up to one year.**	**IFS**
	Short-term paper rate	**Rate on 12-month Federal debt register claims.**	**IFS**
	Government bond rate	**Average yields on all bonds issued by the Federal Government with remaining maturity of more than three years, weighted by the amount of individual bonds in circulation.**	**IFS**
Korea	**Call money rate**	**Average daily rate on call money, weighted by the volume of transactions.**	**IFS**
	Deposit rate	**Average, weighted by the amount of deposits for periods of one year or more but less than two years at nationwide commercial banks.**	**IFS**
	Lending rate	**Minimum rate charged to general enterprises by deposit money banks on loans of general funds for up to one year. From July 1996, the rate is an average, weighted by new loans extended during the period by nationwide commercial banks.**	**IFS**
	Corporate bond rate	**Through January 1992, yields on 91-day bills issued by enterprises without collateral. Beginning February 1992, data refer to corporate bond rate.**	**IFS**
	National housing bond rate	**Arithmetic average of yields, by maturity, on Type 1 National Housing Bonds.**	**IFS**

Country	Data	Description	Source
Malaysia	**Overnight interbank rate**	**Weighted average overnight interbank rate.**	**IFS**
	Deposit rate	**Average rate offered by commercial banks on three-month time deposits to the private sector in national currency.**	**IFS**
	Base lending rate	**Average base lending rate offered by commercial banks.**	**Bank Negara Malaysia**
	Treasury bill rate	**Average discount rate on three-month treasury bills.**	**IFS**
	Government bond rate	**Market yield to maturity on five-year government bonds.**	**IFS**
Philippines	**Overnight interbank rate**	**Weighted average rate on overnight loans between commercial banks, thrift banks, savings banks, and non-bank financial institutions with quasi-banking functions to cover reserve deficiencies.**	**IFS**
	Deposit rate	**Weighted average rate offered by commercial banks on 61- to 90-day time deposits in national currency.**	**IFS**
	Lending rate	**Weighted average rate charged by commercial banks on loans in national currency.**	**IFS**
	Treasury bill rate	**Weighted average rate on 91-day treasury bills denominated in national currency.**	**IFS**
Thailand	**Overnight interbank rate**	**Rate on loans between commercial banks. Beginning in January 1989, daily average of commercial banks' overnight rates for interbank lending.**	**IFS**
	Deposit rate	**Maximum rate offered by commercial banks on three- to six-month savings deposits.**	**IFS**
	Minimum lending rate	**Minimum rate charged by commercial banks on loans to prime customers.**	**IFS**
	Government bond rate	**Maximum coupon rate on bonds allotted to banks and other financial institutions in Thailand.**	**IFS**
Indonesia	**One-day interbank rate**	**Rate on one-day loans between commercial banks.**	**IFS**
	Deposit rate	**Average rate offered by commercial banks on six-month time deposits. Beginning in January 1990, weighted average rate offered by commercial banks on three-month time deposits in national currency.**	**IFS**
	Average lending rate	**Weighted average rate charged by commercial banks on loans to the private sector for working capital in national currency.**	**IFS**

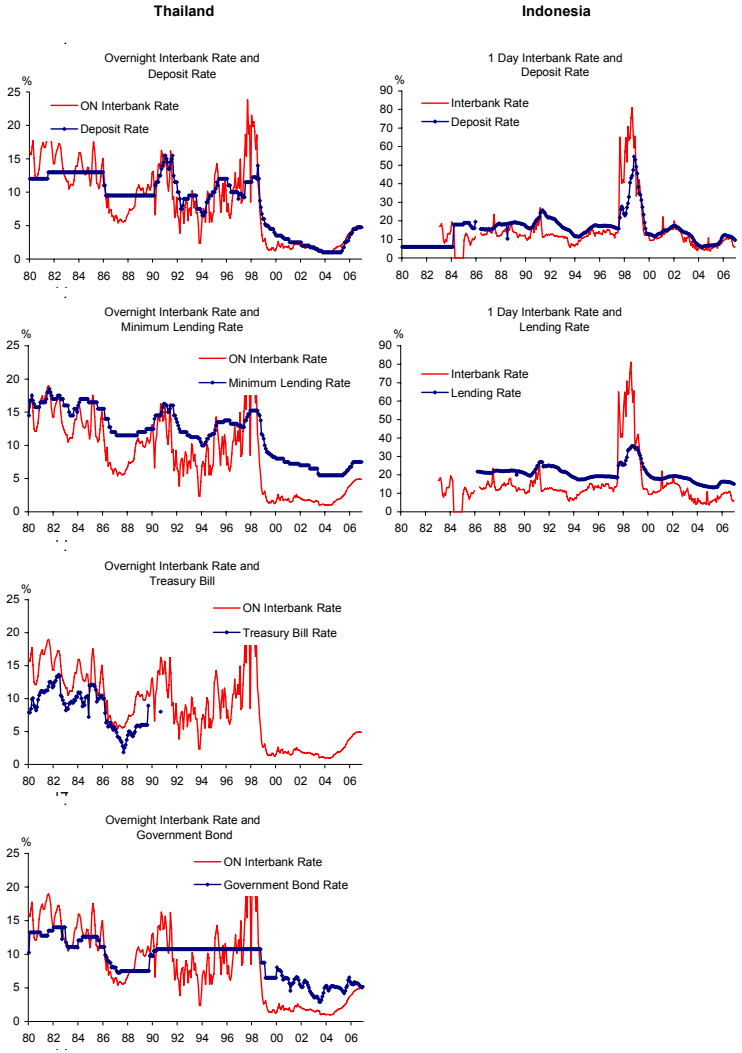
Plots of data



Source: Authors' estimates.



Source: Authors' estimates.



Source: Authors' estimates.

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The changing nature of financial intermediation and its implications for monetary policy

Hans Genberg[58]

Introduction

Monetary policy influences the economy through its effects on credit conditions facing households and firms, for example, the interest rates available on bank deposits and bank loans, and the cost of capital for firms, be it in the form of bank credit, debt issued on the capital market, or equity. While it is convenient for analytical purposes to assume that the monetary authority controls the relevant credit conditions directly through its control of a short-term policy interest rate, this simplification leaves no role for a banking system or for financial intermediation more generally. It thus precludes an analysis of how changes in the nature of financial intermediation may impact the conduct of monetary policy.

This paper builds on a relatively recent but growing literature which puts financial intermediation and financial intermediaries back into macroeconomic models and attempts to draw some conclusions about how central bank policy may need to adjust to accommodate changes in the structure of financial intermediation. It starts by documenting the evolution of financial intermediaries and financial intermediation as observed mainly in developed economies, although arguably this will become a feature of emerging-market and developing economies as well. It is suggested that the traditional distinction between bank-based and market-based financial systems is becoming outdated and should be replaced by a distinction between relationship-based and arm's length interaction between borrowers and lenders. Developments also suggest that markets are becoming more complete and that risk management and distribution by both institutions and households is becoming more efficient.

Implications of these developments for monetary policy are discussed in Sections 2 and 3. In the former it is briefly pointed out that central bank operating procedures will be made more flexible as financial markets develop, allowing central banks that are currently still constrained to using direct instruments of monetary control to switch to more efficient indirect policy instruments.

Section 3 discusses the implications for a central bank's interest rate policy. It is argued that changes in the nature of financial intermediation may alter the neutral interest rate a central bank should aim for as well as the horizon at which it seeks to achieve the inflation target. Furthermore, a case can be made that movements in asset prices and balance sheet aggregates may provide information that is useful for setting monetary policy.

1. Transformation of financial intermediation

1.1 What do financial intermediaries do?

The simplest view of financial intermediation is that it serves to transfer financial resources from net savers in an economy to net investors. While it is of course true that this is an important function of financial intermediaries, this description suggests a far too limited role for intermediation in financial markets, since it emphasises only net financial flows. A more

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complete picture would reveal that net savers in an economy are often both sources and recipients of funds from intermediaries and likewise for net investors. The same household will typically have deposits with a bank or mutual fund while at the same time holding a significant mortgage liability. Similarly a firm may be issuing equity shares or commercial paper to finance its operations, even as it has substantial financial asset holdings through an internally managed pension fund. The recent growth in securitisation has also led to the emergence of financial institutions that intermediate between other financial intermediaries. In an international context current account positions and net international investment positions of economies are often dwarfed by gross financial flows and gross claims and debts, again an illustration of a wider role of financial intermediation than matching only excess demands and excess supplies of funds.

One aspect of the value-added of a financial intermediary is that it transforms assets in several dimensions; in terms of size when it combines small denomination deposits into large loans, in terms of credit quality when it adds its name to portfolios of loans to make them more readily acceptable to investors, in terms of maturity by accepting short-term liabilities as counterparts to long-term loans, and in terms of currency composition when it borrows abroad in foreign currency and extends domestic-currency loans. Each of these transformations will of course entail its own specific risk – liquidity risk, credit risk, interest risk, or currency risk – and the intermediary will have to manage these risks.

One strand of the literature on financial intermediation has devoted considerable attention to the question of why financial intermediation is carried out indirectly by specific institutions rather than directly by corresponding markets. At the most general level the answer lies in differential transaction costs between the two modes of intermediation. More specifically, asymmetric information between borrowers and lenders is often invoked as a reason for the emergence of specialised intermediation institutions. This asymmetric information can potentially lead to adverse selection and moral hazard problems which require screening of borrowers, preventing opportunistic behaviour, as well as verification of the outcome of projects for which a loan has been extended. Significant economies of scale in these monitoring functions can explain the existence of specialist lending institutions. Furthermore, economies of scope between deposit taking and lending activities can explain the emergence of traditional banks.

In light of this brief description, changes in the financial intermediation landscape can be due to the introduction of both new institutions and new instruments. The underlying causes of such changes can be traced to changes in legislation, technological developments, theoretical developments, and even the choice of monetary policy strategy itself. Examples of legislation-driven financial liberalisation include relieving banks from the obligation to lend to “priority” sectors, allowing foreign financial institutions to operate in the economy, extending the range of instruments in which insurance companies may invest, etc. Improvements in information technology and theoretical advances in asset pricing have led to the invention of a vast number of new financial instruments and their use in investment strategies and risk management. This in turn has permitted the transfer of risk with implications for incentives to monitor borrowers, for the dynamics of price adjustments in financial markets, and ultimately for financial and macroeconomic stability, i.e. for outcomes with which central banks are principally concerned. The influence of the choice of monetary policy strategy on the development of financial markets refers to the possibility that the adoption of a particular operating procedure for monetary policy will have a direct influence on the development of financial markets, and it will be discussed further in Section 2 below.

1.2 A brief review of recent developments

During the past few decades significant development of financial intermediaries, financial instruments and financial markets has taken place, driven largely by deregulation, technological advancement and rapid globalisation. As a result, financial intermediation has also undergone remarkable changes, more so in developed countries but also in emerging

economies. These changes have provided diverse choices and opportunities for households and firms in terms of their borrowing and financing as well as lending and investment decisions. For example, firms have been able to resort increasingly to bond and stock markets to obtain funds while households could begin to diversify their portfolios out of bank deposits into securities, mutual funds and derivatives.

One strand of the literature on financial intermediation compares the relative merits of bank-based financial systems, where banks play a leading role in mobilising savings, evaluating investments and managing risks, versus market-based systems, where capital markets are just as important in performing these roles (Levine and Zervos (1998)). In the traditional financial system, banks' intermediation can be described as simply transforming deposits into illiquid loans, and hence there was a clear separation between banks and markets. However, recent financial innovation and the development of non-bank intermediaries, as well as the creation of new instruments and new markets, have resulted in a breakdown of the clear separation between banks and markets.

A growing literature goes beyond the bank-based vs. market-based distinction, and characterises financial intermediation based on how financial transactions are conducted. In this literature, relationship-based intermediation, which depends on a long-term relationship and the sharing of private information between the borrower and the lender, is contrasted with arm's length intermediation, which depends on publicly available information and contract enforcement. Financial deregulation and innovation have blurred the borders between commercial banking and other financial activities such as investment banking and asset management, and the roles of financial markets and banks in both households' and firms' financing and asset allocation have become more integrated. In view of these developments, we could look at financial intermediation by differentiating the system into relationship-based traditional business by banks, arm's length based intermediation by financial institutions, and intermediation through capital markets. Despite the varying pace of developments and important differences across countries (and regions), several general trends in financial intermediation can be observed.

First, most countries are seeing a declining role of relationship-based banking activity. While banks have traditionally played a very important role in channelling funds from savers to borrowers, and they remain the most important single source of finance in many countries, their role in intermediation has declined. For major OECD countries, on average, banks intermediated less than 30% of non-financial sector (including household, non-financial corporate, and government) assets and liabilities in 2004.[59] Even in countries where banks still account for a higher share in intermediation, the importance of relationship-based banking business should be weakened by the observed trend of intense competition in the banking industry and increased credit information availability and information disclosure.

Second, many countries are seeing an increase in the importance of arm's length financial intermediations, which include activities by non-bank intermediaries such as pension funds, mutual funds and insurance companies, non-traditional banking activities such as banks borrowing from and lending to non-bank institutions, and activities related to financial innovations and new risk-management practices such as loan securitisation and trades of derivative products. Recent developments in these areas have resulted in more complete financial intermediations, allowing agents to insure and diversify a broader range of risks and allowing risks to be transferred to parties who are willing to assume them.

Non-bank intermediaries are generally found to be performing an increasing role in channelling funds between savers and borrowers (in advanced economies). In the US, around 50% of households' assets are held with non-bank financial institutions.[60] Improvements in information technology have also lowered transaction costs and allowed

[59] Sources: IMF (2006), OECD, Eurostat.

[60] Sources: IMF (2006), OECD, Eurostat.

more accurate risk assessment by non-bank intermediaries, resulting in more loan originations which have eroded banks' traditional lending role. In response to such competition, banks have diversified their lines of business and expanded to off-balance sheet and non-interest income activities as mentioned above. A notable example is the rapid development of the asset-backed securities market, where banks originate, pool and distribute credit risks by repackaging a portfolio of debt instruments (such as collateralised debt obligations) and selling them to different investors such as insurance and fund management companies.

Moreover, with the expansion of financial instruments and services, domestic financial institutions have become increasingly interdependent, as reflected in the increase in the shares of both banks' liabilities and assets vis-à-vis non-bank financial institutions (in advanced economies). It is common for banks to borrow from or lend to other institutions, or own securities issued by other institutions, or have other institutions as counterparties in various financial contracts they possess. By contrast, in a traditional financial system, domestic financial institutions tended to be rather insulated from one another as banks, insurance companies and brokerage firms each operated in relatively separate markets and managed different products. It is also worth mentioning that national markets are also increasingly interlinked with global markets through increased cross-border borrowing and lending by various financial institutions.

Third, stock and debt securities markets in most countries have achieved remarkable development over the past decades, becoming significant sources of finance for firms and investment vehicles for households. In countries like the US, debt and equity of non-financial corporates as a percentage of non-financial corporates' total liabilities reached about 70% in 2004, indicating a dominant role of capital markets in providing financing for firms.[61] While the pace of developments varies significantly across countries and across markets, in part depending on the institutional infrastructure (such as protection of legal rights, enforcement mechanisms and other factors such as information disclosure and accounting standards), in general, most countries have seen improved market access, with firms more easily able to obtain external financing and increasing numbers of listed companies. Domestic bond and stock markets have also increased their liquidity and depth, as reflected in higher transaction volumes and rising market capitalisation and turnovers.

In view of the obvious importance of financial markets for the transmission of monetary policy, it is natural to ask how the conduct of such policy might be affected by the ongoing transformation of financial intermediation. There are two aspects to this question; operational on the one hand and strategic on the other.[62] The next two sections deal with each in turn.

2. Financial intermediation and monetary policy operating procedures

This section looks briefly at the relationship between changes in the structure of financial intermediation and operational aspects of monetary policy.[63] The focus will be on the choice of policy instrument and the interaction between operating procedures and financial structure.

[61] Sources: IMF (2006), OECD, Eurostat.

[62] Developments in financial intermediation also have implications for financial stability, as events in the major financial markets during August and September 2007 vividly showed. These aspects fall outside the scope of this paper.

[63] Archer (2006) contains a detailed analysis including references to practices in emerging markets. McCauley (2007) emphasises the link between the development of financial markets and the choice of monetary policy instrument.

The most basic distinction to be made is between direct and indirect instruments of monetary policy. Where financial markets are primitive, the central bank may not be able to influence credit conditions other than by setting targets for bank lending, using liquidity ratios to steer lending towards "priority" sectors, setting reserve ratios, and imposing similar more or less quantitative restrictions on the ability of banks to intermediate credit. As financial markets develop, greater use of indirect policy measures can be made. Operations in the domestic interbank market or a short-term bills market will be possible, and when a liquid market for government bonds at a variety of tenures has been established, the central bank could even contemplate operating at different segments of the maturity structure. It is tempting, but not correct (see Archer (2006)), to think of the switch from using direct instruments to market-based ones as being dictated by an exogenously determined pace of reform of financial markets. Rather, the reforms and changes in operating procedures often appear to be mutually reinforcing. As a central bank starts to conduct, say, open market operations in central bank bills, the financial system adjusts and develops so that trading in secondary markets becomes more active, which in turn makes the conduct of open market operations increasingly effective.

The exact form the implementation of indirect monetary policy takes varies across countries depending on the specificity of the market structure that has emerged. For example, while most financially highly developed economies have carried out open market operations using central bank or government liabilities, the Swiss National Bank for many years did so using repurchase agreements in the foreign exchange market. The reason was simply that this market was very much more liquid and could therefore transmit policy impulses more reliably. Unorthodox as it may have been, the practice of carrying out monetary policy through the foreign exchange market does not appear to have materially altered its effectiveness in terms of influencing credit conditions in the economy.

As a first approximation, when different segments of the financial markets are highly integrated with each other there is a presumption that the impact of central bank actions on the structure of interest rates is independent of which segment of the market the central bank is targeting for intervention. This seems to be the view adhered to in a majority of central banks in jurisdictions with well developed markets, as they predominantly conduct policy using short-term instruments.

In developing and emerging markets the choice of instrument is arguably more important. First of all, the graduation from conducting policy based on direct controls to using indirect instruments is important as it spreads the effect of policies more evenly across institutions and markets and reduces the arbitrariness often associated with direct controls. Furthermore, as the choice of indirect policy instrument has an impact on the liquidity and breadth of the chosen segment of the market, the central bank has an important role to play in supporting the development of the financial sector of the economy.

3. Monetary policy when financial intermediation is taken seriously: is the "Taylor rule" enough?

The main focus of this paper is on how the introduction of financial intermediaries into the analysis of monetary policy influences the conclusions we draw as to the appropriate conduct of such policy. We start by reviewing briefly three analytical frameworks that contain an explicit role for financial intermediation in otherwise standard macroeconomic models. That is followed by a stylised representation of these frameworks which allows us to point to the key relationship that distinguishes models that allow for a role of financial intermediation and those that assume that the central bank has full control of credit conditions. After a review of empirical evidence on this relationship, we discuss the implication for monetary policy by asking whether the well known Taylor rule provides a sufficient benchmark against which an effective monetary policy can be judged.

3.1 Three models of financial intermediation

(i) Bernanke and Blinder (1988)

Bernanke and Blinder introduce a distinction between interest rates on bank loans and bonds in a simple macro model to explore the implications of a credit market for aggregate demand. They extend the standard IS/LM model by adding bank loans as a third asset in addition to money and bonds.[64] Their specification of the demand for loans by firms and the supply of credit by banks leads to an equilibrium in which the interest rate on bank loans can differ from the policy interest rate depending on the state of the business cycle (because this is one of the determinants of the demand for loans by firms), on the portfolio preferences of households (because they influence the supply of deposits to banks), and on parameters such as reserve requirements that determine the cost of bank intermediation. Although the authors do not explore the effects of changes in the intermediation technology of banks, their model implies that changes in this technology would alter the equilibrium relationship between the two interest rates.

The implication of this model for the conduct of monetary policy is that the central bank needs to monitor shocks in the market for bank loans and react to these shocks in order to stabilise output and inflation, and it needs to be mindful of possible changes in the equilibrium real policy rate brought about by changes in the bank intermediation process.

(ii) The financial accelerator model[65]

The financial accelerator is based on the fact that credit markets are imperfect due to the existence of asymmetric information and costly monitoring of borrowers by lenders. As a result, a firm that wants to borrow on the market will have to pay a premium over the opportunity cost of internally generated funds. The size of the premium depends, inter alia, on the size of the collateral the firm is able to post, the size of its cash flows, and the monitoring technology available to the borrower.

It is not difficult to grasp intuitively why the effect of a shock in the economy on the business cycle should be amplified in this context. A negative shock to consumption, say, would reduce cash flows of firms, which in turn would increase their external finance premium. Facing a higher cost of borrowing, firms would cut back on investment, which would lead to a further reduction in demand and productive capacity. Similarly, an increase in asset prices would lead to a reduction in borrowing costs due to the increased value of firms' collateral and could therefore have a larger effect on aggregate output than one would expect based only on a wealth effect on consumption. The size of the effect of monetary policy on output would likewise be amplified as the initial impact on cash flows and net worth would influence the external finance premium and lead to further changes in firms' investments.

For our purposes the existence of a financial accelerator means that monetary policy is more potent, and that variables governing the financial intermediation process may have an independent influence on aggregate demand over and above that of monetary policy interest rates.[66]

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[64] Brunner and Meltzer and Tobin had earlier emphasised the importance of assets other than money and bonds for the monetary transmission mechanism. See, for example, Brunner and Meltzer (1963) and Tobin (1969). Meltzer (1995) contains an accessible survey.

[65] See, for example, Bernanke and Gertler (1995), and Bernanke et al (1996) and (1999).

[66] As a matter of wording, it is not clear whether the speed, as distinct from the size, of the adjustment of the economy to changes in monetary policy will be affected by the financial accelerator mechanism. Simulations in Bernanke et al (1999) indicate that only the size of the impact is affected.

(iii) Goodfriend and McCallum (2007)

Goodfriend and McCallum explore the quantitative implications of a dynamic stochastic general equilibrium (DSGE) model of the new Keynesian variety in which a banking sector has been incorporated and given a non-trivial role as a financial intermediary. In the model, banks serve an essential function since their monetary deposit liabilities are required for consumption goods purchases by consumers, and their loans are required to finance the hiring of capital by entrepreneurs. Loan management by banks requires labour inputs and collateral in the form of government bonds and capital. Financial intermediation is hence modelled as an economic activity that requires real resources and is subject to technological progress and shocks. The specification implies that different assets yield different returns in equilibrium. Government bonds require a lower rate of return than capital because they provide greater collateral services in the loan management function of banks. Interbank deposits, identified as a policy interest rate, yield a lower rate still because of the resource costs associated with banks' lending to entrepreneurs.

As in the case of the two previous analytical frameworks, the Goodfriend-McCallum model implies that there will be a wedge between the central bank's policy rate and the interest rates that determine households' and firms' intertemporal expenditure decisions. This wedge is not constant but will depend, inter alia, on banks' intermediation technology ("loan management" technology in their terminology) and on the cost of inputs, labour and capital in the intermediation process. Goodfriend and McCallum show that for plausible parameterisation of their model the nature of financial intermediation will have quantitatively significant influences on both the steady state equilibrium value of the policy interest rate and the nature of the dynamic adjustment of inflation and consumption to shocks.

3.2 An illustrative analytic framework

We next ask whether and how the central idea in the above models – that the interest rate relevant for aggregate demand can differ from the monetary policy interest rate depending on the state of the economy and on the nature of the financial intermediation process – influences the analysis of monetary policy. For the sake of concreteness the discussion will be framed in a simple analytical model commonly used to discuss monetary policy. It contains just four equations, but the general conclusions that will be extracted from it will apply to more complete settings. For simplicity it abstracts from open-economy considerations.[67]

The model consists of an aggregate supply relationship, or Phillips curve

$$\pi_t = ... + \alpha_2 ygap_t + \varepsilon_t^{\pi}, \tag{1}$$

an IS relationship,

$$ygap_t = ... + \beta_3 (i_t^l - \pi_t^{\exp}) + \beta_4 z_t + \varepsilon_t^{y}, \tag{2}$$

a policy interest rate rule

$$i_t^p = \gamma_0 + \gamma_1 (\pi_{t+h}^{\exp} - \pi^T) + \gamma_2 ygap_t + \varepsilon_t^{i^p}, \tag{3}$$

and a relationship linking the policy interest rate and the interest rate relevant for aggregate demand,

$$i_t^l = ... + \delta_1 i_t^p + \delta_2 x_t + \varepsilon_t^{i^l}. \tag{4}$$

[67] Allowing for a foreign sector would introduce additional reasons why there might be differences between domestic policy interest rates and the terms on which the private sector can get credit, since in this scenario such credit could be obtained through intermediation from abroad. This would not alter the principal conclusions of our analysis.

As these equations are well known, only brief comments on each of them will be given, focusing on issues that are relevant for the potential impact of changes in the nature of financial intermediation. As a first general remark it should be kept in mind that the dynamic aspects in the equations are kept very simple for ease of notation. It is quite possible that some or all of the α:s, β:s, γ:s, and δ:s would be functions of a lag operator, in which case these functions might be influenced by changes in the financial system. This possibility, which is illustrated by the series of dots (…..) in the equations, will be discussed in the next section.

With regard to the aggregate supply, or Phillips curve, equation (equation (1)) the only remark is that in some specifications, the output gap measure is replaced by a measure of the marginal cost of production. In this case, and where the marginal cost of production would include costs of capital or financing of purchases of intermediate goods, the relevant borrowing costs would be included as a direct determinant of current, and hence expected future, inflation. As these borrowing costs would influence the aggregate demand equation in the model, we leave them out of equation (1) for simplicity.

The aggregate demand equation depends on the nominal rate of interest on bank loans, i^l, adjusted by the corresponding expected inflation rate to obtain a measure of the real cost of bank credit to households and firms. In addition, to allow for other forms of financial intermediation than through banks, aggregate demand is assumed to depend on a set of variables, z_t, which are meant to capture the cost and availability of these alternative sources of credit for households and firms.[68] It is through these variables that the effect of changes in the structure of financial intermediation will have most of its impact in our model, and therefore potentially on the conduct of monetary policy.

Equation (3) represents a standard reaction function of the central bank which sets the policy interest rate in response to the output gap and to deviations of expected inflation from the target rate at horizon *h*, as suggested by the well known Taylor rule.

Finally, there is a relationship between the nominal interest rate on bank loans which determines spending and the nominal policy rate. As written, this relationship will be able to illustrate the consequences of a variety of models of financial intermediation. For example, if the liabilities of the central bank and bank loans are perfect substitutes then $\delta_1=1$ and $\delta_2=0$ so that i^p and i^l will be equal, and the term $\beta_4 z_t$ will be redundant in the aggregate demand relationship, in which case the central bank has perfect control over the borrowing conditions for households and firms. If i^l represents a long-term interest rate and i^p a short rate, and if the expectations theory of the term structure links the two perfectly, then the *x* variables in equation (4) contain expected future values of the policy interest rate. In neither of these cases will the structure of financial intermediation have any impact on the determination of output and inflation in our model because the central bank can set the relevant interest rate directly. So the only interesting case for the purpose of this paper is when either (or both) bank loans and alternative sources of private sector credit are not perfect substitutes with central bank liabilities. In this case a model for the determinants of their relationship will include some additional variables summarised in the vector *x* in equation (4).

For future references it is useful to substitute (4) into (2) to obtain

$$ygap_t = ... + \delta_2 x_t + \beta_3 (i_t^p - \pi_t^{\exp}) + \beta_4 z_t + \varepsilon_t^y + \varepsilon_t^{i^m} \qquad (2')$$

[68] In this exposition the variables in *z* are treated as exogenous for simplicity. In a complete analysis at least some of them would have to be endogenised. For example, as will become clear later, some of the variables in *z* represent the cost of borrowing in the capital market, which clearly should be an endogenous variable in a full analysis of the financial intermediation process. As we are only illustrating the mechanisms through which changes in this process will affect monetary policy, however, it is not crucial to present a complete general equilibrium model.

which shows that aggregate demand will depend on the nature of the financial intermediation process through the variables in *x* and through $\varepsilon_t^{i^m}$. Furthermore, it is convenient to "solve" the equations for inflation and output in terms of the underlying disturbances in the economy as in (5) and (6).

$$\pi_t = \Pi(\varepsilon^{\pi}, \varepsilon^{y}, \varepsilon^{i^p}, \varepsilon^{i^l}, \varepsilon^{x}, \varepsilon^{z}) \tag{5}$$

$$\text{ygap}_t = \Upsilon(\varepsilon^{\pi}, \varepsilon^{y}, \varepsilon^{i^p}, \varepsilon^{i^l}, \varepsilon^{x}, \varepsilon^{z}) \tag{6}$$

where it should be understood that the functions include past and expected future values of the ε:s in addition to current values. The point of this last expression is to make explicit that shocks in the financial intermediation sector ($\varepsilon_t^{i^l}, \varepsilon^{x}$) are part of the solution for inflation and output, contrary to the common specification where the policy interest rate enters directly into the aggregate demand equation.

It is also useful to characterise the equilibrium real interest rate on bank loans as well as the equilibrium policy rate. Solving (4) for the bank loan rate when the output gap is zero and the inflation rate is at the target level gives

$$i^{l^{eqm}} = \pi^T - \frac{\beta_4}{\beta_3} z_t \,, \tag{7}$$

and from (4) the policy rate must be set so that in a full equilibrium it will equal

$$i^{l^{eqm}} = i^{p^{eqm}} - \delta_2 x_t = \pi^T - \frac{\beta_4}{\beta_3} z_t - \delta_2 x_t \,. \tag{8}$$

Hence, in the policy reaction function we must have

$$\gamma_0 = \pi^T - \frac{\beta_4}{\beta_3} z_t - \delta_2 x_t \tag{9}$$

in order for a stationary equilibrium to be attained. In words, the so called "neutral" level of the policy interest rate depends on features of the financial intermediation process through the variables *x* and *z*. For example, suppose risk aversion or the perceived credit risk associated with lending to firms or households increases. This will lead to an increase in the spread between the risk-free short-term policy rate and the longer-term interest rate on loans. As far as investment or consumption decisions are concerned, monetary conditions have tightened. To maintain a neutral monetary policy stance, the policy rate should decline. Similarly, a structural change in the financial intermediation sector that reduces the costs of financial intermediation implies easier monetary conditions unless it is counteracted by an increase in the policy rate.

This conclusion is a special case of that reached by Svensson (2003) in his analysis of the use of "judgement" by monetary policy makers. Svensson introduces judgement in inflation and output equations by adding variables he refers to as the "deviation". Apart from differences in lag structures these variables are identical to those I have labelled *x* and *z* in equations (2) and (4). This means that what Svensson calls a central banker's "judgement" can be thought of as referring to the use of a more elaborate or different (hence his term "deviation") model than the bare-bones structure involving only the output gap, the inflation rate, and the policy interest rate which is so popular in analytical treatments of monetary policy. Not surprisingly, Svensson concludes that the additional variables (judgement) should be allowed to play a role in the setting of a central bank's monetary policy instrument. In the context where financial intermediaries are an important element of the economy, the implication is that the nature of the financial intermediation sector should have an impact on the conduct of monetary policy as I have argued above.

3.3 Empirical issues

That the financial sector has an influence on how monetary policy affects the economy is well established both empirically and theoretically.[69] But in order to assess the implications for the conduct of monetary policy it is important to distinguish between three ways in which this influence can manifest itself. First, the size and speed of the response of aggregate demand to changes in market interest rate and credit conditions may depend on the nature of the financial intermediation process. This response is captured by the coefficient β_3 in equation (2) of our stylised model. Second, the size and speed of the response of market interest rates to monetary policy interest rates, measured by the coefficient δ_1 in equation (4), can be affected. Third, market interest rates and credit conditions may be influenced by other factors than monetary policy. This is illustrated by the terms $\beta_4 z_t$ and $\delta_2 x_t$ in the model. The frequency, size and persistence of this influence can be of fundamental importance for monetary conditions in the economy as already noted.

What is known about these factors? Singh et al (2007) contains a thorough review of the literature relating to the second issue, the pass-through from policy interest rates to market rates, as well as original empirical results comparing economies with different degrees of financial development. The empirical results suggest that "countries with more developed financial markets – in terms of higher levels of bank competitiveness and breadth and depth of bond and equity markets – tend to have stronger interest rate pass-through". Results are also consistent with the view that the speed of adjustment of market rates to policy rates is faster in economies with more developed financial markets.

Regarding the magnitude and speed of the effect of interest rate changes on aggregate demand, it is well known that in economies where mortgage lending is predominantly based on floating rates the impact of interest rate changes is felt faster than in economies where fixed rate mortgages are more common. It is also possible that other aspects of the financial system impact the sensitivity of aggregate demand to interest rate changes, and it would be useful to investigate this possibility in a systematic cross-country study. Important as cross-country differences in financial systems may be, however, it is likely that changes in the financial system *within* a country will proceed relatively slowly. In this case the central bank will have time to adjust its monetary policy strategy accordingly, and the disruption to macroeconomic stability will be minor.

The third empirical issue concerns the importance of shocks in the credit market itself for macroeconomic outcomes. I will not attempt to survey the very large empirical literature on this subject, but rather use two examples to illustrate that such shocks can be significant. In an influential early study Friedman and Kuttner (1993) used standard VAR analysis to estimate the effects of shocks in the intermediation sector on economic activity. Results pointed to significant influences of shocks to bank capital on the spread between interest rates on commercial paper and Treasury bills, and significant influences of default risk shocks (as proxied by the spread between interest rates on commercial paper with different risk ratings) on output. These effects are closely related to what we have denoted $\beta_4 z_t$ and $\delta_2 x_t$ in the stylised model.

Lown and Morgan (2006) use data on bank lending standards collected by the Federal Reserve to study the effects of variations in non-price lending terms on loan volumes and economic activity, in other words whether other variables than interest rates have an impact on output. Their VAR estimates imply that "[i]nnovations in standards account for nearly a third of the error variance in output at four quarters, even more than is attributable to innovations in the federal funds rate". (p 1583). Like those of Friedman and Kuttner, these results indicate that the developments in the financial intermediation sector can have

[69] References to some of the relevant literature have already been noted. See in particular Bernanke et al (1999) and Cecchetti (1999).

important macroeconomic effects, and that these should be taken into account in monetary policy decisions, the topic of the next section.

3.4 Changes in financial intermediation and the conduct of monetary policy

Based on our analytical framework it is now time to discuss the implications of changes in financial intermediation for the conduct of monetary policy. Following standard practice, let us assume that the objective of the monetary authority is to minimise a loss function that depends on the current and discounted future deviations of the inflation rate from its target value as well as on the current and discounted values of the economy's output gap. Let us further assume that financial intermediation plays a significant role in the economy along the lines discussed above. It then follows trivially from equations (5) and (6) that when the central bank decides on the policy interest rate it must take into account all shocks in the system, including those specific to the financial intermediation sector, as well as the parameters and functions that determine the response of the economy to these shocks. Changes in the process of financial intermediation that lead to changes in the speed and magnitude of the response of aggregate demand to loan rates and that bring about changes in the pass-through of policy interest rates to commercial loan rates must be factored into the monetary policy decisions.

As the output gap and the inflation rate also depend on all shocks in the economy, including those associated with the process of financial intermediation, it may be argued that a central bank which pays attention only to these ultimate target variables as suggested by the Taylor rule will automatically react appropriately to shocks and structural changes in the economy. Hence the question in the sub-title of this section: "Is the Taylor rule enough?".

If we interpret the Taylor rule broadly enough, the answer must be yes. For if the policy reaction of the central bank depends on the current level as well as forecasts of (all) future levels of the inflation and output gaps, then it follows trivially that the policy interest rate will react properly to all relevant shocks in the economy. But this is of course not very helpful, since to be made operational the forecasts of future inflation and output gaps must be made on the basis of currently observed variables. Furthermore, the beauty of the Taylor rule presumably is that it is meant to reduce the complexity of the decision problem for the central bank. And indeed, as it is most often interpreted, the rule suggests that a robust policy response would be a stable function of the current output gap and the expected deviation of the inflation rate from the target at some fixed horizon, often taken to be around two years. Central banks which publish forecasts of inflation at a particular horizon presumably do so because they believe that focusing on this horizon provides a good summary of the relevant information to which they need to react.

Cast in these terms then, the relevant question is whether a Taylor rule as represented in equation (3) is general enough to capture most of the information a central bank needs to pay attention to, or whether additional variables could have a useful role to play. Following the previous analysis, we will discuss this with reference to how changes in financial intermediation may influence three aspects of the policy rule: the size of the reaction coefficients, the horizon of the inflation forecast, and the possible inclusion of additional variables in the rule.

Changes in the sensitivity of the economy to interest rate movements would not require significant modifications in central bank reactions to incoming information, as it would only have to adjust the *size* of the interest rate response. Arguably, changes in the interest rate sensitivity of the economy would occur only gradually, so the risk of monetary policy going significantly off target is likely to be small. This conclusion is reinforced once it is recognised that our knowledge of the size of the impact of policy on inflation and economic activity is in any case relatively imprecise.

A potentially somewhat more significant change in the practice of monetary policy could be required if the *speed* of transmission of interest rate changes is altered as a result of

changes in the intermediation process. Many inflation-targeting central banks describe their decision making process in terms of setting the policy interest rates so as to hit the inflation target at a specific horizon, typically that which corresponds to the presumed lag in the effect of monetary policy. If this lag becomes shorter, say, it is possible that policy reactions would be out of phase, requiring ex post explanations of why the target was missed. Again, to the extent that changes in the speed of transmission occur gradually, there would be opportunities for the central bank to adjust its reaction as evidence of the structural change accumulates. For central banks that communicate policy decisions with respect to a particular target horizon, it could become awkward if changes in this horizon were relatively frequent. It is perhaps for this reason that some central banks refrain from committing themselves to hitting the inflation target at any particular horizon.

Arguably the most important issue with respect to the adequacy of the Taylor rule as a complete guide for central bank policy is whether other variables than the inflation and output gaps should be included. Recently this debate has centred on whether or not monetary aggregates carry more information about future inflation and output gaps than what is already incorporated in the traditional variables in the Taylor rule.[70] In a context where the financial intermediation sector of the economy has a significant effect on macroeconomic outcomes, it may be argued that monetary and credit aggregates, interest spreads, and asset prices would be potentially useful indicators in a policy reaction function.[71]

For example, a shock or a structural change that increases the credit extended by the banking system would in the first instance, i.e. before it had any effect on output and inflation, probably reduce credit spreads, increase asset prices, and increase the volume of money and credit in the economy. A central bank that adjusted its policy interest rate in response to these developments would act in a more timely fashion than one that looked only at the inflation rate and the output gap. The difficulty of course is that asset prices and monetary and credit aggregates respond not only to shocks in the financial intermediation sector but also to most other shocks in the economy. The central bank is hence faced with the usual signal extraction problem, which would prevent any *automatic* reaction to such variables. In the same way that the Taylor rule calls for different reactions to output movements depending on whether the economy has been subject to a demand or a supply shock, responses to financial aggregates, asset prices, and credit spreads would have to take into account the sources of movements in these variables, a difficult, but perhaps not always an impossible task.

In view of these considerations, a prudent conclusion to this section may be that following a Taylor rule may be a necessary but not a sufficient strategy for achieving the goal of price stability with minimal fluctuations in output. It is necessary because forceful policy reactions (i.e. strong enough to increase real interest rates when inflation threatens to exceed the target) would be needed to stabilise inflation when it deviates from the target rate. It is not sufficient, however, because structural changes in financial markets may require adjustments over time in the size of the reactions to inflation and the output gap as well as to the implicit equilibrium real policy rate. Furthermore, smoother paths of inflation and output might be obtained if attention was paid to financial variables that carry information about the underlying shocks in the economy.

[70] See, for example, Reynard (2007) and Woodford (2007).

[71] See Cecchetti et al (2000). Note that a variable may figure in a central bank's policy reaction function even though it is not an ultimate target of monetary policy. This point has often been lost in the debate on whether or not monetary authorities should react to asset prices.

4. Concluding remarks

Extending the scope of financial intermediation in an economy by means of having a greater number of firms involved, a greater variety of firms, and a greater variety of assets has been shown to impact the conduct of monetary policy in terms of both operating procedures and reacting to economic events. While it can be argued that documented changes in the financial system have made operating procedures more flexible and efficient, the same changes pose challenges for central banks in the day to day management of policy levers.

The analysis suggests that innovations in financial markets may change both the neutral policy interest rate and the horizon of the relevant inflation forecast in a Taylor-type rule. A policy maker who does not take this into account would potentially set the interest rate at an inappropriate level. However, even if interest rate policies of many central banks are characterised (and judged) as if they are (should be) set according to a Taylor rule, it is unlikely that, as a practical matter, central banks conduct monetary policy strictly according to a rigid interpretation of this rule with a fixed horizon and fixed coefficients. Monetary authorities are constantly learning about the structure of the economy and its implication for interest rate policy. Consequently there are reasons to be optimistic that monetary policy resolutely focused on price stability will continue to be successful even in the presence of continuous innovations in financial markets.

This being said, there is nevertheless a case for moving away from the notion of a fixed horizon for the attainment of an inflation target and for taking account of monetary, credit, and asset market indicators in the conduct of monetary policy to a greater extent than has been done heretofore.

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Financial market innovation in Australia: implications for the conduct of monetary policy

John Broadbent

Introduction

Financial innovation can be broadly thought of as the introduction of new financial instruments or services, or the discovery of new ways to deliver those services to the community. Innovations can benefit users in two ways: first, by increasing competition among providers; and second, by broadening the range and convenience of financial products. Innovations affect microeconomic behaviour and, where their use becomes widespread, may have quite wide-ranging macro implications as well. There is some recent evidence, for instance, suggesting that financial innovations have been associated with more stable real economic growth while also supporting the longer-term growth prospects of the economy.[72]

Whether financial innovations have facilitated the conduct of monetary policy, however, is less clear cut. Some innovations may have supported or encouraged households and businesses to increase the amount of debt owing – this increase in the share of income going to interest payments would tend to make these sectors relatively more sensitive to changes in monetary policy. At the same time, the compression in margins between borrowing and lending rates may have changed how any particular level of the policy interest rate could be associated with a particular stance of monetary policy. In other words, it may affect our views about what is the appropriate level of the policy rate.

Moreover, where links between markets have been strengthened by financial innovation, a shock in one market may be more easily transmitted to other markets. This increasing interdependence poses new challenges for policy makers.[73] Problems in the US sub-prime loan market are now reverberating through many countries. In Australia's case, for instance, this has temporarily choked off investors' demand for new issues of Australian residential mortgage-backed securities (RMBS), and short-term asset-backed commercial paper (ABCP). For those institutions reliant upon such wholesale markets for the bulk of their funds, this may represent a serious risk to their long-term survival. More generally, it has triggered a sharp repricing of risk which, if sustained, will eventually flow through into higher rates for both households and businesses.

This paper is in two parts. The first looks at several recent financial innovations that have had a significant impact upon the Australian financial system. We provide some background to their origin and then look at their impact upon the conduct of monetary policy. We examine the impacts of securitisation, the rise of mortgage brokers and the development of swap markets, particularly cross currency swaps. The latter part of the paper takes a somewhat longer-term perspective and looks at how secular changes in financial markets have affected the Reserve Bank's monetary policy operations. In particular, it examines how the Bank has needed to reshape its monetary operations in the face of a declining supply of Commonwealth Government Securities (CGS), which traditionally had been its domestic risk-free asset of choice.

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[72] Cecchetti, S, A Flores-Lagunes and S Krause, "Assessing the Sources of Change in the Volatility of Real Growth", *NBER Working Paper Series*, 11946, January 2006.

[73] Noyer, C, "Financial Innovation, Monetary Policy and Financial Stability", *Spring Conference of the Bank of France/Deutsche Bundesbank*, Eltville, Germany, April 2007.

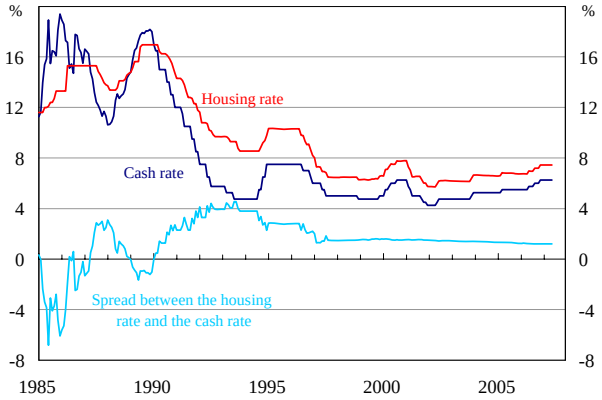
Securitisation and mortgage brokers

While securitisation of residential mortgages has been a feature of the US market since the early 1970s, it did not take off until the early 1990s in Australia, when specialist mortgage originators entered the housing market.

We can point to several factors that allowed mortgage originators to enter the Australian mortgage market at that time:

- First, banks' interest margins on housing loans were at very high levels, at around 4¼ percentage points. The reason was partly cyclical. Banks had not pushed up mortgage rates as high as their funding costs around the peak of the interest rate cycle in the early 1990s, and as market rates fell, they sought to restore their profitability by leaving rates higher relative to money market rates. High interest margins and very low default rates (measured in terms of just a few basis points) meant that housing loans were very profitable.

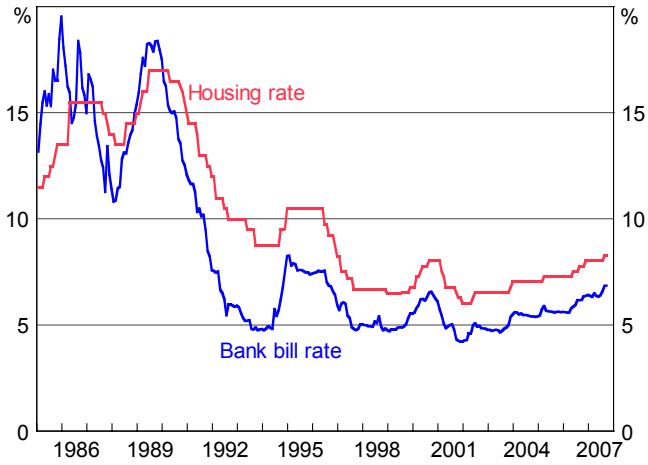
Banks' housing interest rates



Source: RBA.

- Second, the bank bill rate, which is the benchmark interest rate for most floating rate bonds in Australia, stabilised at an interest rate that was well below the housing rate. This decrease in the bank bill rate was largely due to the sharp fall in the inflation rate in Australia, and provided specialist mortgage lenders with stable and predictable funding costs.

Bank bill rate and housing interest rates



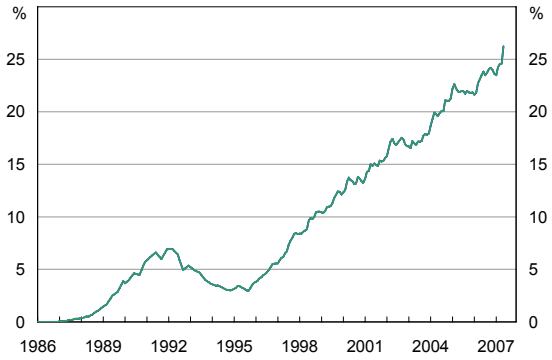
Source: RBA.

- Third, Australian and overseas banks that did not have large mortgage lending operations in Australia were willing to provide specialist mortgage lenders with wholesale lending facilities and help them develop their securitisation procedures. This provided an avenue for those banks to attack a key pillar of the established banks' profitability without needing to build their own costly infrastructure.
- Fourth, Australia's managed funds industry was growing rapidly, mainly due to the introduction of compulsory superannuation (pension funds) for all employees. These institutional investors had a healthy appetite for highly rated debt, including residential and other asset-backed securities.

When mortgage originators first started offering housing loans, their interest rates were about 300 basis points above the cash rate. This was roughly 100 basis points lower than the banks' standard mortgage rates.[74] Established lenders initially responded to this competition by offering 'honeymoon loans', which had a low introductory interest rate for the first year, but then reverted to the standard variable rate. But this did not stem the growth in mortgage originators' market share, and eventually the banks were forced to cut their margins on standard housing loans. By late 1996, mortgage originators accounted for almost 15 per cent of housing loan approvals, and the spread between housing loan rates and the funding rate had fallen to about 180 basis points.

The development of the RMBS market has clearly enabled mortgage originators to flourish. But it has also provided an alternative source of funding (other than deposits, bank bills and bonds) for banks, particularly regional banks which would otherwise have struggled to maintain their growth rates. The Australian RMBS market has grown from less than AUD 5 billion in the mid 1990s to around AUD 165 billion in mid 2007. During that period, the proportion of housing loans that are being securitised has increased from less than 5 per cent to around 25 per cent. Mortgage originators and regional banks are the main securitisers, accounting for 25 per cent and 50 per cent of outstandings respectively. Roughly 60 per cent of these RMBS are issued offshore. These securities are mainly denominated in US dollars and euros, with the proceeds from these issues being swapped back into Australian dollars (we will return to the swap market later).

Proportion of Australian home loans securitised

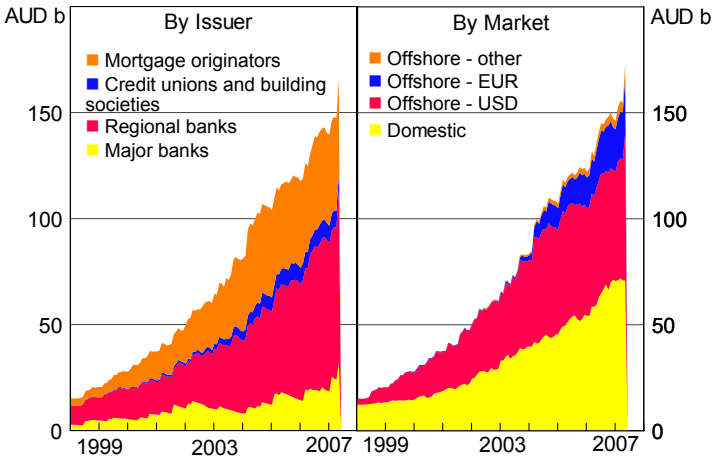


Source: RBA.

[74] Rough estimates suggested that the mortgage originators' costs for providing a housing loan were around 150 to 200 basis points above the cash rate (see Edey, M and B Gray, "The Evolving Structure of the Australian Financial System", *Reserve Bank of Australia Research Discussion Paper* No 9605, October 1996).

RMBS outstandings

Monthly



Sources: RBA; Standard and Poors.

Over the past few years, mortgage brokers have also gained a significant presence in the Australian mortgage market, further adding to the competitive environment. Mortgage brokers make it much easier for households to compare prices and products across a large number of lenders. They are heavily used by those lenders which have limited branch networks, such as the smaller regional banks or other smaller deposit-taking institutions. The major banks also find them a useful means to distribute mortgages to a wider customer base.

Broker-originated loans are estimated currently to account for about one-third of new housing loans. The rise of mortgage brokers has contributed to the decrease in the spread between housing loan rates and the cash rate from 180 basis points to around 120 basis points. Moreover, the use of brokers among the small business sector has also become more widespread in recent years. It is estimated that up to a quarter of loans to small and medium-sized businesses are broker-originated.

Swap markets and bond markets

I noted earlier that over half of the RMBS issues by Australian entities have been into offshore markets. A deep and liquid swap market has been a key element underpinning the evolution of securitisation in Australia. But Australian institutions have been active in the swap market for several decades. In the mid 1980s, the development of the euro-Australian dollar market opened up an important new source of Australian dollar (AUD) funding to the Australian corporate sector. Larger corporates were able to access this market directly, while smaller firms issued bonds in US dollars – where name recognition was not a significant factor – and then swapped the proceeds with the foreign entity. That entity was most commonly a European bank that had issued the AUD securities and distributed them to a predominantly European retail base.

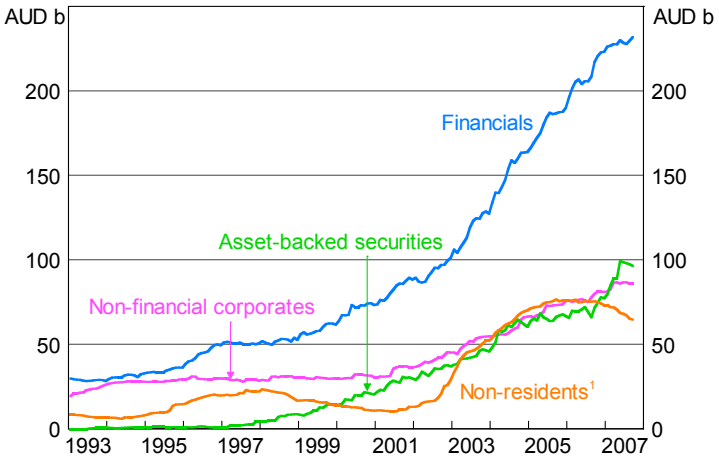
The growth in offshore bond issuance has been broad-based, with outstandings of non-financial corporates, financials and asset-backed vehicles all increasing. This increase has been driven by a range of factors including strong demand for credit from both the household and business sectors, as well as a change in the savings behaviour of Australian households. Savings have moved increasingly towards managed funds, particularly superannuation, and away from bank deposits, requiring banks to seek recourse to wholesale markets to fund credit growth.

Australian entities' offshore bond outstandings have grown rapidly, and at around AUD 400 billion, are appreciably larger than domestic outstandings. As noted, the vast

majority of these outstandings – estimated to be around 90 per cent – are swapped back into Australian dollars.

Non-government bonds on issue offshore

All currency denominations, monthly



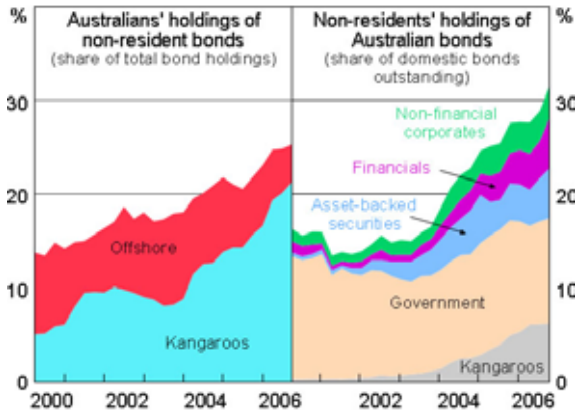
[1] Australian dollar-denominated issuance only.

Sources: ABS; RBA.

Typically, these swap transactions require an entity that has issued AUD, and has an underlying appetite for foreign currency. Some institutions on the other side of these swaps have been issuers in the kangaroo market – the market for AUD securities issued in Australia. These issues are invariably swapped out of AUD. The growth of kangaroo issuance has been particularly rapid since the late 1990s, and especially from late 2003. A number of factors likely explain its growth.

First, the volume of very highly rated securities has been declining since the late 1990s. This has been due to the decline in CGS: the Australian Government has been running a fiscal surplus and there has been little new issuance of state government paper (we will return to this issue later). Second, local investors have wanted to diversify their exposures, while still staying with relatively high-yielding AUD assets. At the same time, non-resident investors have also wanted to diversify their exposures and to acquire relatively high-yielding assets. But they have wanted to combine exchange rate risk with minimal credit risk – close to 50 per cent of all kangaroo issues are rated AAA, with the remainder just a notch or two below.

Diversification and cross-border investment



Sources: ABS; Insto; RBA.

Based on the traditional comparative advantage principles, these swaps have been mutually beneficial for both local and overseas counterparties.[75] For kangaroo issuers the cost of issuing in Australia and swapping the proceeds into US dollars is very similar to the cost of issuing directly in US dollars. This suggests that the kangaroo market has been very competitive with other bond markets.

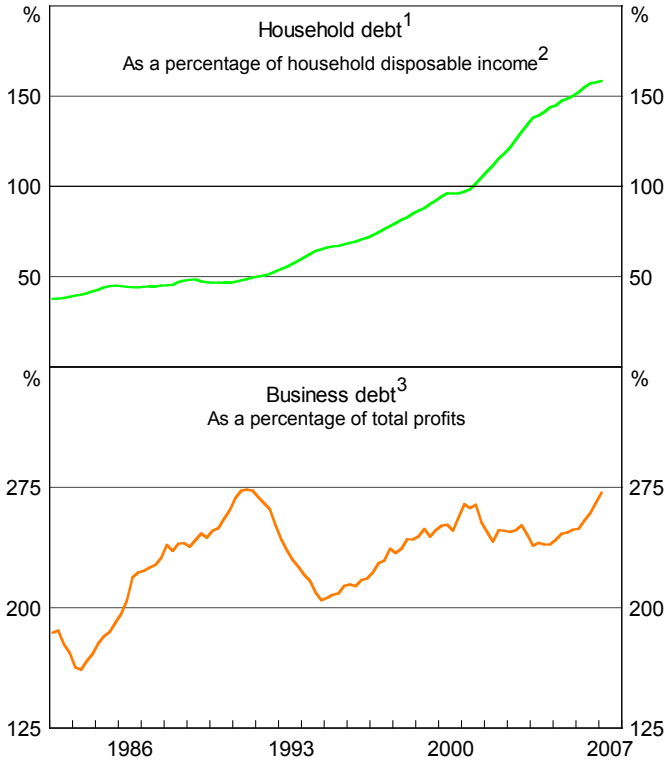
Impact on monetary policy operations

These financial innovations are relevant for the conduct of monetary policy in two ways. First, they affect borrowers' sensitivity to monetary policy. Second, they influence how we implement monetary policy on a day-to-day basis.

Sensitivity of borrowers to changes in monetary policy

Over the past two decades, household sector debt levels have risen from around 40 per cent to 160 per cent of disposable income. Businesses' debt levels have nearly doubled to 275 per cent of income. Both sectors have thus become more sensitive to changes in interest rates.

Household and business debt



[1] Household sector excludes unincorporated enterprises. [2] Disposable income is after tax and before the deduction of interest payments. [3] Business includes both the non-financial corporate and unincorporated sectors.

Sources: ABS; RBA.

This sensitivity to monetary policy changes is also affected by the proportion of loans that are taken at variable rates. In 2005, roughly 90 per cent of Australian housing loans were at

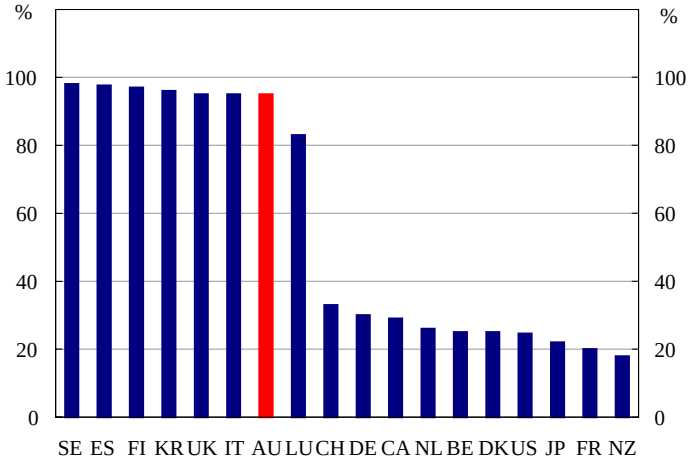
[75] Ryan, C, "Some General Observations on the Kangaroo Bond Market", *Reserve Bank of Australia Bulletin*, April 2007.

variable rates. The rates charged on those loans generally move only when there is a change in monetary policy.

According to the BIS, this is a feature shared with several European countries, though it is by no means predominant in most countries around the world.[76] In the US, Japan and New Zealand, for instance, variable rate loans make up less than 25 per cent of housing loans. Where variable rates dominate, changes in monetary policy tend to flow directly through to mortgage rates, but where fixed rates are more common, the impact of changes in the policy interest rate on mortgage rates is less clear. This can make monetary policy more difficult to implement given that interest rates affecting most borrowers or lenders may only be tied fairly loosely to the policy rate.

Housing loans

Percentage of variable rate loans

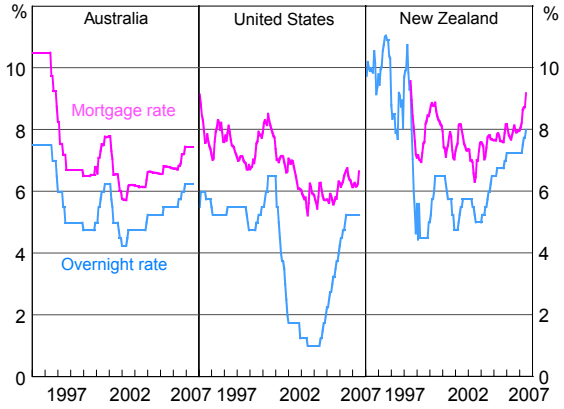


Sources: ECB; European Mortgage Federation; Eurostat; national data; RBNZ.

In the case of Australia, movements in the cash rate typically are quickly passed through into changes in mortgage rates. Indeed, the speed of pass-through has increased over recent years with the result that changes in the policy rate generally feed directly into variable rates charged by financial institutions within a week or so of a policy announcement. Policy changes feed directly into rate changes for both new and existing loans. In contrast, in countries where mortgages are priced off long-term bond rates, it becomes more difficult to anticipate how mortgage rates may change when policy is adjusted. This is because monetary policy is only one of a multitude of factors affecting long-term bond rates. In the US, for example, the series of monetary policy easings that began in 2001 and took the Federal funds rate from 6½ per cent to 1 per cent had only a modest impact on longer-term yields, and hence most mortgage rates. In New Zealand, mortgage rates were relatively sticky in the late 1990s given the fall in the cash rate from over 10 per cent to 4½ per cent. The tightening in monetary policy over the past three years also took a while to flow through into mortgage rates.

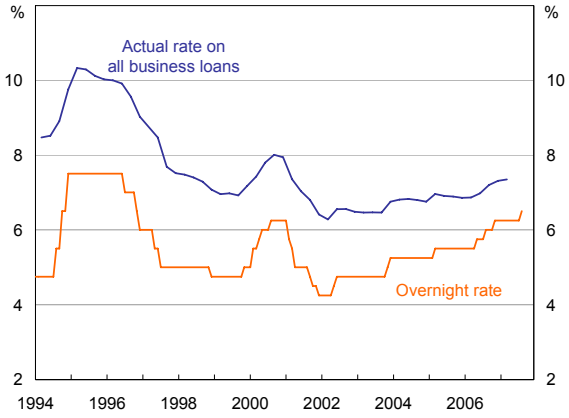
[76] Bank for International Settlements, "Housing Finance in the Global Financial Market", *CGFS Publications*, No 26, January 2006.

Overnight rates and mortgage rates



Moreover, most business loans in Australia are also floating rate. In early 2007, around 80 per cent of loans were priced off either the cash rate or the bank bill rate, up from 60 per cent a decade earlier. As a result, movements in the policy rate are also quickly passed through to business loan rates, making the business sector fairly sensitive to changes in monetary policy.

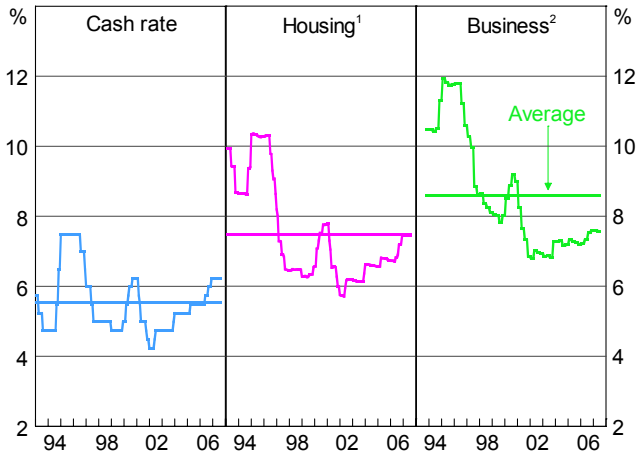
Overnight rates and business rates in Australia



Sources: APRA; RBA.

But the large reductions in interest margins on household and business debt have meant that the stance of monetary policy may not be as tight as historical experience would suggest. At present, the cash rate is 75 basis points above its decade average, but variable rates on housing loans are around their decade average, and variable rates on business loans are around 100 basis points below their decade average.

Variable lending rates



[1] Weighted average rate on new variable rate housing loans; based on securitised loans. [2] Weighted average rate on banks' outstanding variable rate business loans.

Sources: ABS; APRA; RBA.

Role in monetary policy implementation

Financial innovation has also influenced day-to-day implementation of monetary policy. In particular, it has allowed us to broaden the range of securities that the Reserve Bank can use in its market operations.

This wider range of securities includes a subset of kangaroo issues. Broadly speaking, the Bank will accept kangaroos that are issued by a foreign government, or have a government guarantee, and those that are issued by a supranational institution. Both the issuer and the issue must have a AAA credit rating. Approximately 30 per cent of current outstandings of kangaroos are eligible. Currently there are 13 issuers with securities that meet the Bank's repo eligibility criteria.

The inclusion of this subset of kangaroo issues has led to a noticeable expansion of the pool of high-quality securities that can be accepted by the Bank. We have been a little surprised that they are not offered to the Bank as often as would be expected given the size of outstandings, though market liaison suggests that institutions highly value their implicit liquidity characteristics. Currently, kangaroo bonds held under repo by the Bank amount to around AUD 2 billion, or about 7 per cent of the domestic portfolio.

FX swaps and bank bill repos

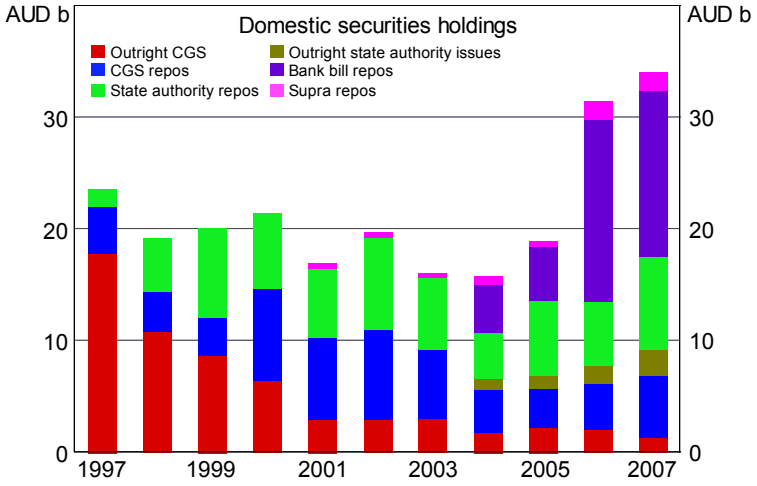
Accepting supranational paper as collateral for the Reserve Bank's domestic dealing operations has been just one initiative we have taken as financial markets have developed and we have needed to refine our dealing operations. For a long period of time, CGS were the only securities that the Bank was willing to hold on its balance sheet, either on an outright basis or as repo collateral. But this changed when the supply of CGS began to decline in the latter part of the 1990s. As a result, we have needed to expand the range of assets we were willing to accept. The expansion of the supply of eligible securities ensures that the Bank does not place any additional pressures upon the CGS market, as well as ensuring an ample supply of securities with which to conduct its daily monetary policy operations. We have gradually expanded the range of eligible assets to include state government paper,

supranational, foreign government and their agencies' securities, bank bills and certificates of deposit issued in the domestic market.[77]

If we take an annual snapshot of the Bank's balance sheet over the past decade or so, changes to how we conduct our monetary policy operations became readily apparent. We have significantly reduced our holdings of CGS, particularly on an outright basis, but also those held under repo (the type of securities given to the Bank as repo collateral is at the discretion of the counterparty – it may be either CGS, state government paper or eligible kangaroo securities). By June 2007, CGS held by the Bank amounted to just AUD 7 billion compared with over AUD 20 billion a decade earlier.

Offsetting the fall in CGS, we have increased our holdings of state government paper (most of which is held under repo) and repos collateralised by bank bills (short-term paper issued by highly rated commercial banks). These comprise the majority of our domestic portfolio, representing about 30 per cent and just over 40 per cent, respectively, of domestic securities holdings.

RBA domestic portfolio



Source: RBA.

Securities often experience a large increase in turnover when the Bank is willing to hold them as collateral for repos. The latest figures available are for the financial year 2005/06, but they do show a few interesting features:

- Total repo borrowing has continued to expand rapidly over the past few years;
- The CGS remains the most actively traded instrument, though the latest figures suggest that its share of the repo market has declined significantly;
- The number of repos collateralised by state government paper has shown a steady increase over the past few years. They account for about 40 per cent of total repo borrowings, up by 10 percentage points since 2002/03; and
- The number of repos collateralised by bank paper has seen a two-fold increase over the past three years.

[77] Subsequently, on 6 September 2007 the Bank announced that it would be willing to accept bills and CDs from a wider range of financial institutions, longer-dated bank paper, highly rated RMBS and highly rated ABCP.

Table 1

Annual repo turnover by instrument

AUD billion

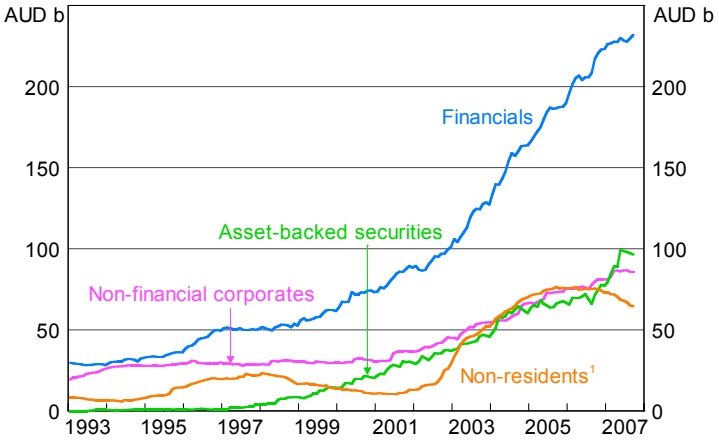
Year	CGS	State Government	Bank Paper	Other	Total
2001/02	4359	1920	169	263	6711
2002/03	3038	1698	350	304	5390
2003/04	3659	2604	968	289	7520
2004/05	7712	3902	635	569	12818
2005/06	5947	5280	1123	1089	13439

Source: AFMA.

The other major change in the Reserve Bank's monetary operations over the past few years has been the increase in the use of FX swaps. If the domestic banking system is short of funds, the Bank will undertake a swap in which it lends Australian dollars to the market in exchange for foreign currency for a specific period and at an agreed exchange rate for the reversal of the transaction.[78] This transaction has the same effect on domestic liquidity as using open market operations to buy securities under repurchase agreement. Like domestic repos, these provide the flexibility to undertake market operations and importantly, as the FX swap market is deep and liquid, transactions of some size can be readily undertaken to offset large shifts in system cash. Reflecting the greater usage of FX swaps for liquidity purposes, turnover in these instruments has doubled in the past couple of years to over AUD 210 billion in 2006/07.

RBA asset composition

Excluding net FX reserves



Source: RBA.

[78] The exchange rate for the reversal of the swap is determined by adjusting the current exchange rate for the interest rate differential between the two relevant countries for the time to maturity of the swap.

Table 2

Open market operations

AUD billion

	2002/03	2003/04	2004/05	2005/06	2006/07
Repurchase agreements[1]					
Purchases	304	272	391	409	459
Sales	17	11	10	6	2
Outright purchases[2]	3	5	5	4	3
Total operations in domestic securities	324	287	405	419	464
Foreign exchange swaps[1]	90	139	106	157	211
Total	414	426	511	576	675

[1] First leg of transaction. [2] CGS only until 2002/03. Thereafter includes State and Territory government securities.

Source: RBA.

Conclusion

The growing use of securitisation together with the development of the swap market and the non-government bond markets have lowered the price of credit and expanded the range of households and corporates to whom credit is readily available.

Increased debt levels, in conjunction with Australian borrowers' preference for variable rate loans, suggest that borrower sensitivity to monetary policy changes has tended to increase. At the same time, the associated reduction in interest margins implies that policy, at any given level of interest rates, may not be as tight as historical experience would suggest. But these developments are relatively easy to incorporate into what the Reserve Bank considers to be the appropriate setting of monetary policy.

The development of swap markets and non-government bond markets – including the kangaroo market – has enabled the Bank to broaden the range of securities that it uses in its market operations. This has been very useful as the supply of CGS – for many years the Bank's preferred security – has been declining.

In summary, the Reserve Bank has needed to alter the way it has conducted its monetary policy operations as financial markets have developed. Innovations in these markets have made the financial system more efficient, but they have not hindered the Bank in the implementation of its monetary policy.

Developing financial markets and operating monetary policy in Asia

Robert N McCauley[79]

1. Introduction

A central bank needs to frame and to set monetary policy at the strategic level. It also needs to adopt operating procedures to implement its chosen policy. This is where the rubber hits the road. In this image the road is the underlying banking and financial markets. They change over time, and the appropriate monetary operating procedures will change over time with them. This paper explores the reciprocal relationship between developing financial markets and conducting monetary policy operations. Its intended audience is central bankers in East Asia, but it draws on experience outside the region.

This paper develops three themes in each direction of the reciprocal relationship. Each pair of themes includes two analytic statements and a policy recommendation.

Section 2 of the paper argues how monetary operations can contribute to financial development. The first theme here is that there are typically degrees of freedom in conducting monetary operations. The second theme is that the choices made in respect of operating procedures are fateful for financial development in that whatever instruments and markets the central bank uses for its operations will tend to gain liquidity and breadth. The third theme follows as a consequence: the central bank should use its degree of freedom in performing monetary operations consciously to further financial market development. An immediate implication is that the right choices of instruments and markets will depend on the current state of financial market developments.

Section 3 argues that, while policymakers make important choices in conducting monetary policy operations, they cannot make any choices they want. Financial developments and financial development constrain monetary operations in three ways. First, the balance sheets of the government and the central bank limit operations. Second, financial development in general and the balance between the banking system and securities markets, in particular, shape the choice of instruments in executing monetary policy. Third, the central bank should align its operating choices to the state of financial development.

2. Operating procedures serving financial development

The burden of the argument of the first half of this paper is that there are synergies between the central bank objectives of monetary stability and financial development. These arise from the degrees of freedom in the asset and liability composition of the central bank balance sheet under modern central banking. Given that central bank operations will tend to impart liquidity to the chosen instruments, the central bank can make its choices with an eye to developing financial markets.

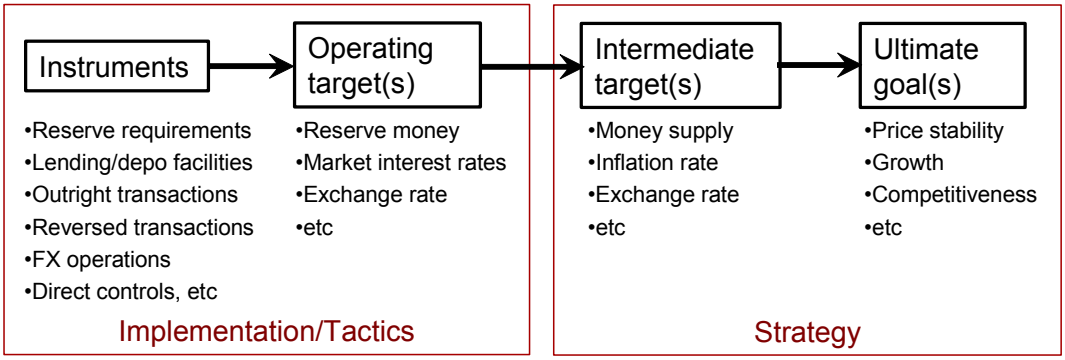
[79] robert.mccauley@bis.org. Thanks are due to Claudio Borio, Jane D'Arista, Andy Filardo, Corrinne Ho, Sukdhave Singh, Eli Remolona and Pongpen Ruengvirayudh for discussion of the issues, and Daranee Saeju for data on Thai repos, though they bear no responsibility for the errors or judgements herein. The views expressed are those of the author and not necessarily those of the Bank for International Settlements.

2.1 The degrees of freedom in conducting monetary operations

The dominant monetary policy approaches nowadays do not carry with them a theory or a prescription for the central bank balance sheet. Fiat monetary systems managed with a view to stabilising inflation and growth, with or without formal inflation targeting, have no particular implications for the balance sheet of the central bank (Papadia and Würtz (2007)). On the asset side, such systems are indifferent to domestic or foreign assets, sovereign or private obligations, and permanent or frequently reversed transactions. Such systems share banknotes as a liability but can operate with bank reserves adequate for no more than clearing purposes, or with required reserves, whether remunerated or not.

This point can be made in terms of the schematic diagram below (Ho (2007)). The varying choices with respect to, from right to left, ultimate goals, intermediate targets, and operating targets are compatible with a range of instrument choices.

The tactical and strategic aspects of monetary policy



It is helpful to contrast this state of affairs with monetary approaches that carried clear implications for the central bank's balance sheet, the "real bills" doctrine and the currency board approach. The "real bills" doctrine of central banking embodied in the original Federal Reserve Act had a theory on the proper assets of the central bank: discounts against short-term, self-liquidating obligations of the private sector and gold. A central bank that held or discounted government paper, by contrast, was thought to court inflation. In retrospect, of course, the "real bills" doctrine has been criticised as offering no proof against an inflationary monetary policy and as pro-cyclic. Whatever its flaws as a monetary regime, however, this doctrine had a theory on what the central bank and, by extension, the banking system should carry as assets.

Similarly, the currency board approach carries clear implications for the monetary authority's balance sheet. It requires a match of gold, silver or foreign exchange against its banknotes outstanding. For example, the Hong Kong Monetary Authority (2007, pp 93–94) earmarks part of its foreign assets as a "backing portfolio", which "holds highly liquid US dollar-denominated securities to provide full backing to the Monetary Base as required under the Currency Board arrangements". As it happens, this backing portfolio only represents a portion of the Exchange Fund's foreign assets, with the balance having as its counterparts accumulated fiscal surpluses and essentially the net worth of the Exchange Fund. Thus, the Exchange Fund's assets and liabilities can be seen as a "currency board plus", but for the present purpose the aspect worth emphasis is that the currency board part has implications for assets, liabilities and the relationship between them.

It is worth pausing to marvel at how modern monetary approaches have elaborated the three right-hand elements in the diagram above, even as they have fallen silent on the first. The result is that the operations of monetary policy take place in increasing isolation from the

strategy of monetary policy. While central bankers pay attention to operations,[80] it is the rare monetary economist who casts a glance at the operational side of policy (Friedman (1999) and Woodford (2000)).

For the present purpose, the orphan status of operations creates an opportunity. This is because the choice of operating instruments makes a difference to the evolution of financial markets, as argued in the next section.

2.2 Monetary operations and financial market liquidity

The choice of a particular operating instrument tends to have positive external effects on the liquidity of the chosen market. Examples of such effects can be given from the Federal Reserve's history and more recent Asian history. The prospect, all too transitory in retrospect, of the US Treasury running surpluses to an extent that the Federal Reserve would have had to change its operating procedures' reliance on Treasury securities led to a useful (if ultimately moot) re-examination of alternatives (Broaddus and Goodfriend (2001), Kohn (2002), Marshall (2002) and McCauley (2002)).

The original Federal Reserve Act: support for the bankers' acceptance market

The 1913 Act sought to develop a market in the United States for the financing of US foreign trade. Theretofore US trade had been financed in Europe, mostly in London. This was thought to be an undesirable state of affairs both from the standpoint of the cost and from the standpoint of currency exposure, since the London acceptances were denominated in sterling (LaRoche (1993)).[81]

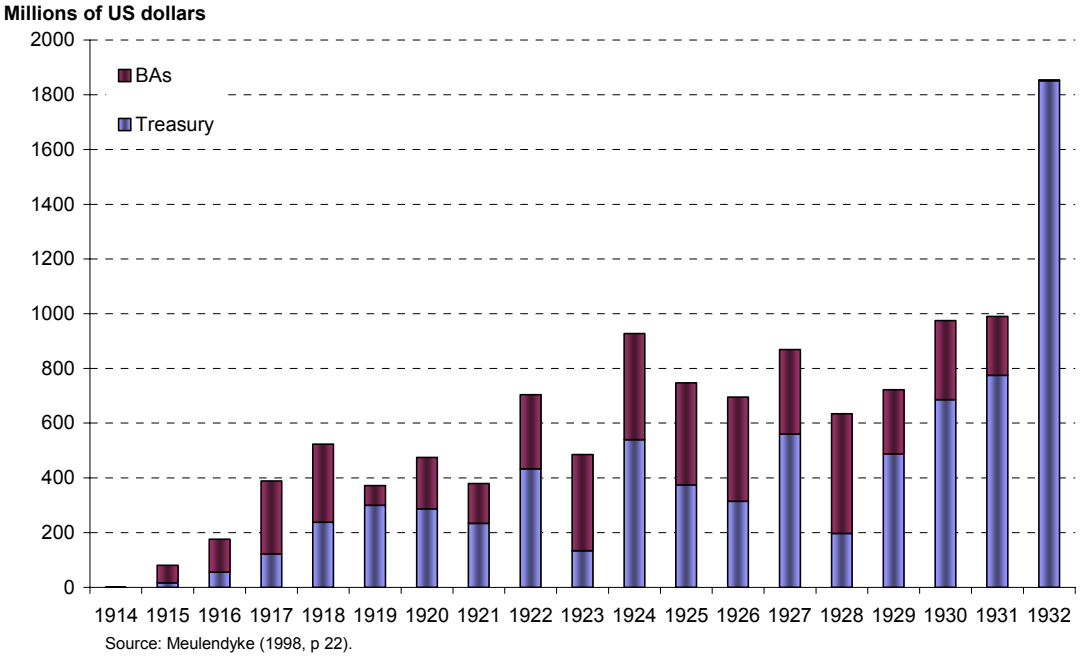
The Act provided two incentives for the relocation of the financing of US trade. It made bankers' acceptances (BAs) eligible for discount or outright purchase by the new Federal Reserve and exempted the acceptance liability from reserve requirements. The Federal Reserve Bank of New York also purchased acceptances for the account of foreign central banks, adding its signature and in effect making the private paper into a government obligation.

The developmental use of the Federal Reserve's balance sheet worked. Although Federal Reserve holdings of BAs declined in World War I, they came by the late 1920s to finance a third to a half of US imports and exports (LaRoche (1993, p 134)). In practice, the Federal Reserve both bought BAs outright and entered into repurchase agreements against them. It held on average a third of the outstanding stock and at times half. In terms of the Fed's portfolio these holdings of private paper bulked larger than holdings of Treasury paper before the US entry into World War I and in 1923, 1926 and 1928 (see graph below).

[80] See Kneeshaw and Van den Bergh (1989), Borio (1997), Van 't dack (1999), Borio and McCauley (2001), Patrawimolpon (2002), Bank of Korea (2002), Monetary Authority of Singapore (2003), Tuano-Amador (2003), Ryoo (2006) Central Bank of China (2006), Bank of England (2007), Archer (2006) and Ho (2008).

[81] By the 1980s, much of Japanese external trade was financed with US bankers' acceptances. One of the aspirations of those who sought to internationalise the yen was to build up the yen bankers' acceptance market. See Sakakibara and Kondoh (1984) and McCauley (2006b).

Federal Reserve holdings: Treasuries and bankers' acceptances



Note: Holdings of BAs in the early years include puchases under repo agreements.

Source: Meulendyke (1998, p 22).

Federal Reserve support for the BA market resumed in 1955 but never reached the levels seen between the World Wars. In the 1970s the Federal Reserve concluded that the market could stand on its own and ceased endorsing acceptances for its foreign correspondents. In 1977 outright purchases ceased and in 1984 repos against BAs ceased. BAs' exemption from reserve requirements boosted outstandings in the high-inflation and high interest rate years of the late 1970s and early 1980s. However, the subsequent reduction of reserve requirements for large certificates of deposit and Eurodollars in 1990 left BAs little advantage over commercial paper and other means to finance trade and the market has since languished.

The Federal Reserve "bills only" controversy, 1953–1961, and market liquidity

After the post-war agreement with the Treasury in 1951 to unpeg interest rates on Treasury securities, the Federal Reserve debated whether to operate in Treasury bills only or in the full range of Treasury securities. Washington favoured a "bills only" approach while New York argued for the flexibility to operate across the yield curve. The differences between Washington and New York have usually been pinned on a difference of views on the economics of the yield curve or a difference on the need for clarity of goals given the recent pegging of long-term rates. On the economics, the Washington position trusted to arbitrage across highly substitutable securities of different maturities to transmit the effect of operations in short-term bills while New York argued that occasional "limited direct entry into the long-term market" could usefully affect the yields on imperfectly substitutable securities (Ritter (1980, p 110)). On the clarity of goals, the "approach left longer maturity coupon securities free to trade without Federal Reserve interference, helping the market-clearing mechanisms to function and emphasizing that longer term interest rates were no longer pegged" (Meulendyke (1998, p 35)).

Whatever the force of these arguments,[82] the effect of the locus of operations on market liquidity is an additional, since neglected, difference between the two sides. President Sproul of the Federal Reserve Bank of New York argued in testimony before Congress against the claim by Chairman Martin that operations in bills had contributed to the "depth, breadth and resiliency" of the Treasury note and bond market. Instead,

> "It is my information and observation that the market for longer term securities has remained at least as "thin" under existing open market procedures as it was before these procedures were adopted. I think it has lost depth, breadth and resiliency, whether you view it in terms of dealer willingness to take position risks, volume of trading or erratic price movements" (Ritter (1980, p 108)).

In short, an important part of the argument for operations in longer-dated coupon securities was that they would help make this market segment more liquid.

Federal Reserve operations in the repo market: nurturing the securities dealers

Nowadays the Federal Reserve operates in repos to fine-tune the availability of bank reserves. Its daily transactions were said by Lumpkin (1993, pp 70 and 73) to amount to $1.5–$6 billion in 1992, compared to daily total transactions of $629 billion then reported by the primary dealers. The argument for the use of repos has echoes of the argument for bills only: by conducting short-term reversed operations, the Federal Reserve does not affect the price discovery in the underlying securities. But the original use of repo operations had more to do with market development in general, and the nurturing of a group of non-bank securities dealers in particular.

The Federal Reserve's repo operations in its first 60 years were predominately a means to provide liquidity to non-bank dealer firms. Lumpkin (1993, p 69) reports that the Federal Reserve conducted repos in 1917 with member banks, but these were discontinued "a few years later" until 1975, when bank dealers were made eligible as repo counterparties. In the 1920s and early 1930s repos were "infrequently" conducted with non-bank dealers. Meulendyke (1998, p 27) reports that repos against Treasury securities and BAs would be arranged at the initiative of the dealers for periods of up to 15 days, with early repayment permitted. At the systemic level, Meulendyke highlights the safety-valve function of such dealer-initiated operations, in that they relieved shortages caused by Treasury cash management or other autonomous factors. In addition, however, from the standpoint of the dealers and their customers, such accommodating transactions with the central bank at times of "temporary credit stringency" must have been reassuring.

After a lull during World War II, repo operations were resumed in mid-1949 (Lumpkin (1993, p 70)) or 1951 (Meulendyke (1998, p 37)). The latter notes a shift to operations carried out at the Fed's initiative "to provide temporary, but immediate, reserve assistance to the central money market at times of unusual strain on that market" (quoting the New York Fed's report on operations in 1953 to the FOMC).

> "Until the 1970s, RPs were done only with nonbank dealers at preannounced rates – usually at or slightly below the discount rate – although beginning in 1968, the RP rate was occasionally set slightly above the discount rate. The practice of arranging RPs only with nonbank dealers was a holdover from the earlier view that RPs served primarily to finance dealer positions in securities. On occasion during the 1950s and 1960s, an RP would still be arranged at the request of dealers facing difficulties in financing their positions in the markets. In discussing repurchase operations at [one of] the FOMC's annual reviews [in 1961] Governor

[82] Friedman and Schwartz (1963, p 633) note that if the "securities market is so fluid and interconnected that the effects of purchases or sales in any part of the market are transmitted very rapidly to all other parts", then the structure of rates would not be affected by a departure from the "bills only" doctrine.

> J. L. Robertson objected to the FOMC's use of the instrument, arguing that RPs were not security purchases in the open market, as authorized by the Federal Reserve Act, but were actually loans to dealers… Governor Robertson was particularly troubled by the practice at the time of lending through RPs only to nonbank dealers and at rates below the discount rate… Most members disagreed. They considered RPs to be an appropriate instrument that had proved to be of inestimable value in the implementation of monetary policy; their continued use was authorized."[83]

On this reading, before repos became the main Federal Reserve instrument they served to nurture non-bank securities dealers. Into the 1960s these could approach the Federal Reserve for financing of their government securities. Whether the rate at which the transaction could be conducted was in some sense favourable in relation to the rate that member banks would pay at the discount window would have been a very secondary consideration. The more important impact would have been on the financial management of the primary dealers and even more on their customers' assessment of the counterparty risk of the dealer.

The character of the repo operations subsequently became more symmetrical, more competitive and more inclusive. In particular, the introduction of matched sale-purchase transactions in 1966 meant that repos could drain as well as inject liquidity, the introduction of the "competitive go around" technique of contacting all the primary dealers at once in 1972 rendered the operation more competitive, and the addition of bank dealers to the list of eligible counterparties in 1975 made the operations more inclusive.

Still, the nurturing of the non-bank dealers continued to have an effect. Lumpkin (1993, p 67) cites the attraction of repos to investors subject to "prudent investor" or other types of asset restrictions, such as public bodies required to invest tax receipts or the proceeds of bond issues in Treasury securities. These could invest in repos against Treasury securities instead of buying them outright. In some cases, such investments would be restricted to repos with primary dealers designated by the Federal Reserve.

> "Money market mutual funds are also major participants in the RP market… Because RPs are deemed to be loans under the Investment Company Act of 1940 and carry risks not typically associated with direct security investments, mutual funds often limit their RP investments to RPs with maturities of seven days or less that are arranged with member banks of the Federal Reserve System or dealers on the Federal Reserve Bank of New York's list of reporting dealers."

Stepping back, the operations by the Federal Reserve Bank of New York in the repo market not only added transaction volume to this market, but also raised its profile among institutional investors. Thus, cash-rich entities like state and local governments more readily placed funds in the market, and insurance companies and pensions holding securities more readily in effect lent their holdings of Treasury securities to the market-making dealers. When, as in the early 1980s with the Drysdale crisis, risky and inconsistent market practices were revealed, the Federal Reserve and the Treasury helped write legislation to improve the workings of the market. These days, repo transactions between private parties dwarf those between private parties and the Federal Reserve. Taking a long and broad view, the Federal Reserve involvement not only helped make the New York repo market among the most liquid markets in the world, but also intentionally helped to nurture non-bank securities dealers.

[83] Meulendyke (1998, p 37 with interposed footnote 39 from p 230) added the Robertson objection to the 1998 edition; perhaps research occasioned by the Salomon Brothers scandal had brought this discussion to her attention.

Asian central banks in the forex swap market vs repo market

Before the Asian financial crisis, Asian government bond markets tended to be small and illiquid, and repurchase markets in them were not well developed. Central banks used variations in reserve requirements to varying extents (Dasri (1990)). Open market operations were often conducted in short-term foreign exchange swap markets. These in effect served as the money market for currencies like the Singapore dollar and the Thai baht. Central bank operations not only recognised the liquidity of these markets, but also contributed to them.

Since the crisis, with the development of government bond markets in the region, the repo markets have gained liquidity. Central bank operations in repos in Malaysia, the Philippines, Singapore and Thailand have contributed to liquidity in these markets.[84] Still, owing to limited central bank holdings of government paper, large needs to absorb liquidity have tended to be met by resorting once again to the foreign exchange swap market, as well as with central bank paper in some cases. Thus, Bank Negara Malaysia reports forward purchases of dollars of $16.6 billion, the Bangko Sentral ng Pilipinas, $9.6 billion, the Monetary Authority of Singapore, $55 billion and the Bank of Thailand $9.5 billion (net) at end June 2007.

The Bank of Thailand's choice of the tenor of its repo operations

If the choice to conduct operations in repo markets has furthered their development in recent years, then it would not be surprising if the maturity of the repos chosen for operations had an effect on market liquidity. In effect, the Bank of Thailand has conducted two natural experiments in the course of its inflation targeting period since May 2000. It first chose to use the 14-day repo as its policy rate and operating instrument in May 2000 and then switched to the overnight repo rate in January 2007. The immediate impact of both moves was to make the market more liquid at the chosen tenor.

The experiment is easily described. To assess the effect of the choice of policy rate and operating instrument on market liquidity, repo transactions at the chosen tenor and at other tenors were aggregated over a four-month window before and after the month of each change in operating procedures. The null hypothesis is that the change in policy had no effect on the distribution of market transactions by maturity of the repo.

The first move in May 2000 concentrated liquidity into the 14-day maturity, mostly at the expense of other term transactions, both 7-day repos and those with maturities of a month or over (Table 1). The share of 14-day repos more than doubled to over half. The Chi-square statistic confirms the "inter-ocular impact test" and rejects the hypothesis of the independence of the policy choice and the tenor of market transactions.

[84] Faced with a shrinkage of government debt outstanding, the Reserve Bank of Australia and the Reserve Bank of New Zealand have to varying extents come to use foreign exchange swaps more. See Reserve Bank of Australia (2003) and Reserve Bank of New Zealand (2006).

Thai repo market turnover by maturity around May 2000

In billions of baht

	Tenor of repo transactions		Total
	14-day	Other	
4 months pre-May 2000	730	2,003	2,733
4 months post-May 2000	1,549	1,362	2,911
Total	2,279	3,365	5,644

Note: The Chi-square statistic for the independence of the choice of operating tenor and market turnover is 410.8, while the critical value for $p < .0001$ is 10.83.

Sources: Bank of Thailand; author's calculations. Table 1

Nevertheless, overnight repos became the most transacted tenor, especially as interest rates were raised from mid-2004. Thus, one can interpret the shift by the Bank of Thailand to the overnight repo in January 2008 either as a response to this market development or as a response to certain central banks abandoning the 14-day repo as the focus of policy (Ho (2007)). However one interprets the policy move, it led to further concentration of liquidity in the overnight tenor (Table 2).

Thai repo market turnover by maturity around January 2007

In billions of baht

	Tenor of repo transactions		Total
	Overnight	Other	
4 months pre-January 2007	4,870	2,746	7,615
4 months post-January 2007	6,935	2,349	9,284
Total	11,805	5,095	16,900

Note: The Chi-square statistic for the independence of the choice of operating tenor and market turnover is 229.7, while the critical value for $p < .0001$ is 10.83.

Sources: Bank of Thailand; author's calculations. Table 2

While the shift to the overnight repo can be interpreted as the response of operating procedures to market development, the two natural experiments provide strong evidence that the choice of operating procedures also shapes the development of markets. Choices within an operating instrument matter as well as choices across operating instruments.

2.3 Choosing monetary operations to further financial market development

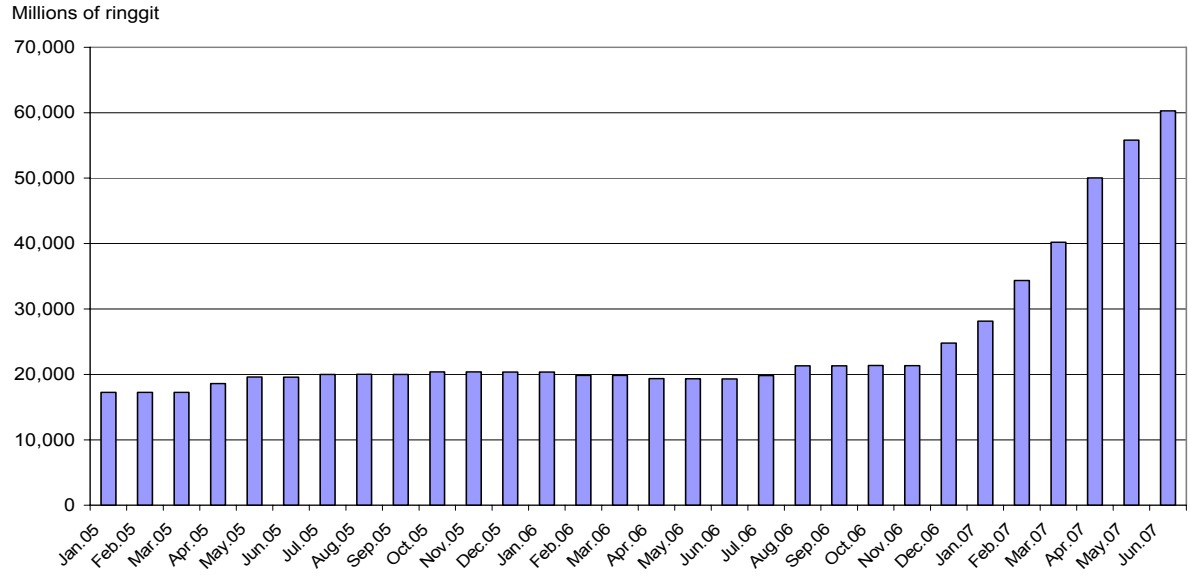
The syllogism advanced by this half of the paper can be simply put. The major premise is that the operations of a central bank confer liquidity on a particular market. The minor premise is that modern strategies for managing fiat money are silent on the composition of the balance sheet of the central bank. The conclusion therefore follows that central banks can choose monetary operating procedures in general, and operating instrument(s) in particular, in order to develop financial markets.

I contend that this conclusion applies to industrialised and emerging market economies alike. David Marshall's historical review (2002, p 46) concluded "The Federal Reserve used its choice of open market instruments to influence the growth of financial markets in ways it deemed useful for the public interest". More recently, the fine points of the Eurosystem's operating policy have been tweaked most importantly to remove the incentives for massive overbidding in regular operations (maintenance period timing, maturity of operations, see ECB (2003)). In addition, however, moves have been made to damp overnight interest rate volatility, including more frequent fine-tuning operations (ECB (2007)). Damping such volatility has more to do with accommodating market participants in the EONIA swap market than any inherent monetary policy interest. From a developmental perspective, this accommodation makes sense.

Two policies pursued by Bank Negara Malaysia provide examples of the choice of monetary instruments to further financial market development. The first concerns repos. As noted, a number of Asian central banks have depended more on repos to drain funds from the money market since the Asian financial crisis. However, the predominantly foreign assets held by these central banks have tended to place a limit on the available portfolio holdings of government paper that can be repo'ed out. Bank Negara Malaysia has borrowed government bonds from the buy and hold government provident fund that can be used in repo operations. Moreover, a comparison of the bidding in the resulting repo transactions with bidding at similar maturities for outright deposits with Bank Negara Malaysia revealed a preference for the repo over the outright deposit.

The second policy involves the substitution of Bank Negara Malaysia securities for outright deposits as a means to drain liquidity from the money market. This required a change in the law that had limited outstanding Bank Negara Malaysia securities in relation to its capital. The increase in the central bank paper outstanding since the new law went into effect has been dramatic. Outstanding amounts tripled in the first half o f2007 to over $17 billion equivalent. The substitution of negotiable securities for short-term deposits with the central bank has contributed materially to the liquidity of the money market.

Bank Negara Malaysia bills and notes outstanding



Source: Bank Negara Malaysia Monthly Statistical Bulletin.

3. Financial market development as a constraint on monetary operations

The first half of this paper has argued that the choice of instruments and other aspects of a monetary policy operating framework affords policymakers the opportunity to advance the development of financial markets. At the same time, however, the development of financial markets constrains and challenges policymakers. The second half of this paper takes up these constraints and challenges. Constraints arise from the government and central bank balance sheets and from the growth of securities markets in previously bank-dominated financial systems.[85] The challenge to a central bank is to align its operations appropriately with financial development.

3.1 Government and central bank balance sheets

Government and central bank balance sheets impose important constraints on monetary operations. The first affects the availability of "risk-free" assets (a concept that dates almost to the period when the Federal Reserve was pegging Treasury interest rates). The second affects the likelihood that the money market is in structural deficit or surplus, and thus the character of the modal monetary operation (injecting or draining) and the availability of domestic assets to use in reversed transactions.

The government balance sheet

A most important constraint is the size of the government debt, which under normal circumstances itself reflects the flow of past fiscal deficits or surpluses. Thus, quite apart from the real bills doctrine, the Federal Reserve's initial choice – that is, before World War I – of operating instrument was constrained by the small size of the federal government's debt. Some Asian central banks before the Asian financial crisis also had little in the way of government debt with which to operate. As noted, at the very beginning of the present century, many committee meetings took place and journal articles were written on the premise that the stock of US government debt would shrink and possibly force the Federal Reserve to resort to private paper.

Australia and New Zealand avoided the recessions and substantial foreign engagements that belied the fiscal expectations in the United States. Today, the prolonged fiscal surpluses of Australia and New Zealand have themselves posed challenges to the existing monetary policy procedures. The Reserve Bank of Australia (2003) has responded by operating in bank bills, much like the Federal Reserve once operated in BAs. The Reserve Bank of New Zealand (2006), by contrast, has preferred to cash up its money market with massive foreign exchange swaps in order to avoid taking on such private sector assets (though it will from September 2007 accept IBRD and EIB paper denominated in New Zealand dollars).

The central bank balance sheet

The most economical, or perhaps minimalist, central bank balance sheet, that of the Federal Reserve, is not much larger than the monetary base.[86] That is, liabilities consist of outstanding currency and a smaller sum of bank reserves. The growth of outstanding currency is accommodated by the Federal Reserve's purchases of assets. The structural balance in the money market associated with an economical balance sheet is likely to be a deficit. That is, the central bank's burden is likely to be to provide enough liquidity to the money market to accommodate cash and reserve demand (including that for clearing). Such

[85] For a treatment of the effect of changes within the banking system, see Archer (2006). This section does not touch on the implications of the growing importance of derivatives. See Hohensee and Lee (2006) and BIS (2005, 2007).

[86] See Papadia and Würtz (2007) on the "lean balance sheet".

an economical central bank has cash-needy entities (eg securities firms) as its natural counterparts.

In many of the economies of East Asia, by contrast, the central bank's abundant assets consist of foreign assets that stand at a multiple of the monetary base. Thus, the structural balance in the money market is likely to be a surplus and the central bank's burden is likely to be to drain enough liquidity from the money market to prevent interest rates from plunging toward zero. In doing so, it will find it problematic to conduct reversed transactions against domestic assets like government securities, owing to its lack of holdings of the paper. Such a central bank has cash-rich banks and institutions as its natural counterparts.

Cooperation between the debt manager and the central bank

Government and central bank balance sheets impose less of a constraint if there is thorough cooperation between debt managers and central bankers. Considerable cooperation in East Asia and the Pacific has been evident in Singapore, Australia and India. In all three the government has issued (Singapore and India) or contrived to keep in existence (Australia) government debt in excess of the needs imposed by the public sector borrowing requirement.

McCauley (2003 and 2006a) develops the argument for close cooperation between the debt manager and the central bank.[87] This has been adopted in India, where, notwithstanding a fiscal position that is only approaching long-run balanced growth, the government has agreed to overfund its fiscal needs. It thereby makes its debt available to the central bank to sterilise the effect on base money of intervention to resist the appreciation of the rupee. This has resulted in the filling in of the government yield curve, since the government has dropped its previous reluctance to issue short-term debt in view of its having a readily realisable financial asset as the counterpart of the overfunding (a blocked account at the Reserve Bank of India).

3.2 The importance of securities markets: the view from corporate balance sheets

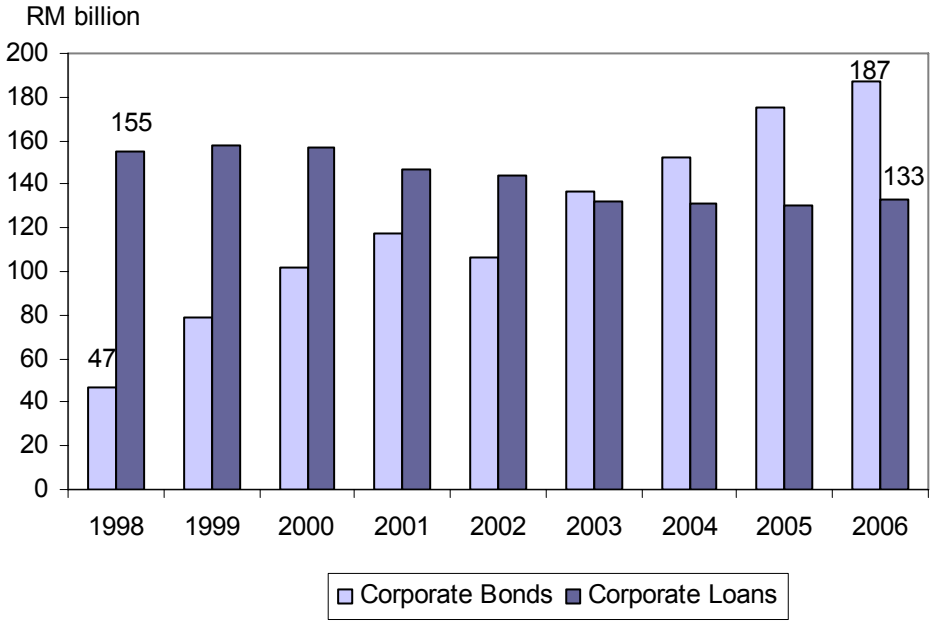
Another constraint on a central bank's choice of operating instrument is the importance of the securities markets in the overall financial system. If the flow of funds from the household sector to the non-financial business sector, or within the non-financial business sector, takes place primarily through a combination of institutional investors (mutual funds, insurance companies and pension funds) and securities markets, then operations confined to the banking system may not be transmitted effectively.

Since the Asian financial crisis, bond markets have grown substantially in the region (Jiang and McCauley (2004)). Especially in Malaysia and Korea, not only have outstanding government bonds grown, but outstanding corporate bonds have also seen rapid growth (BIS (2006)). In Malaysia in particular, large firms rely more on corporate bonds than on bank loans. Under these circumstances, for instance, an increase in reserve requirements might just accelerate the shift from reliance on bank borrowing to reliance on bond issues rather than slow overall credit flowing to the corporate sector.

More generally, the cost of debt capital for the larger firms in the corporate sector no longer depends solely on the pricing of bank loans. Large firms' decisions regarding the holding of inventories, the acquisition of land, and the purchase of capital equipment should be seen as increasingly a function of short-term paper and bond yields.

[87] See Friedman and Schwartz (1963, pp 634–636) for an interpretation of the "bills only" controversy in terms of the cooperation between debt managers at the Treasury and the Federal Reserve.

Size of corporate bond market against corporate loans[1]



[1] Excludes loans to small and medium-sized enterprises.

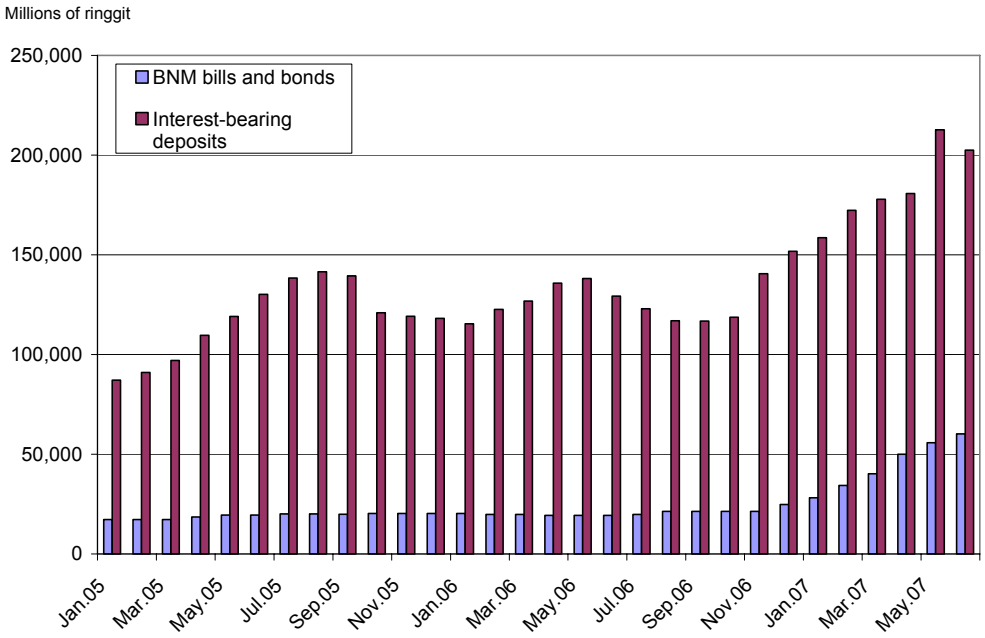
Source: Bank Negara Malaysia (2007, p 92).

3.3 Aligning monetary operations to financial market development

In a bank-dominated financial system, the central bank can conduct monetary operations with banks and remain confident that its policy impulses will be transmitted to the banks' customers, both depositors and borrowers. As securities markets gain in importance, however, the central bank faces the challenge of aligning its monetary policy operations with the altered flow of funds in the economy.

This challenge can be visualised by a juxtaposition of the graph above, showing the reliance of large firms in Malaysia on the bond market, with the graph below, showing the security and deposit liabilities of Bank Negara Malaysia. The security liabilities consist of Bank Negara Malaysia bills and bonds and these showed an expansion in 2007 as noted above. The deposit liabilities are meant to capture the stock of outstanding operations in which banks in Malaysia tender for outright deposits at the central bank. These daily operations, for periods as short as days and as long as months, are the workhorse draining operation of the central bank. The outstanding stock is approximated by taking the banking system's holding of deposits with the central bank (leaving the government's deposits to one side) and subtracting required and excess reserves. The remainder can be taken as a proxy for the interest-bearing deposit liabilities of the central bank, which can be appropriately compared to the interest-bearing central bank securities outstanding. Both serve to drain liquidity, but one operates through bank balance sheets, and the other through the robustly expanding bond market.

Security and deposit liabilities of Bank Negara Malaysia



Source: Bank Negara Malaysia, Monthly Statistical Bulletin.

As can be seen, 2007's increase in central bank bills and bonds has brought the security liabilities up to over a quarter of the deposit liabilities. Moreover, since the juxtaposition has not taken into account any repo transactions, the security-related draining operations are not fully captured by this comparison. It is fair to conclude that progress has been made in bringing central bank operations into alignment with the development of financial markets in this case.

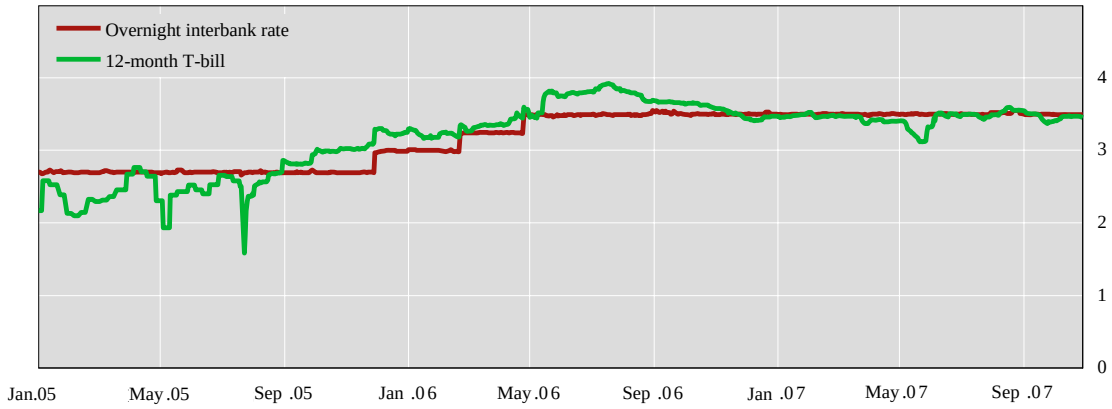
Deeper securities markets make it less likely that bank interest rates and those on short-term securities will become unhinged again. This was the experience in 2005 in the lead-up to the unpegging of the ringgit in July 2005. A great deal of speculative capital flowed into Malaysia's financial markets in (a correct) anticipation of a move and in (an incorrect) expectation of a substantial immediate gain in the event of a move. Some of these funds were parked in short-term securities, especially at the short end of the Malaysian government securities market and in Bank Negara Malaysia bills. As a result of the weight of non-resident demand, the interest rates on such paper fell noticeably below the Bank Negara Malaysia overnight policy rate (see graph below). In effect the entire stock of such paper was acquired by non-residents, so that the higher opportunity cost of the banks able to participate in central bank draining operations became irrelevant to the pricing of the government and central bank paper in the market. Thus, the rates enforced by central bank operations in the interbank market lost their effect on the yields prevailing in the market for short-term government securities.

More balance in the central bank operations between bank deposits and securities cannot prevent a recurrence of such an anomalous pattern of short-term interest rates, given the huge scale of capital flows that are being experienced in the region. The larger the stock of central bank paper, however, the less likely a recurrence becomes. This observation should not be read to suggest that there was a large loss associated with the disconnect between bank and short-term security interest rates. The speculative pressure did not extend far out along the yield curve, so that borrowing conditions for Malaysian firms were not greatly affected. And the anomalous pattern of rates did not last long. Speculative investors threw in the towel in August as it became clear that there would not be an uncontrolled pop of the exchange rate. Indeed, there was a huge outflow of funds from Malaysia in the second half of

2005, which can be seen in the graph above as a fall in the outstanding draining operations, the counterpart of a substantial decline in foreign exchange reserves. This set of events, of course, had some parallel in China, which also depegged in July 2005.

Money market interest rates in Malaysia, 2005–2007

In percentage points



Sources: Bloomberg; CEIC.

4. Conclusions

Monetary policy operating procedures and instruments offer central banks an opportunity to contribute to the development of financial markets. This may be most true for central banks in emerging markets, but the opportunity cost of holding the paper for the banks able to participate in central bank draining operations became irrelevant to the pricing of the paper in the market. The degrees of freedom in choosing instruments, given the lack of constraints flowing from the dominant strategy of managing fiat currencies to achieve low inflation and stable economic growth, can be put to good use.

At the same time, the state of financial development constrains the choice of monetary operating procedures as well. When the debt stock of the government is small or the foreign assets of the monetary authority are large, monetary operations may end up with a character not observed elsewhere. Whether the debt stock of the government can be expanded to play a major role in the monetary operations of a central bank with large foreign assets depends on the particular circumstances of each country, and especially the relationship between the ministry of finance and the central bank. With or without this help, the central bank faces the challenge of aligning its operations to the main trends of financial development, including the growth of institutional investors and securities markets at the expense of bank intermediation.

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Using financial market information in monetary policy: some examples from New Zealand

Clinton Watkins

Introduction[88]

Central bankers have long recognised that financial markets contain useful information for macroeconomic surveillance and the conduct of monetary policy. Financial markets provide a valuable window for timely information on (domestic and global) economic and financial conditions. This is due to the vast amount of information aggregated by markets, to their forward looking nature, and to the fact that future asset returns are sensitive to economic conditions. Central bankers also pay close regard to financial markets because certain key markets are important initial linkages in the monetary policy transmission mechanism in many economies.

Market information can be incorporated into monetary policy-making in a variety of ways. This paper outlines some key elements of the Reserve Bank of New Zealand's (RBNZ) approach to incorporating financial market information into monetary policy. It begins by looking at the type of questions we wish to answer using financial market information, our framework for market surveillance and how that fits into the RBNZ's structure.

The subsequent sections focus on some practical examples of our market analysis. During the current policy cycle, the behaviour of retail borrowers has changed in response to changes in the shape of the yield curve, which has in turn altered the characteristics of monetary policy transmission. In New Zealand (NZ), it is critical to understand pricing and forward policy rate expectations and to ensure that policy works through the yield curve so that the behaviour of borrowers will be affected. The paper looks at the influence of policy on the yield curve and transmission to retail borrowing, our analysis of forward policy expectations embedded in the yield curve, and a tactical survey of traders on policy expectations and reactions to policy announcements. Finally, the paper discusses how market information is incorporated into the macroeconomic modelling process.

1. Market information and monetary policy

The primary objectives of the RBNZ are to implement monetary policy and to maintain financial stability by (i) operating monetary policy so as to maintain price stability, and (ii) promoting a sound and efficient financial system. Financial market surveillance is integral to achieving both of these objectives, although this paper focuses on using financial market information to pursue the first objective.[89] Accordingly, different types of monetary policy oriented questions that we wish to answer using financial market information can be thought of in terms of short-, medium- and long-term horizons.

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[88] The author would like to thank David Drage, Tim Hampton, Leni Hunter, Christina Leung, Ian Nield, Michael Reddell, Adam Richardson, Ian Woolford (all of the RBNZ) and Chris Becker (of the Reserve Bank of Australia) for helpful comments and suggestions. The views expressed are those of the author and do not necessarily represent those of the RBNZ.

[89] Market analysis for both monetary policy and financial stability purposes is conducted within the same section of the RBNZ.

- In the short term, we are interested in the policy expectations that are currently priced into financial asset prices and the yield curve by market participants, and how these expectations evolve with the economic dataflow, market relevant events and the other financial market variables.
- In the medium term, it is beneficial to know why financial market participants are trading, how market participants will react to policy announcements, what the influence of policy will be on markets, and whether there are persistent frictions or distortions present in markets that mean financial market variables deviate to some extent from reflecting "fundamentals".
- In the longer term, we are interested in the transmission of monetary policy through the relevant wholesale and retail financial markets, as well as the existence of systematic relationships amongst financial market variables, and between financial market and macroeconomic variables.

Overall, financial market information can be thought of as:

- information obtained from markets directly, and from market participants through liaison;
- asset price and yield moves, flows and transactions;
- risk taking and hedging behaviour;
- characteristics of financial instruments, market and institutional structure; and,
- underlying views on macroeconomic and financial conditions.

The market surveillance framework used by the RBNZ, and how this fits into the monetary policy process, is discussed below.

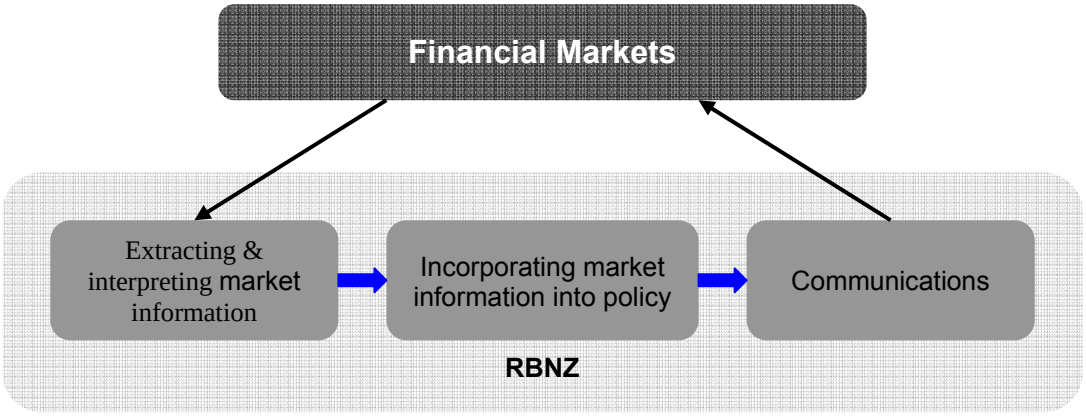
2. The market surveillance framework

What is market surveillance at the RBNZ?

Like many central banks, we view market information or intelligence as a synthesis of both desk-based research and direct contact with market participants. Information obtained from these two broad sources is analysed through a variety of financial and economic frameworks to assist with interpreting financial market developments. Interpretation is an important element of the market surveillance process. The Financial Markets Research (FMR) team at the RBNZ not only summarises and reports on market developments; its main function is to interpret these developments in terms of financial or economic frameworks that the Bank's economists and decision-maker[90] can relate to macroeconomic modelling at the Bank, and use to pursue the Bank's policy goal. At the RBNZ, incorporating financial market information into monetary policy involves (i) extracting and interpreting market information, (ii) using this interpretation of markets in policy development, and (iii) using this interpretation in communicating policy to markets (see the diagram below).

[90] Under the Reserve Bank Act, the RBNZ Governor is the single decision-maker. For monetary policy, the Governor is supported by the Monetary Policy Committee and the Official Cash Rate Advisory Group.

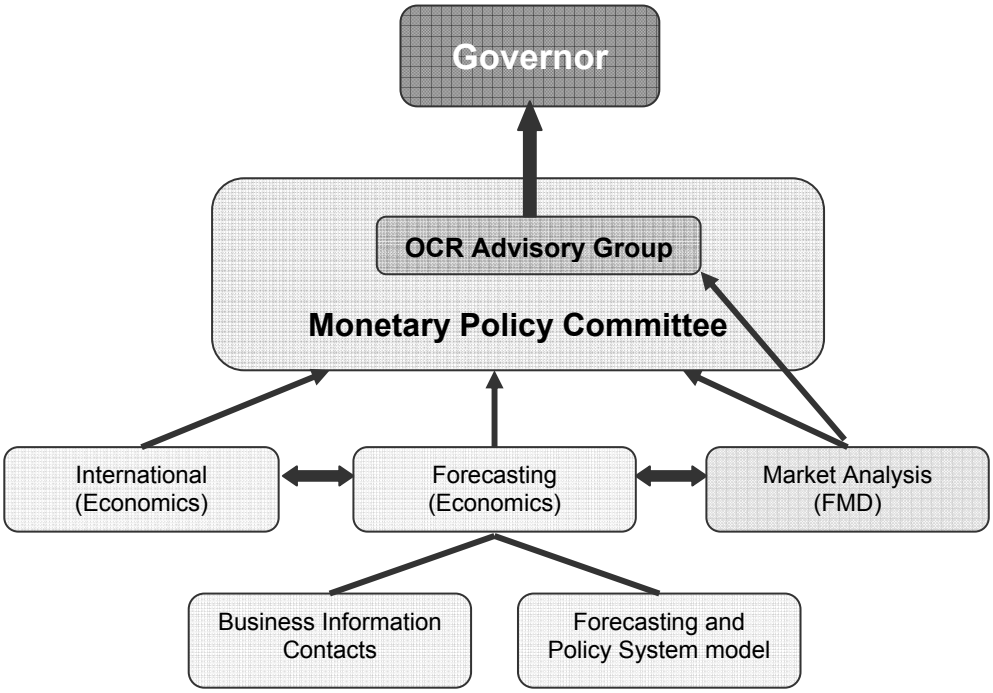
Incorporating financial market information into monetary policy



Market information in the monetary policy process

The diagram below depicts a stylised RBNZ monetary policy process. The process is focused around the Bank's Forecasting and Policy System (FPS) model, which provides a framework for analysis of the domestic economy, projections, and discussion of developments at meetings of the Monetary Policy Committee (MPC). The model is operated by the Forecasting team in the Economics Department, who also provide detailed economic analysis on various aspects of the domestic economy. The Market Analysis team provides information directly to the MPC as well as to the other teams involved in the policy process. This information will be discussed below in detail. Other components feeding into the process include "*Business Information Contacts*", which is a programme of liaising with firms on economic developments, and international economic forecasts. The MPC deliberates on the economic and financial market information, modelling and projections. Individual members of the Official Cash Rate Advisory Group (OCRAG), as a sub-committee of the MPC, provide written recommendations to the Governor on policy. The group collectively provides advice on communicating the policy decision.

Where market analysis fits into the policy process

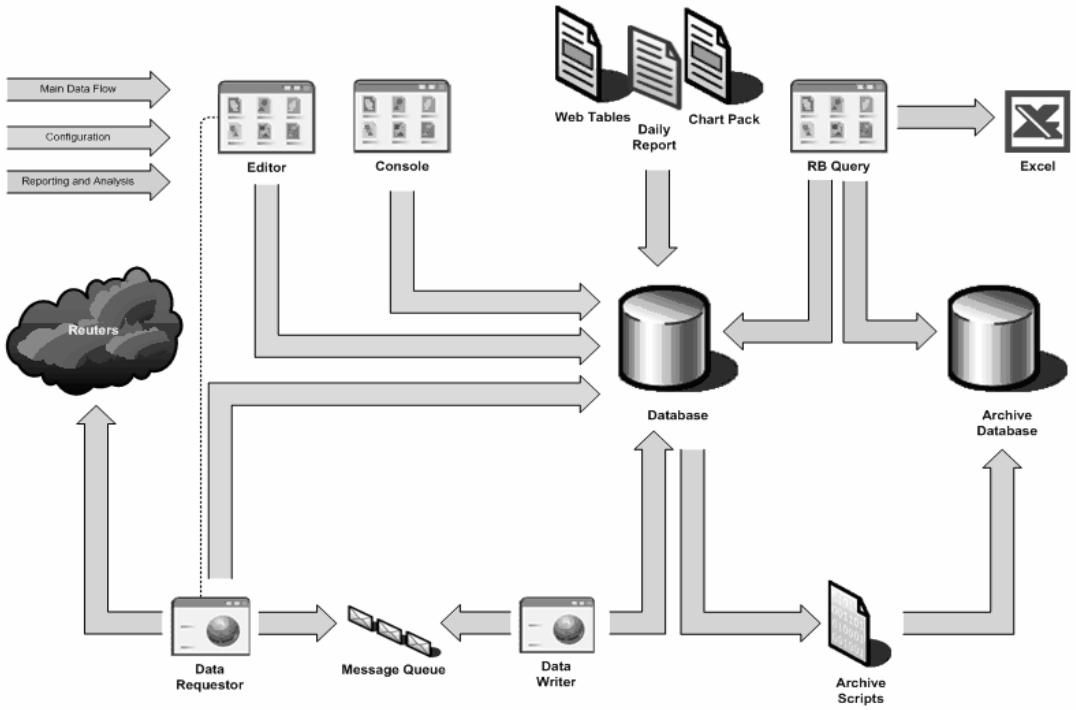


Gathering information for market surveillance

The RBNZ has had a dedicated Financial Markets Research team since the mid-1990s, situated within the Bank's Financial Markets Department (FMD). The team draws in information from four main sources: (i) open data sources and financial market databases, (ii) direct contact and liaison with market participants, (iii) surveys conducted by the Bank, and (iv) internal information flows from other sections of the RBNZ.

External financial market databases provide access to real-time market price and yield information across a vast array of markets. The Bank has an internal "Market Watch" financial market data system that captures "tick" observations. At present, the system captures data on about 950 financial prices (and other variables such as volumes) from both domestic and global markets. This data is regularly checked for completeness and accuracy. The database provides access to high frequency, hourly and daily snapshots of these variables via a spreadsheet-based query system available throughout the Bank. It provides the main data source for the Market Analysis team's quantitative tools, reports and "chart packs". The diagram below shows the system architecture for the Market Watch database.

Architecture of the Market Watch database



A range of quantitative tools are regularly used to analyse market developments, including: short-term policy rate outlook models; models for analysing cash market pressures; tools that provide information on the transmission mechanism and various yield curves; and tools to estimate options implied distributions on foreign exchange rates and other variables. The tool building process is ongoing to keep up with developments in financial economics technology, and the evolving structure of markets. Developing these tools relies on in-house, commercial or investment bank, academic, and central bank research. Some of these tools replicate methods used by market participants to understand market developments or analyse trades. This helps analysts at the RBNZ to interpret traders' views and trading rationales. In the following sections, some of our quantitative tools will be discussed.

Market liaison is conducted through day-to-day telephone contact, periodic surveys, visits to local and overseas dealing rooms, and formal meetings with both domestic and offshore market participants. Day-to-day market liaison efforts focus on contact with traders and asset managers in the important transmission mechanism markets, and some peripheral markets. To a lesser degree, we engage market strategists and economists in discussion. More time and effort is put into speaking with traders because the Market Analysis team aims to understand the functioning of markets, and to the extent we can, what is driving investment flows. We believe an important means of understanding market developments, particularly those involving changes in views, dynamics or structure, is to speak directly with those actively transacting in the markets of interest. We also meet on a regular basis with higher level financial market and treasury staff in the domestic banks.

A priority of the Financial Markets Research team is to develop and maintain close and strong relationships with a broad network of market contacts covering the key domestic and main global markets of relevance to domestic monetary policy and financial stability.[91] While

[91] Global benchmark interest rate, currency, commodity and equity prices are monitored. Domestic markets closely related to the transmission mechanism include money markets (overnight index swaps, physical bank bills, bank bill futures, forward interest rate agreements), wholesale capital markets (interest rate swaps), government and corporate bonds (including those issued by offshore corporates called Kauri bonds), offshore issuance of NZ dollar denominated securities (Uridashi bonds, Eurokiwi bonds), foreign exchange (spot,

desk-based research on market data is very useful, surveillance based purely on this approach has disadvantages. For instance, many market indicators move in reaction to data or an event, rather than leading it. Market price deviations from values consistent with fundamentals usually give little guidance on the timing of correction. Further, data on some sectors, such as hedge funds' leverage and strategies, is sporadic and poor. The shortcomings of purely desk-based research reinforce the importance of effective strategies for gathering market intelligence through direct contact with market participants.

There are risks that information gained through direct contact could be biased or distorted. We use a relationship management approach to mitigate these risks (as do the Bank of England and the US Federal Reserve). By maintaining long-standing relationships with market participants, the information provided can be "handicapped" according to the reliability of the source over time. Moreover, we place a great deal of importance on fostering internal information flows amongst the various groups interacting with financial markets, both those trading with market participants, and those liaising more generally. Maintaining a broad spectrum of market information sources lessens the risk that a biased or distorted information source might colour the Bank's interpretation of market developments.

The Market Analysis team is co-situated with the Bank's dealers who transact with domestic markets for liquidity management purposes (the Domestic Markets (DM) team), and the dealers who manage the Bank's foreign reserves by transacting in foreign exchange and offshore fixed income markets (the Foreign Reserves Management (FRM) team). The analysts sit in a "dealing room" environment. The co-location of the market analysts with the RBNZ market operations traders promotes information flows from the wide range of market participants with which the Bank has a trading relationship.

Working closely with the DM team provides the market analysts with access to information on liquidity management operations (foreign exchange swaps, basis swaps, open market repurchases and reverse repurchases), influences on the settlement cash level (government flows, settlement cash forecast, commercial bank cash holdings), and use of the Bank's standing facilities (Overnight Reverse Repurchase Facility, Bond Lending Facility, Repurchase Facility). Information flows from the FRM team primarily cover a wide range of currency market developments, as well as providing a window on currency market participant views on the domestic and international economies. The Market Analysis team also operates a "Market Test Portfolio". This is a small portfolio that allows the team to trade in a limited number of fixed income securities (physical and futures). Trading in markets assists the process of understanding market microstructure, developing transactional knowledge, and building relationships with financial market counterparties.

Information flows from other parts of the Bank are also useful in market analysis and interpretation, particularly areas such as those involved with wholesale payment systems and banking supervision. For instance, being the operator of the wholesale settlement and depository systems, we have access to a wealth of detailed transactional information.[92] Various parts of the Bank conduct surveys of financial institutions and market participants. RBNZ financial market turnover, pricing and holdings surveys are an important source of information for the Financial Markets Research team. These include daily foreign exchange turnover and bond turnover, wholesale and retail interest rates, and monthly non-resident bond holdings. Ongoing efforts aim to improve information flows across the RBNZ, particularly from these areas.

The Market Analysis team is located in a separate department to that in which macroeconomic analysis takes place, although there is substantial communication between

---

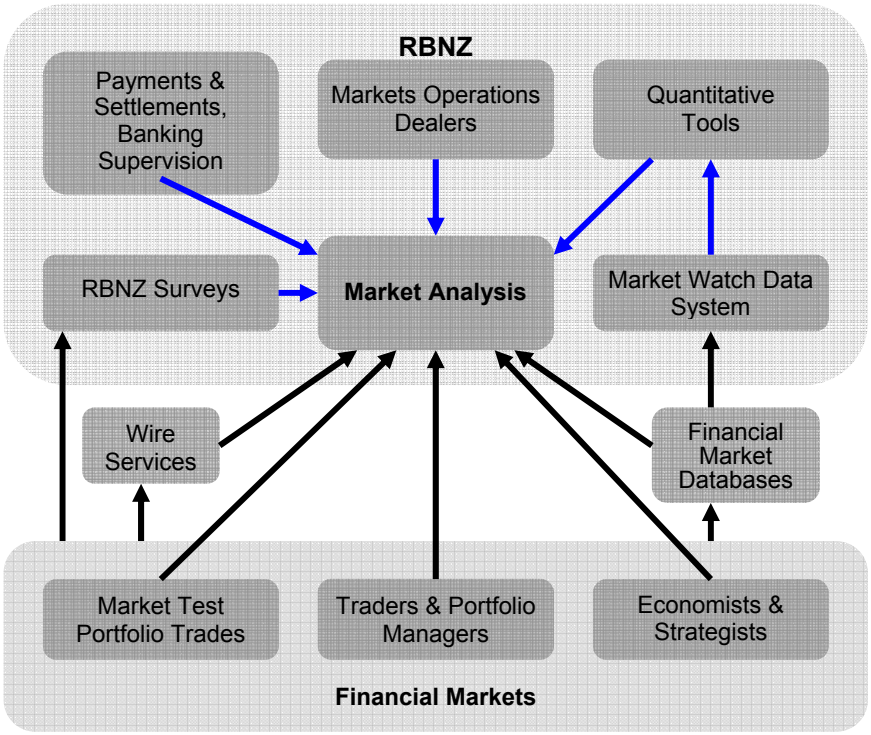
options, forwards), and mortgage interest rates (a key retail interest rate market). For financial stability purposes, an even broader range of markets are analysed.

[92] Although some legal issues and system technology constraints currently limit the extent to which this data can be accessed for analysis.

the two areas. One benefit that results from this separation is that it encourages the market analysts to provide a market-based interpretation of economic data and developments, and contestable advice into the monetary policy process. Often, market information is cast as a market-based counterview to economic modelling in the policy process.

The diagram below shows the main information sources used in market analysis and interpretation at the RBNZ.

Market surveillance information sources

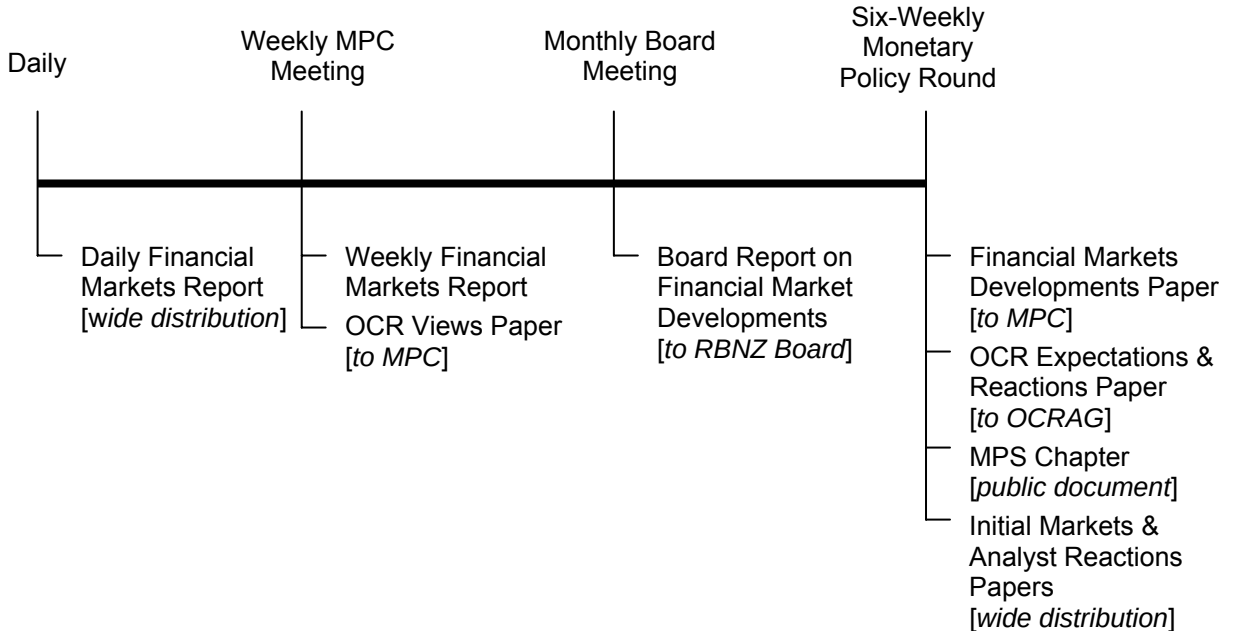


Market surveillance contributions to the monetary policy process

The Market Analysis team's primary client is the MPC. To service this committee, the team has developed several key outputs. These include: a daily report on developments in domestic and offshore markets distributed widely within the bank; weekly MPC reports on financial market developments, and analyst (OCR) views; a financial markets development paper and a market expectations and reactions survey for each of the 6-weekly monetary policy rounds; and a chapter for the quarterly Monetary Policy Statement (MPS). A monthly paper is written for the Reserve Bank Board[93] to provide appropriate financial markets background for Board Members in their assessment of the Bank's policy performance. Research is conducted for other key committees of the Bank as well as the MPC.

[93] The Board of the Reserve Bank performs an oversight and governance function; it does not advise on or have any input into monetary policy decision-making. In contrast to the MPC, which consists of internal staffers (with two external observers), the Board Members are selected from outside the Bank by the Minister of Finance.

Market analysis reporting in the monetary policy process



The following sections provide an overview of some of the financial market analysis that contributes to the financial market surveillance outputs. The next section provides an example of how a recent inversion in the yield curve affected retail borrower behaviour, lengthening the lags involved in monetary policy transmission. This highlights the critical importance for NZ of understanding forward policy expectations over a long horizon.

3. Monetary policy transmission through mortgage interest rates

Inflation pressures in NZ over recent years have been fuelled by significant increases in borrowing by households. This has happened, surprisingly, during a period in which monetary policy has been tightened significantly. Faced with this apparently counter-intuitive phenomenon, Governor Bollard posed the following question to the Financial Markets Research team:

> "*I have been raising the Official Cash Rate but it doesn't appear to be having much impact on the interest rates that borrowers are paying. What is going on?*".

Retail interest rates on residential mortgage debt are an important component of the transmission mechanism of monetary policy in NZ[94] for several reasons. For example: (i) around one third of NZ households hold mortgages;[95] (ii) 8 percent of households own an investment property and these tend to be highly geared with mortgage financing; and (iii) small businesses often rely on the proprietor's residential mortgage for business investment funding.

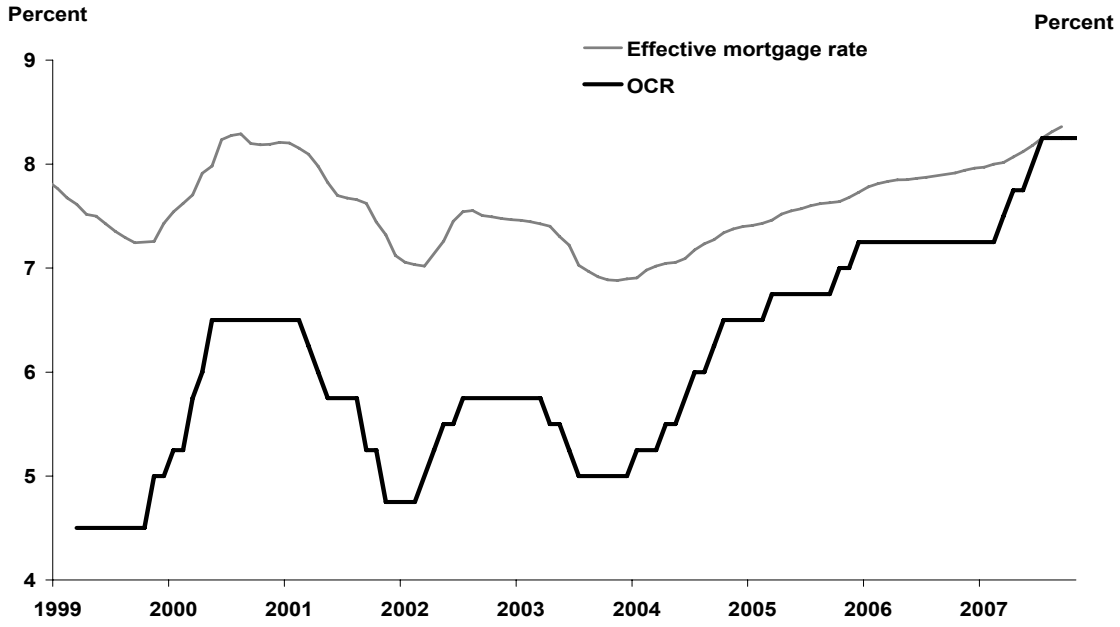
The average interest rate paid on outstanding residential mortgage debt (the "effective mortgage rate") has risen at a relatively slow pace during the current tightening cycle, particularly over the first two years (2004 to 2006; see the chart below). While the OCR

[94] For a detailed discussion, see Drew, A and R Sethi (2007), "The transmission mechanism of New Zealand monetary policy", *Reserve Bank of New Zealand Bulletin*, 70(2).

[95] Scobie, G, T Le and J Gibson (2007), "Housing in the Household Portfolio and Implications of Retirement Saving: Some Initial Findings from SOFIE", *New Zealand Treasury Working Paper*, 07/04.

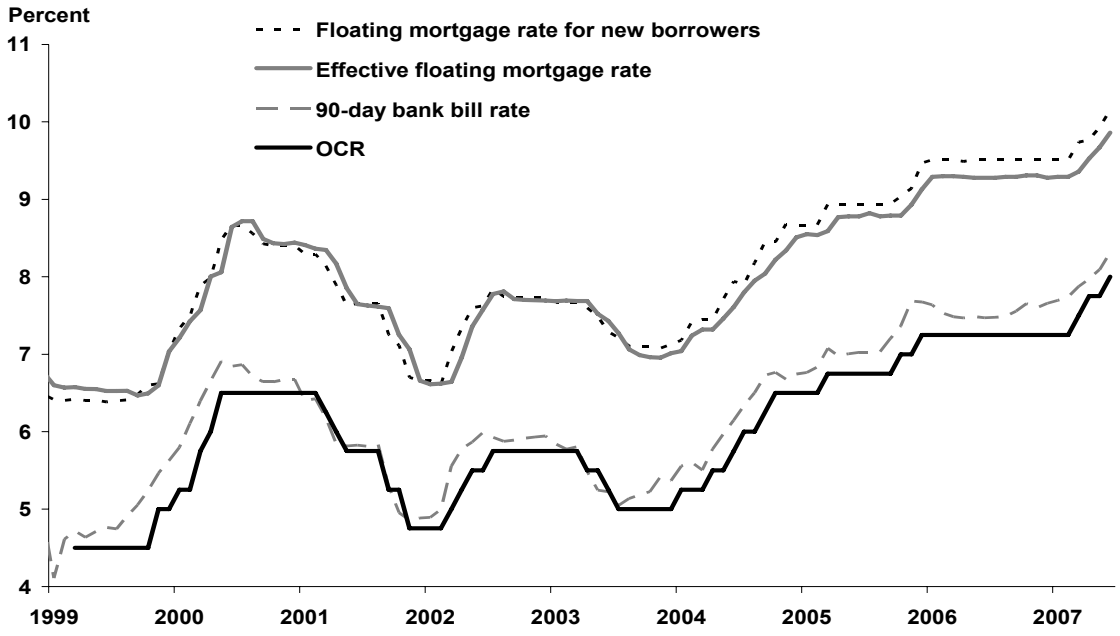
should affect the level of mortgage interest rates, there are a number of other important factors that also influence the impact of the policy rate on the effective mortgage rate.

The effective mortgage rate and the OCR



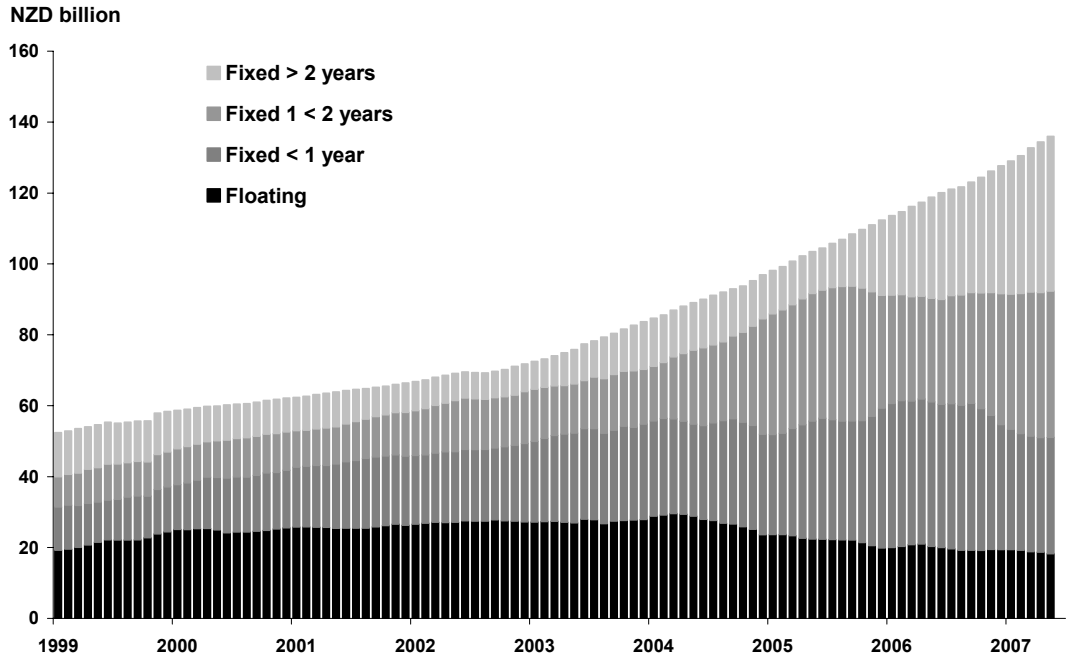
Mortgages in NZ are written on either short-term interest rates or fixed borrowing rates. Pricing of short-term (or "floating") rate mortgages depends on the 90-day bank bill yield, a rate that reflects near-term monetary policy expectations. As the chart below indicates, the channel from the OCR through floating borrowing rates appears to have worked effectively over the current tightening cycle.

The effective floating mortgage rate



However, both new and existing borrowers have moved from floating to fixed borrowing rates[96] (see the chart below). The relationship between the OCR and effective fixed mortgage interest rates is relatively weak compared to the relationship with the effective rate for floating rate mortgages. The growing proportion of fixed rate mortgages, particularly those with a maturity of more than one year, has increased the lags involved in the transmission of monetary policy. This is because there will be a period of time between a tightening in monetary policy and the point at which existing fixed rate mortgages mature, and new mortgages are negotiated. These lags have been one factor behind the subdued response of the effective mortgage rate to the OCR since 2004.

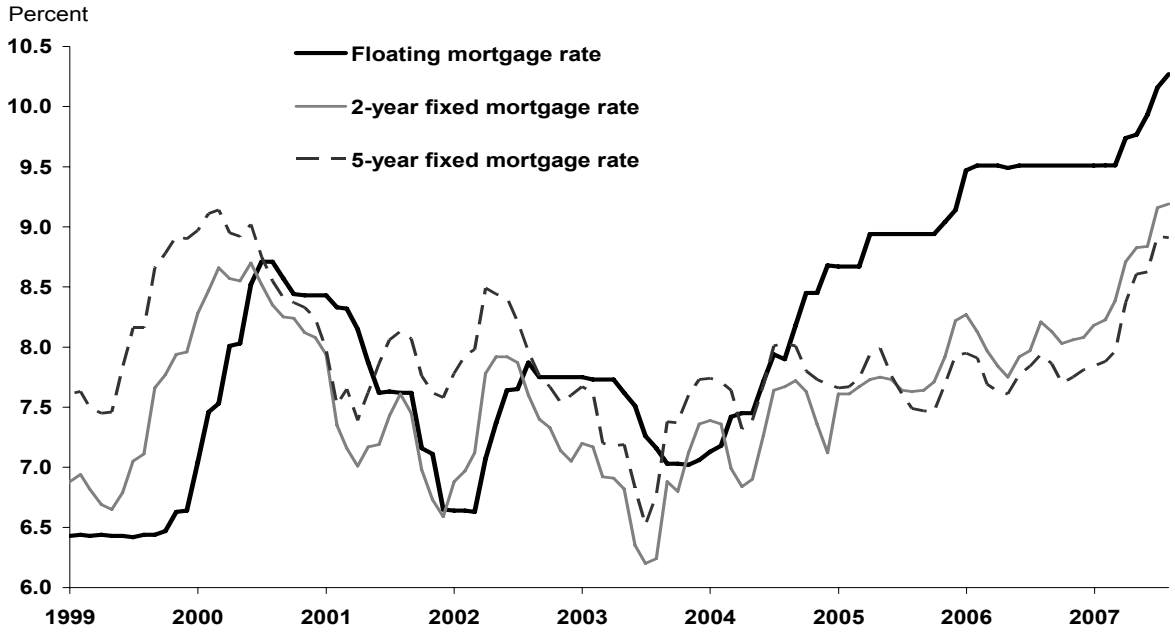
Fixed and floating mortgage tranches



The reason that borrowers have been attracted to fixed rate mortgages during the current tightening cycle is that interest rates for fixed rate mortgage debt have been low relative to floating mortgage rates (see the chart below). During previous tightening cycles, fixed mortgage rates have generally been higher than floating mortgage rates, so the current cycle is relatively unusual.

[96] The duration of the NZ mortgage portfolio is relatively short when compared with US mortgage debt, but longer than Australian mortgage debt. In contrast with the US, NZ mortgages typically do not have any embedded optionality to refinance at a lower rate if interest rates fall.

Floating and fixed mortgage rates



Mortgage lending banks manage the interest rate risk involved in providing fixed rate mortgages through the domestic interest rate swaps market.[97] Accordingly, funding costs for fixed rate mortgages depend on the level of interest rate swap rates. Bank bills and interest rate swaps make up what we consider to be the benchmark commercial bank liability yield curve in NZ.

In a stylised sense, the short-term end of the NZ yield curve responds predominantly to cyclical factors, that is, monetary policy and market expectations of future monetary policy based on market participants' views of the domestic macroeconomy. Changes in longer-term interest rates are influenced by structural factors, and for a small open economy like NZ, these structural factors largely reflect longer-term expectations of global growth and inflation developments, as reflected in long-term global interest rates.[98]

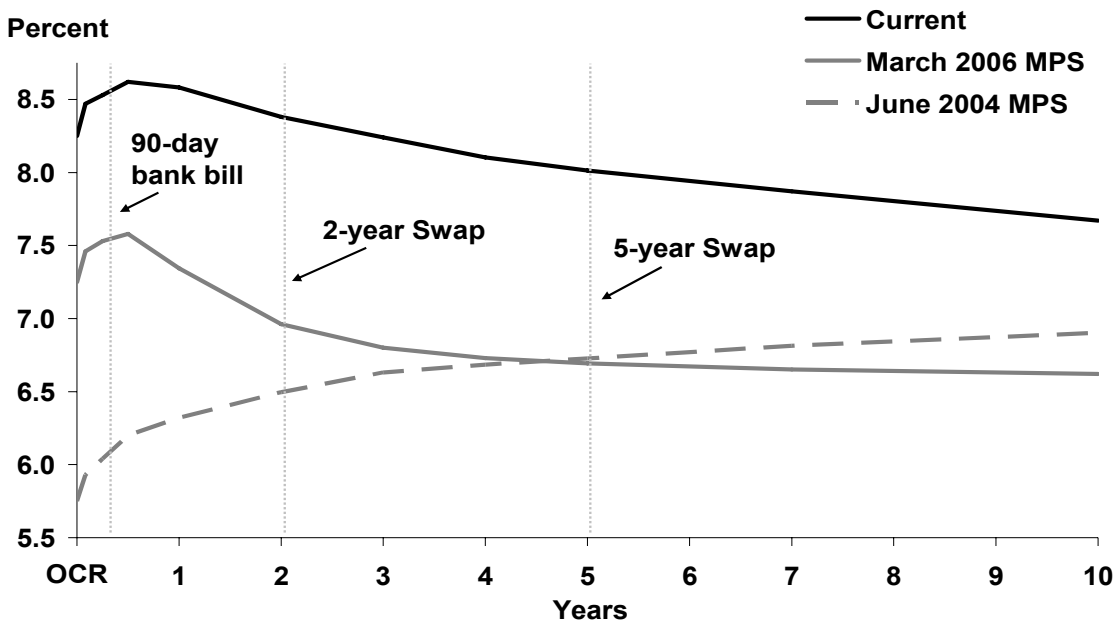
Despite significant tightening since January 2004 (325 basis points to date), longer-term interest rates have remained anchored at relatively low levels for much of the cycle. The chart below shows the yield curve at selected points during the tightening cycle – on the June 2004 and March 2006 MPS announcement dates, and the current curve. Funding costs for 2- to 5-year mortgages became substantially lower than costs for floating rate mortgages between 2004 and early 2007.

[97] The majority of commercial bank funding is raised at a maturity of less than 90 days. The mismatch between short-maturity liabilities and longer-maturity assets (the fixed rate mortgages) raises an interest rate re-pricing risk for the banks. This risk is managed through the interest rate swaps market. To hedge fixed rate mortgages, banks pay a stream of fixed interest rate flows and receive a stream of floating (90-day) interest rate flows.

[98] Of course long-term interest rates are seen as expectations of future short-term interest rates (expectations hypothesis). Long-horizon future short-term rates are strongly influenced by the evolution of the global macroeconomy.

The yield curve inverted and became more curved during 2005/06

Commercial bank liability yield curve



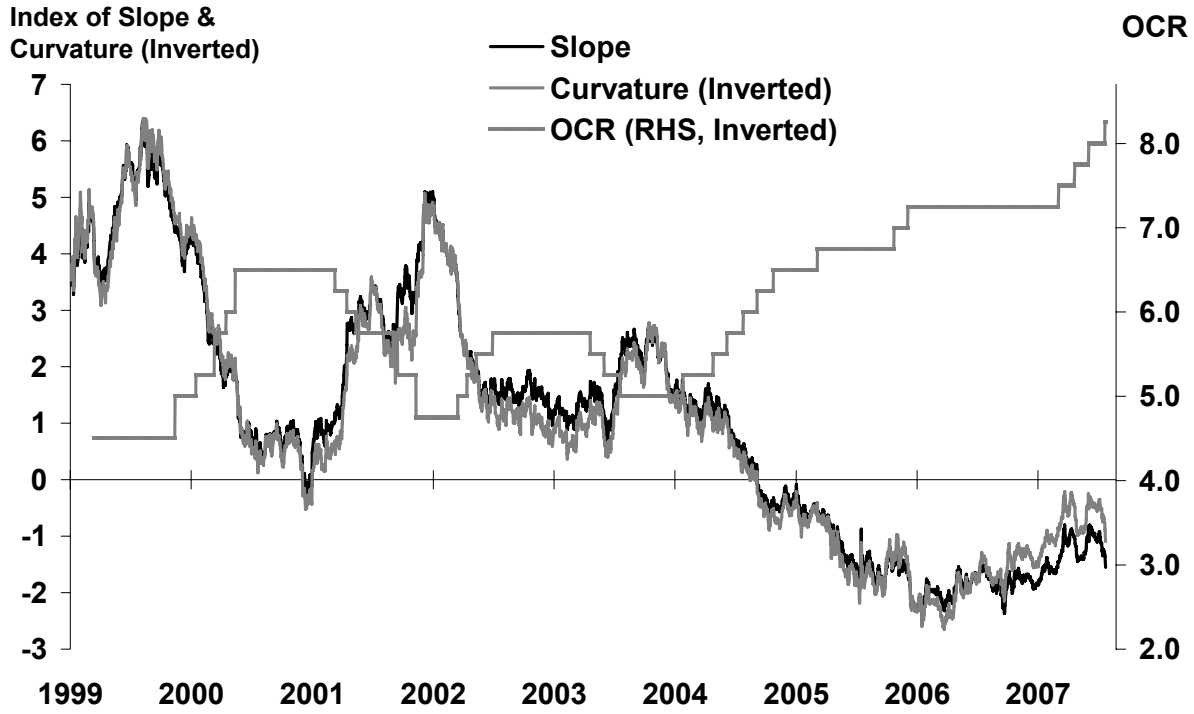
Long-term NZ interest rates remained at low levels, anchored by low global long-term rates.[99] The combination of anchored long-term interest rates and higher short-term interest rates saw the yield curve invert (become negatively sloped) rapidly. The yield curve also became more downward curved around mid-term maturities (2- to 5-year rates). Two reasons behind the increased downward curvature were relatively large issuance volumes of 2- to 5-year NZ dollar denominated securities in offshore markets,[100] and a degree of pessimism amongst offshore investors on NZ growth prospects. As the chart below indicates, the degree of inversion and downward curvature of the yield curve is extreme here relative to the previous two policy cycles.

[99] Bollard, A (2006), *Easy Money: Global Liquidity and its Impact on New Zealand*, Reserve Bank of New Zealand.

[100] These comprise Uridashi bonds, which are NZ dollar denominated bonds issued by offshore entities in Japan, mostly to retail investors but also to some institutional investors, and Eurokiwi bonds, which are NZ dollar denominated bonds issued by offshore entities to institutional investors in the euro markets. In issuing these bonds, interest rate risks are hedged by receiving a fixed interest rate and paying a floating interest rate in the swaps market, putting downward pressure on the commercial bank liability curve. The amount of outstanding Uridashi and Eurokiwi bond issuance is more than double the level of government bonds on issue (NZD 56.3 billion versus NZD 24.6 billion).

Shape of the yield curve during the current tightening cycle has been unusual

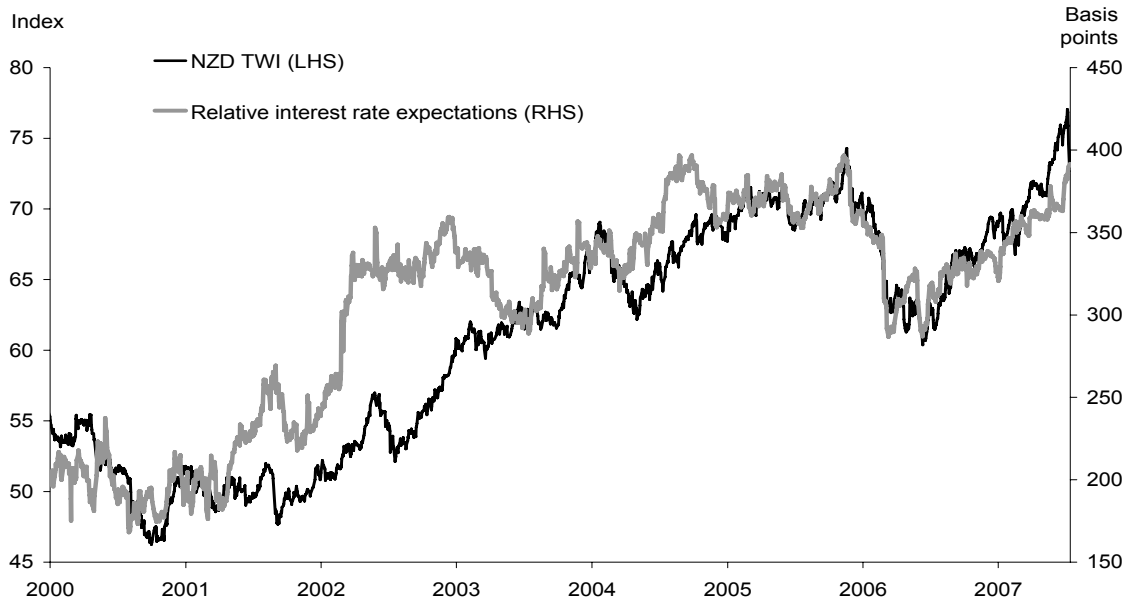
Slope and curvature estimates from a quadratic model



Despite the muted reaction of longer-term interest rates to increases in the OCR, tightening did flow through the exchange rate channel as the NZ dollar appreciated in line with relative short-term interest rate expectations[101] (see the chart below).

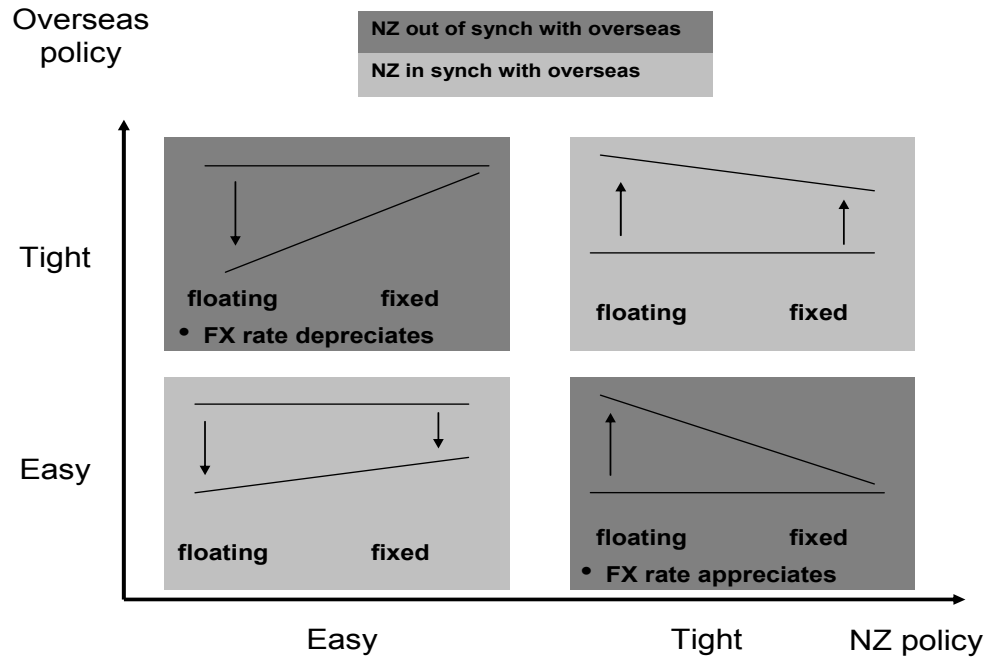
[101] Relative interest rate expectations are defined as the difference between NZ money market futures yields and a Trade Weighted Index (TWI) weighted average of US, UK, eurozone, Japanese and Australian money market futures yields.

The NZ dollar Trade Weighted Index and relative interest rate expectations



Financial conditions in NZ, and the behaviour of the domestic yield curve, have been heavily influenced by relatively easy policy conditions in the major global economies for much of the current tightening cycle. This illustrates the extent to which the policy mix in NZ depends on global policy conditions and the impacts on financial conditions in NZ when domestic monetary policy is out of synchronisation with policy in the major global economies. The four broad alternative mixes of financial conditions are shown in the diagram below, with the situation currently faced represented by the lower right quadrant.

The NZ policy mix depends on overseas policy

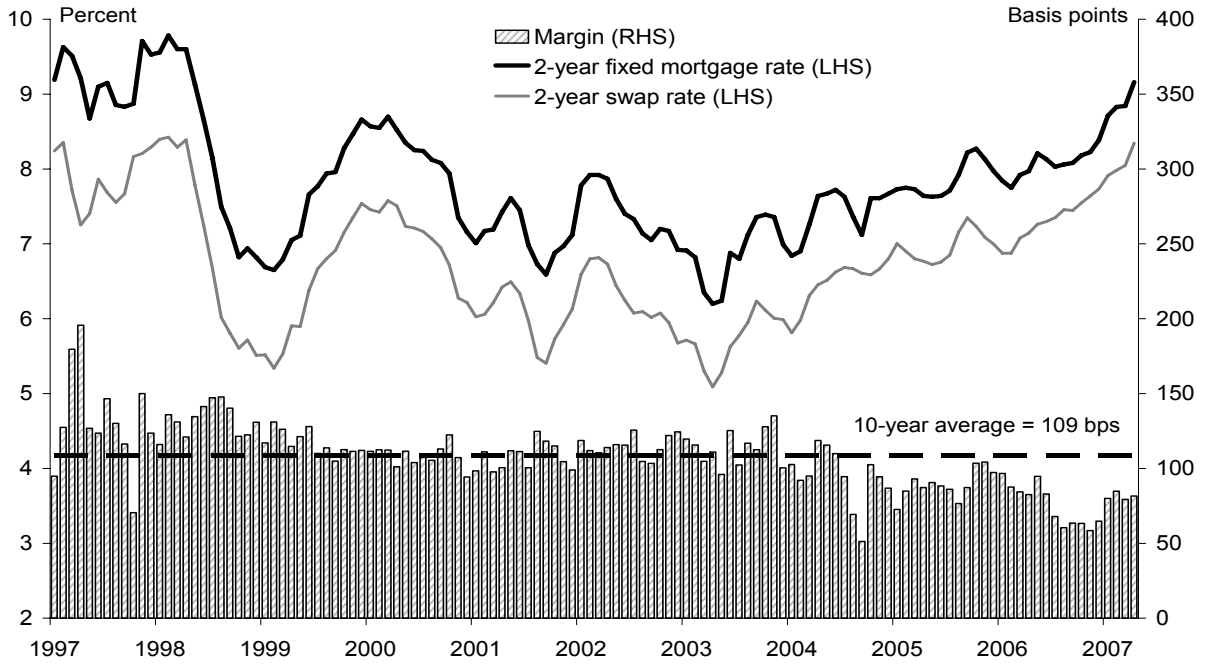


Note: off-diagonal "out of synch" effects are not symmetric.

Another factor exerting a downward influence on fixed-term mortgage interest rates during the current tightening cycle has been strong competitive behaviour amongst the domestic

commercial banks. Competition for market share in fixed rate mortgages has led to compressed lending margins (this is illustrated with regard to 2-year rates in the chart below). This helped mortgage rates stay closer to the level of wholesale interest rates than would have otherwise been the case.

Margins on 2-year fixed mortgages



Our experience with recent developments in the transmission of the OCR to retail borrowing rates suggests three lessons for policy-making in NZ:

- The changing behaviour of borrowers in response to the shape of the yield curve has meant the Bank has had to pull longer and harder on the policy lever to achieve a material tightening in financial conditions. With a greater proportion of fixed rate mortgages, there may be considerable lags involved in delivering relief to the economy during an easing cycle. Lags involved in the transmission of the OCR to the effective mortgage rate now depend on the schedule of mortgage re-pricing; that is, when tranches of fixed rate mortgages mature and are re-negotiated at a new interest rate.[102]
- Expectations are arguably as important as, if not more important than, actual policy moves in managing the shape of the yield curve. The next two sections cover some examples of how we analyse future expectations, using both quantitative and qualitative tools.
- Though the lags in the transmission of policy through the interest rate channel have been longer than in previous cycles, the Bank has had substantial impact on borrowing costs, and in particular the effective mortgage rate. As existing and new borrowers take on mortgages at higher interest rates, the effective mortgage rate is likely to continue to increase, which suggests there is further interest rate pressure in the pipeline.[103]

[102] Researchers at the RBNZ are working on incorporating a "mortgage agent" into a new Dynamic Stochastic General Equilibrium macroeconomic model.

[103] Recent pipeline interest rate pressures are fully discussed in the June 2007 *Monetary Policy Statement* (MPS), pages 20 to 22.

4. Interpreting implied policy rate expectations

Understanding market expectations of future policy is important for any central bank. In NZ, understanding money market policy expectations and how they are transmitted through the yield curve to longer-term capital markets is critical to effective monetary policy, as illustrated in the previous section. Affecting the economy through the interest rate channel requires the management of market expectations so as to influence interest rates beyond the 2-year horizon to as great an extent as possible, given the exogenous impact of global interest rates.

Money market expectations of future policy in NZ can be estimated for around 12 months ahead, and are most accurately measured over the next three or four decisions, given that money markets are most liquid over this horizon. At the RBNZ, we estimate policy expectations using both Overnight Indexed Swaps (OIS) and bank bill futures. OIS expectations models are our preferred method given that rates in the OIS market give a "cleaner" read on markets' expectations regarding the policy rate itself. This is because of the smaller term premium embedded in OIS yields relative to other money market instruments.[104] The OIS instrument is a relative newcomer to NZ markets, having been first traded in 2002, but volumes and liquidity have rapidly expanded in this market over the last five years.[105] In terms of monetary operations, the OIS market is used to derive the reference rates from which Domestic Market operations are conducted.

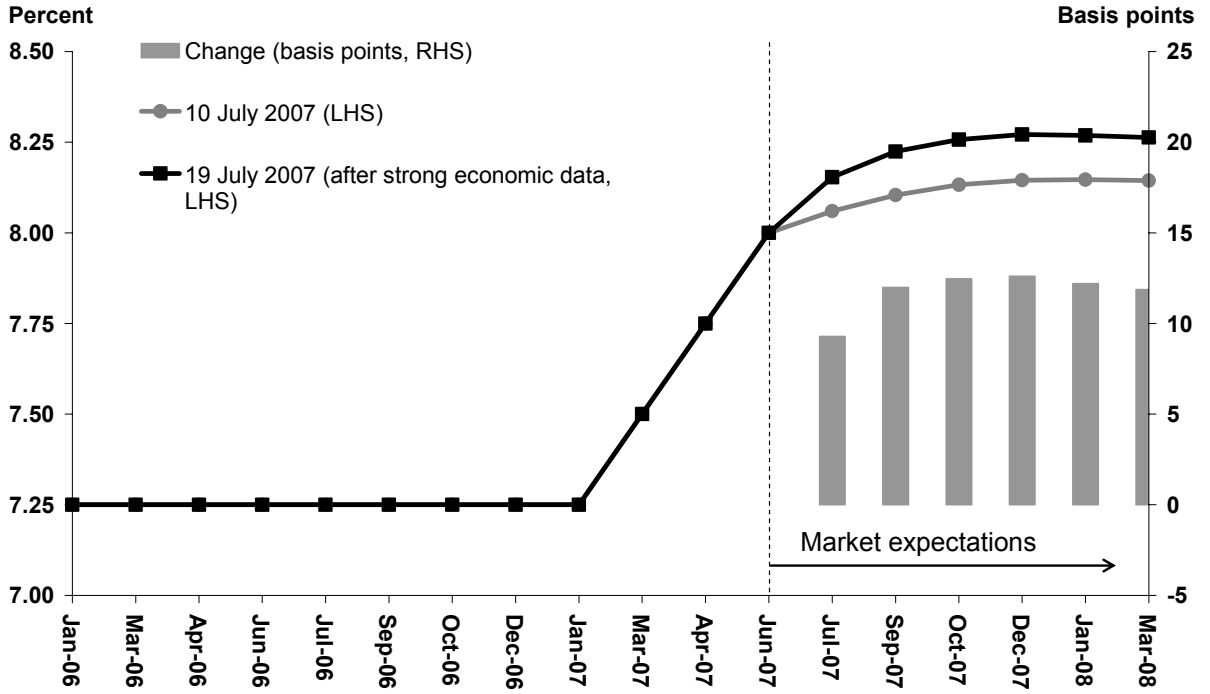
The chart below illustrates an example of OIS implied market expectations before and after recent stronger than expected economic (retail sales and CPI) data. At the time, markets had moved from pricing in a 30 percent chance of a 25 basis point rate rise in July, to pricing in a 70 percent chance. Further out, markets had fully priced in an 8.25 percent OCR by September.

[104] For further information on OIS markets see Choy, WK (2003), "Introducing overnight indexed swaps", *Reserve Bank of New Zealand Bulletin*.

[105] Deep and liquid OIS markets exist in a number of countries. We regularly estimate OIS policy rate expectations models for NZ and several other economies including the US, the eurozone, Japan, the UK, Canada and Australia. Overseas policy expectations are used to build our interpretation of how markets view monetary policy and macroeconomic developments in these economies, and our assessment of future global interest rate movements.

Market expectations of the Official Cash Rate

Based on OIS rates, without a term premium



Regarding near-term policy expectations, our market intelligence aims to understand the reasons why markets move on a particular piece of economic data (or other event), and what the distribution of market expectations, or the risks, around current market pricing are. In the example above, market contacts pointed to a strong rise in non-tradable inflation as likely to have been of particular concern to the Bank. Risks had shifted toward the likelihood of an OCR increase in July, and over the following days, as markets digested the stronger data, market sentiment became more skewed toward a rate increase. Individual market participant views tended to be broadly similar, suggesting a reasonably narrow distribution of expectations around market pricing.

However, money market models of implied expectations in NZ are generally only useful over a horizon of up to 12 months. We use implied forward rates from models of the full yield curve, those of Nelson and Siegel (NS), and Svensson,[106] to analyse longer-term market expectations. While there is a plethora of complex models, NS is more parsimonious, and imposes a lower requirement on data. This is important for modelling the NZ commercial bank liability curve as there are relatively few data points on the yield curve with which to estimate the model.[107]

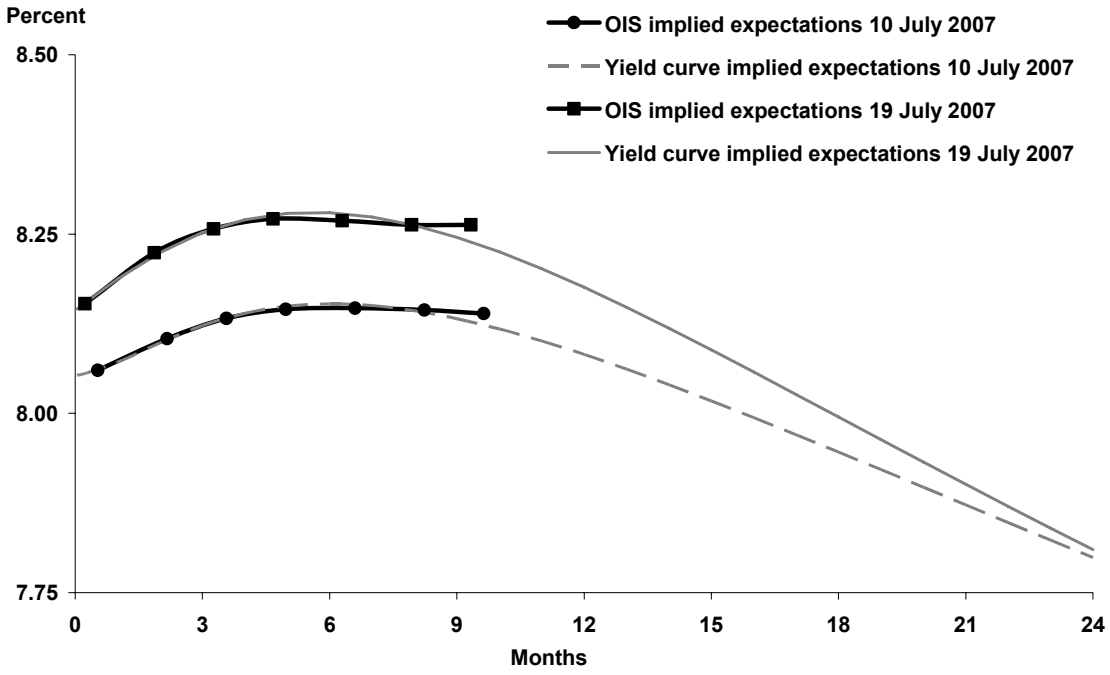
The chart below shows that interest rate expectations implied by the NS model increased over most of the 2-year horizon ahead in response to the stronger than expected data mentioned above. Expectations regarding the length of time before the chance of a rate reduction also lengthened.

[106] See Nelson, CR and AF Siegel (1985), "Parsimonious modelling of yield curves for US Treasury bills", *NBER Working Paper Series*, no 1594, and Svensson, LEO (1994), "Estimating and interpreting forward interest rates: Sweden 1992-4", *NBER Working Paper Series*, no 4871.

[107] Using the commercial bank liability curve to estimate the yield curve means that a risk premium must be subtracted from the implied overnight forward curve so that this can be interpreted as a policy rate expectation curve.

Yield curve implied Official Cash Rate expectations

Using OIS and the NS model with an estimated risk adjustment



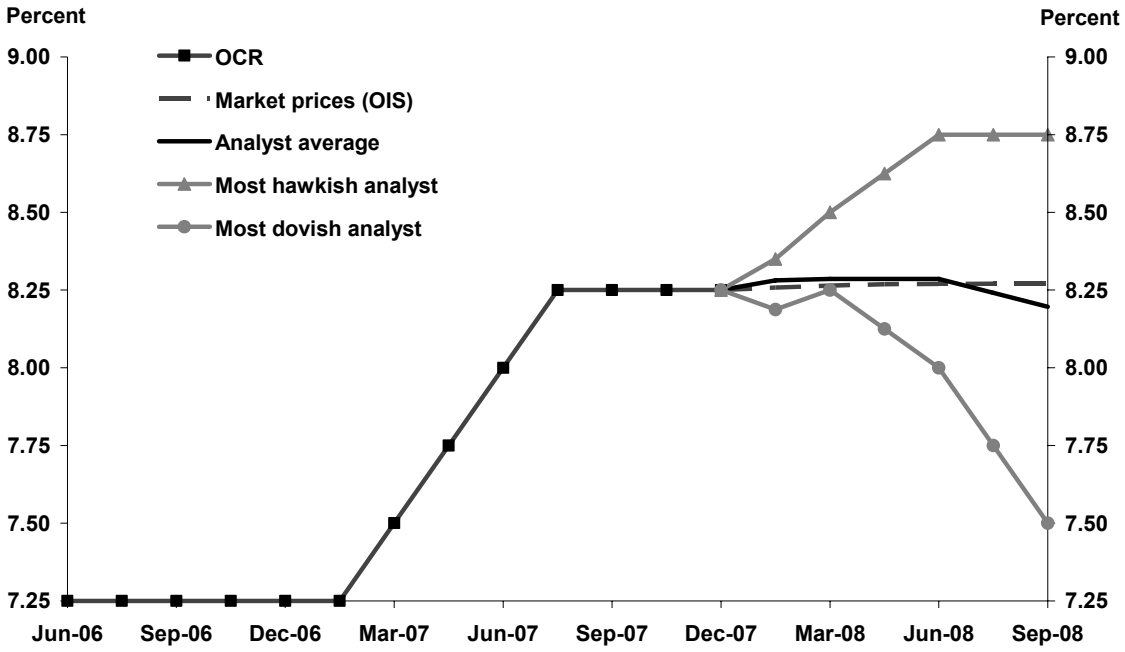
Models such as NS describe the yield curve in terms of three broad components – slope, curvature and long-run (or asymptotic) level. Recent research in the macro-finance literature suggests that most of the information in yield curves can be summarised by models that represent the curve using these three factors.[108] For market intelligence purposes, these three factors are useful and intuitive given that trades commonly made by market participants are based on views around level, slope and curvature.

Another way of considering a distribution of expectations around implied market pricing is to look at survey data on analyst forecasts (see the chart below). These forecasts can differ substantially from market pricing, so they are usually compared and contrasted with market pricing. In the example below, both the median of analyst forecasts and market prices were revised up substantially following the stronger data.

[108] There is a growing literature in this area in which yield curve models are joined with small macroeconomic models. See, for example, Ang, A and M Piazzesi (2003), "A No-Arbitrage Vector Autoregression of Term Structure Dynamics with Macroeconomic and Latent Variables", *Journal of Monetary Economics*, 50, 745–787.

The range of analyst forecasts for the Official Cash Rate

Reuters survey of analysts and market prices, 6 December 2007

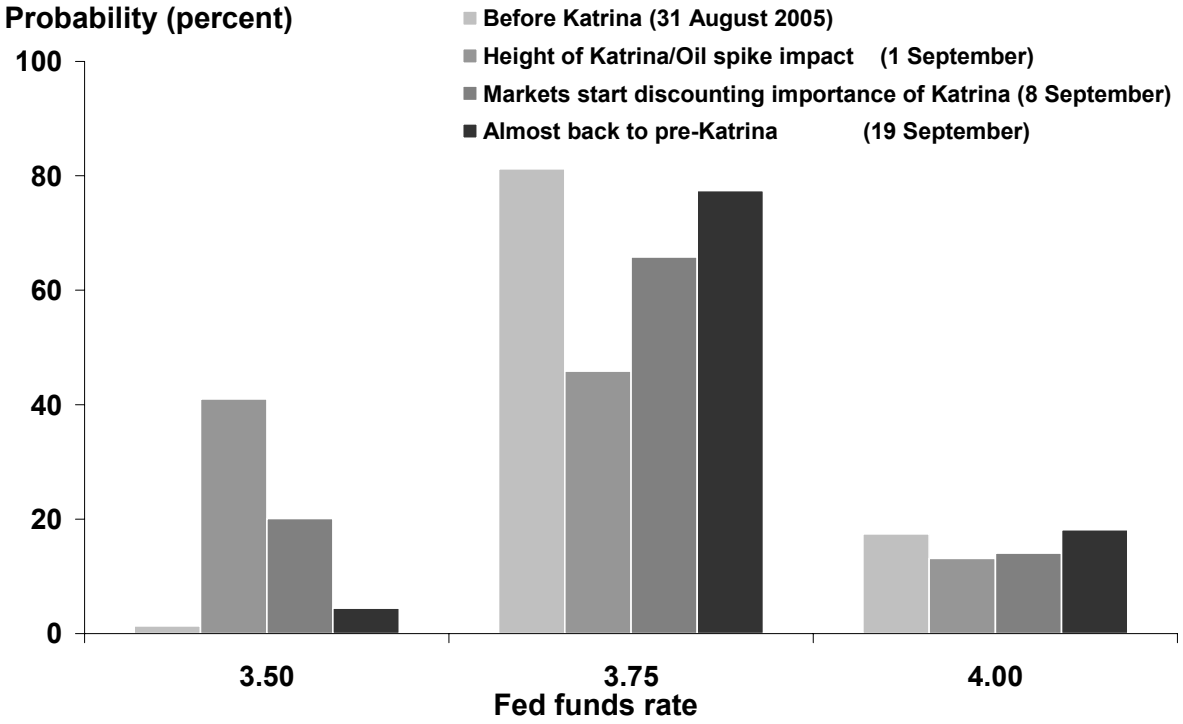


In markets where exchange-traded options on money market instruments exist, it may be possible to estimate a distribution of market expectations for upcoming policy decisions direct from options prices. An example is expectations regarding US Federal Reserve policy.[109] A distribution of future policy expectations is particularly useful for understanding market pricing when there is substantial uncertainty in markets over the future course of policy, or market expectations are skewed. Of course, the mean of the distribution should equal the point estimates implied by models of expectations that use OIS or futures rates. The example below shows an estimate of the distribution of Fed funds futures before and after Hurricane Katrina and the associated oil price spike that created uncertainty in market expectations of future Fed policy. We regularly use a variety of expectations models, including the Fed funds options model shown below, to assist in building a market-based interpretation of economic developments in several of the major global economies.

[109] A model proposed recently by researchers at the Federal Reserve Bank of Cleveland provides a tractable method of extracting a distribution of expectations on future Fed funds decisions using the prices of options on Fed funds futures. See Carlson, JB, BR Craig and WR Melick (2005), "Recovering Market Expectations of FOMC Rate Changes with Options on Federal Funds Futures", *Working Paper 05/07*, Federal Reserve Bank of Cleveland.

Fed funds rate, September FOMC – distribution of market expectations

Implied by the prices of options on the September 05 Fed funds futures contract



5. Market expectations and reactions survey

Ahead of each policy announcement,[110] we conduct a tactical survey of traders on the market's expectations regarding the policy announcement, and likely reactions to market-generated hypothetical scenarios around the policy decision and accompanying statement. These scenarios are based on what markets see as "least market reaction", "plausible dovish", and "plausible hawkish" policy announcements.

The purpose of the survey is twofold: (i) to inform the Bank on how to frame and communicate policy in a way that will be credible to markets, accurately convey the Bank's policy assessment, and achieve desired market pricing around the policy outlook; and (ii) to guide the Bank as to what market pricing the announcement can and cannot achieve.

The market-generated hypothetical scenarios are not intended to be prescriptive, but are intended to be informative in the policy development and communication process. As Blinder[111] notes, "*Should central bankers listen to the markets? Yes, in the sense that we should all listen to news broadcasts; but not in the sense that children should listen to their mothers*". Armed with an understanding of the distribution of views around current market pricing, the Bank can interpret how markets are likely to react to the "news" component of the policy announcement. If the announcement is likely to surprise the market, the survey

[110] OCR decisions in March, June, September and December are accompanied by a press conference and a Monetary Policy Statement that includes a brief policy assessment and four chapters of commentary, analysis and projections. OCR Reviews in January, April, July and October are released as an interest rate decision and brief policy assessment only, by newswire.

[111] Blinder, AS (2006), "Monetary policy today: sixteen questions and about twelve answers", *Central Banks in the 21st Century*, Bank of Spain.

provides the information on which to base an interpretation of by how much and in what direction interest rates and the NZ dollar will move.

The survey itself is conducted by telephone[112] or email, and focuses on four areas:

- What OCR expectation is priced in by the market for the next and future OCR announcement dates?
- What OCR decision and statement would generate the least market reaction, and if some market reaction is unavoidable under that scenario, what would it be?
- What OCR decision and statement would constitute a plausible hawkish scenario under which market interest rates would increase? How would interest rates react across the yield curve, and how would currency markets react?
- What OCR decision and statement would constitute a plausible dovish scenario under which market interest rates would decrease? How would interest rates react across the yield curve, and how would currency markets react?

Under each hypothetical scenario, we distil how markets expect the Bank to: (i) view recent economic data; (ii) express its key concerns going forward; and (iii) express its policy outlook. In doing so, we also build a profile of what kind of participants are active in NZ interest rate and currency markets, of their views and positioning, and of whether market views across types of participant are concentrated, broadly dispersed or polarised. The table below provides a hypothetical example of the qualitative survey results.[113]

Stylised example: how traders characterise a hawkish, least market reaction, and dovish announcement

Hawkish	Least market reaction	Dovish
Raise the OCR by 25 basis points and suggest that "further tightening is *likely*".	**Raise the OCR by 25 basis points and suggest that "further tightening *cannot be ruled out*".**	**Leave the OCR unchanged, and note that "while some upside risks remain, recent increases in the OCR are likely to dampen domestic demand sufficiently".**
Here we provide phrases which traders would expect to see in a statement consistent with the hawkish scenario, and which would trigger market interest rates to increase in line with the estimates in the next chart.	**Here we provide phrases which traders would expect to see in a statement consistent with the least market reaction scenario, having the impact on interest rates in line with the estimates in the next chart.**	**Here we provide phrases which traders would expect to see in a statement consistent with the dovish scenario, and which would trigger a decrease in market interest rates in line with the estimates in the next chart.**

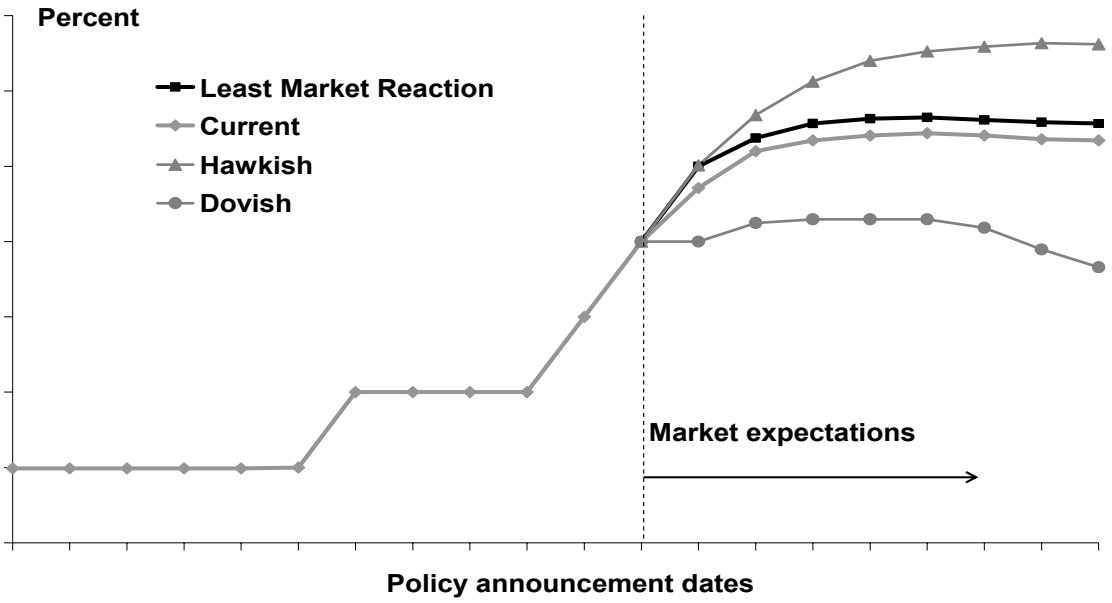
We also interpret traders' quantitative estimates of currency, money and capital markets' reactions to the three hypothetical policy scenarios, and represent these graphically (see the chart below). Combined with traders' perceived likelihood of these scenarios, these estimates give the Bank a distribution of views around current market pricing.

[112] Respondent institutions are selected to provide a representative sample of significant or price-making participants in the money markets (primarily bank bill futures and OIS), and the wholesale capital market (interest rate swaps). The survey is aimed at ascertaining traders' views of the expectations in these markets, and as such, respondent individuals are usually either traders or asset managers with direct participation in the markets of interest. To incorporate the views of currency market participants, NZ dollar traders are also included.

[113] To foster open communication with traders, individual responses to the survey are confidential, and are not included in the report prepared on the survey results.

A stylised version of traders' impression of the likely market reaction to the OCR scenarios[114]

OCR expectations based on OIS rates, without a term premium



Of course, there are potentially significant communications risks inherent in conducting the survey and having detailed discussions with market participants in close proximity to an interest rate decision. These risks are mitigated in several ways. We interview experienced market professionals with whom we maintain long-standing relationships. These respondents are well informed on the context and purpose of the survey, and the questions we ask the respondents follow the same four key areas in each survey.

6. Incorporating market information into macroeconomic modelling

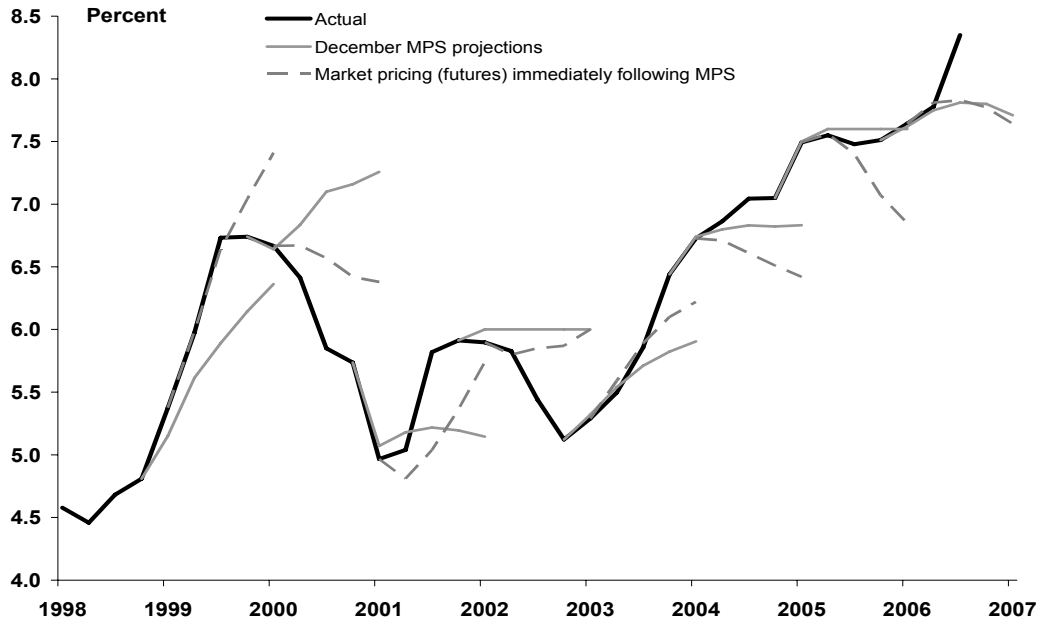
Standard macroeconomic models used for monetary policy analysis incorporate quantitative financial market variables – usually a short-term and a long-term interest rate, an exchange rate, economically important commodity prices and a domestic equity market index. Some models incorporate implied quantitative information such as policy rate expectations or risk premia. Given the richness of quantitative and qualitative information that can potentially be obtained from financial markets, standard macroeconomic models incorporate only a limited amount directly. However, the process around the use of monetary policy models in central banks often incorporates a great deal of financial market information.

In the model used at the RBNZ, key financial market variables include the 90-day bank bill rate, the yield on 5-year interest rate swaps, the NZ Trade Weighted Index (TWI, representing the exchange rate), foreign interest rates, and several commodity prices. Most of these variables are largely exogenous to the model, the exception being the 90-day interest rate projection. The RBNZ model differs from most models used by central banks, which take the path of short-term interest rates as exogenous, as a constant, or as implied by money market interest rates.

[114] This is a stylised mock-up of the chart in which we provide quantitative estimates of the market reactions to each scenario, and does not resemble the outcome of an actual survey, or the RBNZ OCR.

Our 90-day interest rate projection for three years forward is disclosed to markets in the MPS, and reflects the interest rate path needed to maintain inflation within the target band over the policy horizon, based on the information available and the Bank's current views of the economic and inflation outlook. The interest rate track can be market moving information if the projection differs from market expectations, to the extent that traders interpret the projection as suggestive of the Bank's policy bias. During the policy process, the 90-day interest rate projection is compared with market interest rates and policy expectations. This provides an understanding of how the model deviates from current market pricing, and a measure of how the MPS may surprise markets. Following the MPS release, we observe the market reaction to interpret the extent to which market pricing has been influenced by the announcement, and the degree of consistency between market prices and the projected short-term interest rate. The chart below shows the 90-day interest rate projection compared with the bank bill futures pricing immediately following the policy announcement for each December MPS from 1998 to 2006.

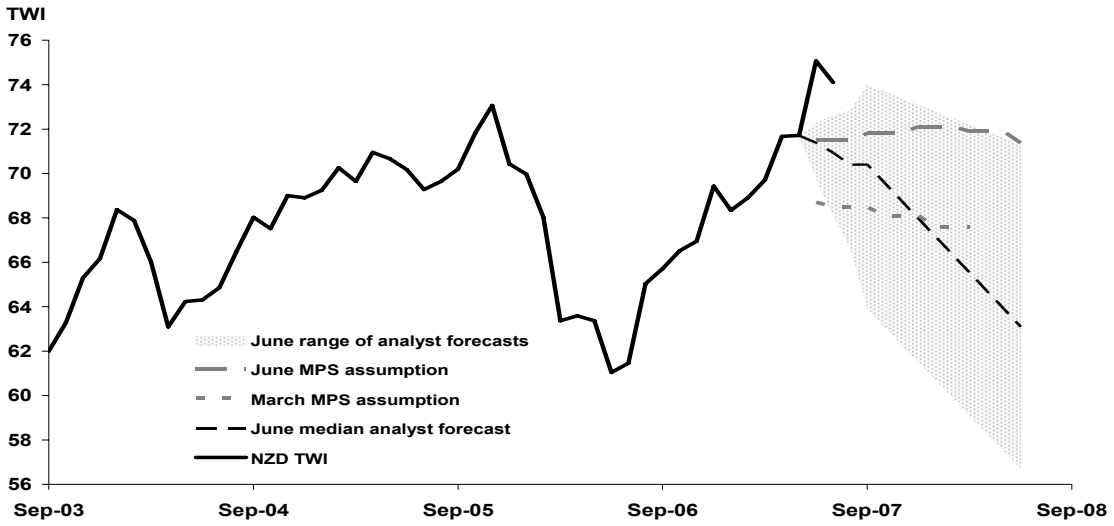
Market pricing and the projected 90-day interest rate



We also use the endogenous interest rate projections within the model to quantify the relative impact on inflation pressures emanating from new economic information received since the previous forecast round. This serves as a useful tool for focusing the MPC's discussion on the most significant developments. The market reaction to these surprises, that is the change in implied policy rate expectations, provides a cross-check against the model's interpretation of the marginal effect of each piece of data on the policy and inflation outlook.

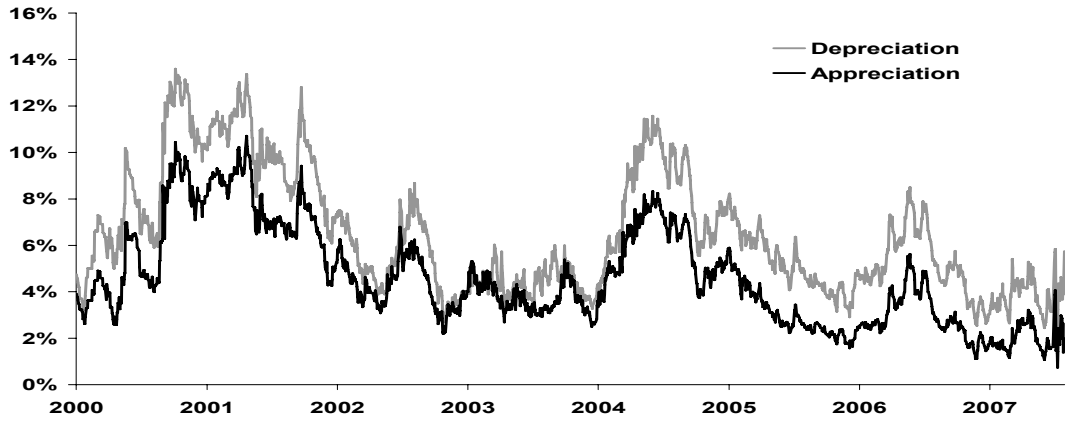
An important exogenous variable in the model is the trade-weighted exchange rate. Although the specification of the future TWI path is a technical assumption, it often garners much attention from market participants. Accordingly, it is important to understand this assumption in the context of market expectations. We compare the assumed path of the TWI with analyst expectations (see the chart below).

Analyst forecasts of the TWI and the June MPS assumption



Another way to evaluate our foreign exchange rate assumption is to compare it with options implied market expectations. Unfortunately we cannot do this for the TWI itself, as the index is not actively traded in over-the-counter options markets. However, we can analyse options implied market expectations of the largest component of the TWI, the NZ dollar/US dollar exchange rate. We estimate risk neutral probability density functions[115] as a guide to the distribution of currency expectations around current spot and forward exchange rates.[116] The chart below shows the probability of a 10 percent appreciation or depreciation in three months time relative to the three month forward NZD/USD exchange rate.

Probability of a 10 percent move in the NZD/USD exchange rate in 3 months



Beyond the financial market variables that enter the RBNZ model directly, financial market information is used to: (i) set the context within which the modelling of global and domestic

[115] Risk neutral probability distributions are considered consistent with observed market prices under the assumption that market agents are risk neutral. Risk aversion means that the options implied distributions deviate from the "true" probability distribution that market participants attach to different outcomes of the underlying asset's price because options implied expectations also reflect risk-taking preferences.

[116] Noting that forward foreign exchange rates reflect interest rate differentials between the two currencies, and given persistently positive NZ-US interest rate differentials, the NZD/USD forward rate is likely to be biased toward depreciation relative to "true" expectations.

macroeconomic conditions is discussed at MPC meetings; (ii) guide and cross-check the assumptions made in macroeconomic modelling; (iii) cross-check the projections derived from the model; (iv) highlight and guide the evaluation of discrepancies between the projections and market expectations; and (v) guide understanding of the risks around the projections. As Hildebrand notes, "*Financial variables may contain information that can contribute to the projection or they may raise questions about the projection*".[117] While assumptions and projections may not necessarily be intended to reflect market or analyst expectations, discrepancies between market expectations and model variables are examined closely in the monetary policy process.

Conclusion

While there is a great deal that can be achieved with desk-based financial market research, we believe market intelligence involving direct contact with market participants through strong long-term relationships adds an invaluable dimension to our analysis. In our experience, the benefits of a dedicated team of market analysts with direct market contact lie in the ability to incorporate well structured analysis and interpretation of market developments, via rigorous economic and financial frameworks, into monetary policy formulation.

A constant challenge in market surveillance is to ensure analysis remains focused on gaining strong insights into the activity and functioning of markets. We need to discover and communicate the essence and motivation of flows and positioning undertaken by the various market players, as opposed to merely reporting market movements and reaction to economic releases. We continue to broaden and deepen our experience in this area, mainly by extending and strengthening our relationships with market participants; further developing our quantitative tools for analysing yield curves, market expectations of policy rates and other economic/financial variables, and risk premia; adding to our information resources by extending market surveys and obtaining more information via the settlement and depository systems we operate; and improving information flows from other parts of the Bank.

[117] Hildebrand, Philipp M (2006), *Monetary Policy and Financial Markets*, Swiss National Bank.

Equity prices as leading indicators: the Asian experience

Kenneth N Kuttner

Introduction

Formulating monetary policy inevitably requires making predictions about the economy. This has become increasingly true as central banks have moved away from policies based on the management of intermediate targets (e.g., money or exchange rates) and toward frameworks defined in terms of the ultimate policy objectives (i.e., output and inflation targets), using indicators or information variables to guide policy toward those objectives.[118] This shift is most explicit in inflation targeting (IT) regimes since, as emphasized by Svensson (1997), forecasts of output and inflation are essential ingredients in the implementation of IT – and publishing those forecasts is *de rigueur* for inflation targeters. While less explicit, economic forecasts are also central to the policy process of central banks that do not formally adhere to IT, such as the US Federal Reserve.

With monetary policy becoming increasingly forecast-based, the search for useful leading economic indicators has intensified. Much attention has been focused on the prices of assets such as stocks and bonds – including a variety of indicators derived from bond yields, such as the slope of the yield curve and risk spreads. There are good reasons to seek to extract information from asset prices: to the extent that they are forward-looking, they will reflect new information before it becomes incorporated into the macro data.

The focus of this paper is on the price of equities, which, in the case of the United States, has been seen as an important, but somewhat unreliable, leading indicator. While the stock price is included in the index of leading economic indicators published by the Conference Board, econometric analyses, such as those of Stock and Watson (1989, 2001), suggest it is not particularly helpful in out-of-sample forecasting exercises.[119] In recent years, however, stock market movements in the United States appear to have tracked macroeconomic fluctuations relatively closely, raising the possibility of a closer connection between the two. In particular, the boom of the late 1990s, the recession of 2001, and the period of robust growth that began in 2004 all appear to have been led by a corresponding movement in stock prices – and, at least until interrupted by the late-summer subprime mortgage crisis in the United States, record stock market gains seemed to point to continued economic expansion.

Similar observations could be made about equity prices among emerging market economies in Asia, where the spectacular gains enjoyed since 1998 (following the even more spectacular losses during the financial crises of 1997–98) have coincided with a period of rapid economic expansion. As shown in Figure 1, stock prices in much of emerging Asia have recovered most of the ground lost in 1997–98, with Korean equity prices even surpassing their previous peak. Stock prices have risen especially rapidly since 2003, even in Indonesia and the Philippines, where equity markets were very slow to recover from the crisis.

Indeed, the sharp rise in stock prices has been viewed with alarm by some observers. One oft-stated fear is that the surge in the price of equities (and other assets, such as real estate)

[118] See Friedman (1990) for a thorough review of the targets, instruments, and indicators of monetary policy.

[119] An old joke among forecasters is that "stock prices have successfully forecast eight of the past five recessions".

has been driven by some combination of over-borrowing and "excess liquidity" in the financial system, and that these factors will eventually contribute to another financial crisis. Collyns and Senhadji (2002), among others, have documented how such a process contributed to the crisis of 1997.

Against this background, the purpose of this paper is to investigate the information content of equity prices for a set of Asian economies. The primary focus of the analysis will be on the forecasting power of stock prices for real output growth and inflation. A secondary goal will be to determine the extent to which increases in equity prices (including the most recent rise) can be interpreted as a symptom of "excess liquidity".

The scope of the paper is intentionally narrow. It does not claim to be a systematic analysis of *all* plausible financial leading indicators, along the lines of Stock and Watson (2001). Conspicuously absent, for example, are long-term interest rates (or the yield spread), which have been found to be highly informative in the US context.[120] With liquid long-term bond markets a relatively recent development in many countries, however, data limitations preclude a rigorous quantitative analysis of indicators such as the yield spread.[121] Nor does the paper address the question of whether the monetary authority should respond to asset price fluctuations, independent of those fluctuations' implications for future macroeconomic outcomes.[122]

In its motivation and objectives, this paper is most similar to that of Mauro (1989), which examined the forecasting properties of equity prices for a large group of both developing and developed economies. There are a number of important differences, however: the present paper uses more recent data and focuses specifically on the emerging Asian experience, including two countries (Thailand and Indonesia) that did not appear in Mauro's analysis. Other differences are the inclusion in this paper of other financial indicators (such as interest rates and monetary aggregates), an analysis of stock prices' predictive power with respect to inflation, and an assessment of out-of-sample forecasting performance. In addition, this paper also examines the possible importance of "liquidity" growth in explaining stock price appreciation. A number of recent papers have examined this hypothesis in other contexts, including Baks and Kramer (1999), Gouteron and Szpiro (2005), and Rüffer and Stracca (2006).

To preview: the findings presented in section 1 show that stock prices *are* a reasonably good leading indicator for real output growth for Malaysia and Korea, and to a slightly lesser extent, Thailand. The improvement in out-of-sample forecasting performance is marginal, however, even in those countries where the in-sample relationship is strong. An analogous set of results is presented for inflation in section 2, the main conclusion of which is that stock prices contain virtually no information relevant for predicting inflation. Section 3 explores the connection between "liquidity" and stock prices. No evidence of a connection (at least in a forecasting sense) between "liquidity" and stock price fluctuations emerges from the analysis; nor is there a connection between (a proxy for) "excess *global* liquidity" and output or stock prices. In Korea and Malaysia, there has been a tendency for stock price changes to precede changes in liquidity, defined as narrow monetary aggregates – but this may reflect the effects of stabilization policy during the 1997–98 period.

[120] See, for example, Estrella and Hardouvelis (1991).

[121] The Bank for International Settlements (2006) recently published a comprehensive overview of the development of bond markets in Asia.

[122] A large and still somewhat unsettled literature has grown up around this question: see, for example, Bernanke and Gertler (1999), and its rejoinders.

1. Stock prices and real output

Aside from their visibility and availability, there are several scenarios in which equity prices might contain information that would be useful, in the context of a simple macroeconomic model, for forecasting real output. First, an increase in (expected future) productivity (e.g., from a favorable supply shock) would tend to increase the stock price and output. Second, as discussed in more detail below, policy-induced interest rate reductions will, at least over some horizon, tend to increase (expected future) profits, while reducing the discount rate applied to those earnings; both will raise equity values, while the rate reduction itself will lead to an expansion in output. Third, equity prices should also contain information about other, non-monetary demand shocks, such as fiscal policy – but because the effect of the interest rate on equity values would work in the opposite direction from the profit effect, the *net* impact is *a priori* ambiguous. A particularly attractive feature of equity prices (as well as other indicators based on prices determined in financial markets) is that they are *forward-looking*, and incorporate information about fundamental shocks well before they have an effect on macroeconomic prices or quantities. This property may be especially useful in an emerging market context, where timely macroeconomic data are often not available.

The baseline analysis involves quarterly data for real output and a measure of equity prices. Industrial production (or alternatively, manufacturing output) is used as the gauge of real output. (Ideally, it would be desirable to use a broader measure of output, but the availability of real GDP data is more limited.) The MSCI/Barra country index is used as the gauge of stock prices. Also included in the analysis are a number of additional indicators: the exchange rate, the short-term interest rate, and various measures of money or credit (i.e., "liquidity"). Except for the stock price, all national data are available from the International Monetary Fund's International Financial Statistics (IFS). However, in some cases a longer or more complete time series was available directly from national sources, such as central banks. The series for global liquidity is that of Rüffer and Stracca (2006), and was obtained directly from the authors. A complete description of data sources can be found in the Appendix to this paper.

The analysis of emerging market data can present certain challenges, and the present exercise is no exception. One common problem is that many of the series – especially industrial production and the monetary aggregates – are characterized by jumps or discontinuities introduced by methodological or definitional changes. Fortunately, such discontinuities are relatively easy to detect (many are flagged in the IFS database) and correct using suitable level adjustments. In the case of Indonesia, several observations on industrial production from 1997 and 1999–2000 are simply missing, and there is no alternative but to leave these as missing values. Data availability is also an issue. In this case, the main constraint is the MSCI stock price series, which begin in December of 1987.

Figure 2 plots the four-quarter growth rates (in percentage terms) of equity prices and output for the five Asian economies covered by the analysis, plus the United States. The plots reveal a number of interesting patterns, and also some important differences across countries. Perhaps most notable is the strong co-movement between stock price and output fluctuations in Korea, Malaysia, and Thailand. (In annual data, the contemporaneous correlations of log differences are 0.40 and 0.55 for Korea and Thailand, but only 0.12 for Malaysia.) The high degree of correlation in these countries contrasts with the much weaker relationship observed for Indonesia and the Philippines, where the correlation coefficients are only 0.19 and −0.07. The US data make for an interesting comparison: here, the link between output and stock prices appears quite strong during some episodes, such as the 2001 recession, but markedly less so in others. Overall, the correlation coefficient is 0.38.

A high degree of correlation is not sufficient to make the stock price an informative leading indicator, of course. The crucial additional requirement is that stock price movements *precede* output fluctuations. Although this is a rather subtle feature to discern from the plots, the link between the two series seems to be nearly contemporaneous for the three countries

in which a strong correlation is observed. In Korea and Malaysia, there do appear to be some instances in which the stock price leads output by a few months; however, comparable episodes are not evident in the Thai data. Again, a comparison with the United States is revealing: here, sharp stock price movements clearly signaled many of the turning points of the 1970s and 1980s with a lead of many months. Stock prices failed to anticipate the 2001 recession, however, and the overall level of equity prices did not decline significantly until the downturn was already underway.

Forecasting regressions are a simple but useful tool for gauging the information content of leading indicators, such as stock prices. The baseline regression used to assess the predictive power of equity prices is

$$\Delta y_t = \alpha + \sum_{i=1}^{4} \beta_i \Delta y_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta s_{t-i} + \sum_{i=2}^{4} \delta_i q_{i,t} + e_t \quad (1)$$

where y is the log of real output, s is the log of the equity price index (deflated by the consumer price index), and the q_i are quarterly dummies included to capture the strong pattern present in many of the series, particularly real output. Since equation (1) corresponds to the output equation from a bivariate vector autoregression (VAR), tests for the exclusion of the Δs terms can be interpreted as tests for Granger causality from stock prices to output.[123]

Specifications similar to (1) which are commonly used in forecasting applications implicitly incorporate important assumptions about the series' time series properties. Specifically, it is assumed that the logs of real output and the real stock price are both integrated of order 1, and that the two series are not cointegrated. If the data were trend stationary, first differencing would produce a misspecified model whose forecasting performance would be impaired by the failure to incorporate trend reversion. Similarly, if a cointegrating relationship existed between the variables, forecasting performance would be improved by the inclusion of an error correction term.

Fortunately, a preliminary analysis of the data shows that difference stationarity is an appropriate assumption for industrial production and stock prices: only for Korean industrial production does the Augmented Dickey-Fuller test reject the null of non-stationarity. (As noted below, however, using linearly detrended industrial production for Korea dos not alter the results.) Engle-Granger cointegration tests similarly fail to reject the null of no cointegration between the two variables. Thus, the differenced specification (1) is reasonably appropriate for the data used in the analysis.

In assessing the information content of stock prices at a slightly longer horizon, a similar equation was used to forecast four-quarter-ahead output growth as a function of lagged four-quarter output growth, and the *one-quarter* change in the stock price,

$$\Delta_4 y_t \equiv y_t - y_{t-4} = \alpha + \beta \Delta_4 y_{t-4} + \gamma \Delta s_{t-4} + e_t . \quad (2)$$

Note that both specifications assume output and the price level are integrated of order one, and neither incorporates the possibility of cointegration between (the levels of) real stock prices and real output.

The results from estimating equations (1) and (2) for each of the five Asian economies, plus the United States, are given in Table 3. The results generally confirm the impressions gleaned from Figure 2: at least on an in-sample basis, stock prices have a great deal of predictive power for real output in Korea and Malaysia, and to a slightly lesser extent, in Thailand.[124] For all three of these countries, the sum of the four γ_i coefficients in (1) is highly

[123] By reducing the amount of idiosyncratic "noise" inevitably present in any one indicator, factor methods, such as that proposed by Stock and Watson (2002), and used by English et al. (2005), could be useful.

[124] In the case of Korea, using detrended industrial production instead of its growth rate yields very similar results: the stock price coefficients are jointly significant at the 5 percent level, and the coefficient in the four-quarter-ahead specification is significant at 1 percent.

significant, as is the sole γ in specification (2). (The estimates are reported in the top line of the table, and the associated p-values in italics on the second line.) Moreover, the estimated coefficients are consistent with an *economically* significant relationship, with a 10 percent downturn in stock prices implying a 1 to 2 percent decline in industrial production. For Thailand, the exclusion restriction is not rejected at the 10 percent level, suggesting a slightly less statistically robust relationship. Consistent with the plots in Figure 2, the γ stock price coefficients are statistically insignificant for the Philippines and Indonesia, regardless of which specification is used. The strong results for Korea and Malaysia are broadly consistent with those for the United States, where the stock price terms are highly significant in forecasting regressions estimated over the same sample period.[125]

Having established some degree of forecasting ability, for at least a subset of the countries being analyzed, a natural question to ask is whether stock prices have any *additional* predictive power over and above that contained in other financial indicators, such as interest rates or monetary aggregates. An answer in the affirmative would strengthen the case for using the stock price as an information variable for monetary policy, while an answer in the negative would indicate that using the alternative financial indicator (or indicators) is more informative.

A straightforward way to assess the marginal information content of equity prices is simply to include alternative indicators (represented by the variable *x*) in the two forecasting equations used above, resulting in

$$\Delta y_t = \alpha + \sum_{i=1}^{4} \beta_i \Delta y_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta s_{t-i} + \sum_{i=1}^{4} \theta_i x_{t-i} + \sum_{i=2}^{4} \delta_i q_{i,t} + e_t \quad (3)$$

and

$$\Delta_4 y_t = \alpha + \beta \Delta_4 y_{t-4} + \gamma \Delta s_{t-4} + \theta x_{t-4} + e_t \,. \quad (4)$$

As in Friedman and Kuttner (1992), the relevant test for marginal predictive power will be whether the γ coefficients remain significant once the *x* has been included. The set of candidate financial indicators considered in the analysis includes six variables: a real short-term interest rate (defined as the nominal interest rate, minus the inflation rate over the previous year), the depreciation of the real exchange rate (defined as the rate of change in the bilateral exchange rate vis-à-vis the United States, minus the rates of change in the respective consumer price indexes), and the rates of change in real reserve money, real narrow money, real broad money, and real credit. All rates of change are calculated as quarterly log differences.

The sums of the estimated γs from equation (3), and the F-statistics for their joint exclusion, appear in Table 4. (As before, the associated p-values appear in italics, below.) Although the table contains a proliferation of numbers, the basic message is quite simple: the inclusion of alternative financial variables does little to change the (in-sample) predictive power of stock prices. For Korea and Malaysia, the stock price remains highly significant regardless of which indicator is included in the forecasting regression. The Thai results are again slightly weaker, but the sum of the γs remains significant at the 5 percent level, except for the case in which narrow money is the competitor (and even then, the p-value is 0.056).[126] Similar results are obtained using the four-quarter-ahead regression (4) instead of (3), but for brevity, these estimates are not reported. The robust statistical significance of the γs suggests that stock

[125] The results are not qualitatively changed by the exclusion of the 1997–98 period of financial crisis, although the statistical significance is somewhat reduced. The possible impact of the crisis period on the results will be examined more closely below in the analysis of out-of-sample forecasting performance.

[126] The one unexpected result in the table is that, in the United States, the stock price is no longer significant when real credit is included.

prices contain information over and above that contained in other, commonly used financial indicators.

As is well known, good *in-sample* predictive power often fails to translate into an improvement in *out-of-sample* forecasts. Some examination of out-of-sample performance is therefore an essential step in determining any indicator's value in the policy process. The procedure used here to gauge that performance is similar to that used elsewhere, e.g., Stock and Watson (2001), and involves estimating the forecasting equation (2) up through some time period τ, and then calculating the forecast errors from period $\tau + k$ through the end of the sample.[127]

In order to address, in a limited way, the possible sensitivity of the results to the chosen estimation and forecasting periods, three different sets of dates are used. For the first exercise, the forecasting regression is estimated on data through 1996Q2 (i.e., the last observation forecast is output growth from 1996Q2 through 1997Q2), thus excluding the financial crisis that began in the fall of 1997. The forecast evaluation period in this first exercise begins with the 1996Q3 observation, and *includes* the crisis period. In the second exercise, the estimation end date and the forecast evaluation start date are both moved up to 1999Q4 and 2000Q1, respectively, so that the crisis period is included in the estimation, but not in the forecast evaluation. The third exercise excludes the crisis period entirely, with an estimation end date of 1996Q2 and a forecast evaluation start date of 2000Q1.[128]

The metric used to evaluate forecast performance is the standard one: the forecast root mean squared error (RMSE). In order to determine the value added of including the stock price in the forecasting equation, the forecast RMSE with the stock price included is compared to the RMSE of the forecast generated from (2) with the stock price omitted (i.e., with $\gamma = 0$): if including the stock price improves the out-of-sample forecasting performance, then the ratio of the former to the latter will be less than one.

The results from these forecasting exercises appear in Table 5. The key forecasting metric, the ratio of the RMSE from the model with the stock price to that without, is reported in the last column of the table. The second-to-last column gives the ratio of the RMSE from the model with the stock price to that from a naïve "no change" forecast, i.e., one in which next quarter's output growth rate is forecast to be the same as this quarter's.[129]

The main findings of these exercises are threefold. First, good in-sample predictive power does, to some extent, translate into an improvement in out-of-sample forecasting performance. Korea, Malaysia, and Thailand – the three countries for which the stock price entered the forecasting regressions significantly – all show a reduction in forecast RMSEs when the stock price is included. The same is true for the United States. By contrast, including the stock price fails to improve the output forecasts for either the Philippines or Indonesia.

The second conclusion to be drawn from these exercises is that the inclusion of the stock price yields a relatively modest reduction in forecast RMSE: the largest observed is a 7 percent improvement in the case of Malaysia, for the case in which the model is estimated on data through 1999Q4. This compares with a 12 percent improvement for the United States over the same period. In broad terms, these results are similar to those of Stock and

[127] Sometimes, the estimates are updated recursively over the forecast evaluation period, although that is not done in this paper's analysis.

[128] Gaps in the industrial production series limit analysis for Indonesia to an estimation period ending in 1996Q2, and a forecast evaluation period starting in 2001Q2.

[129] This ratio of forecast RMSEs is sometimes referred to as Theil's U statistic.

Watson (2001), who found that the inclusion of asset prices (such as stock prices) yielded only small forecasting improvements for the G7 countries.[130]

The third finding to emerge from this analysis is that, while the 1997–98 crisis period may have been unusually volatile, it is not anomalous in terms of the link between stock prices and output. This conclusion follows from the observation that including this period in the sample used to estimate the model leads to a pronounced improvement in forecasting performance over the 2000–05 period. Had the crisis been anomalous, in the sense of generating spurious shifts in the regression coefficients, its inclusion should have led to a deterioration in the forecasts, rather than an improvement.[131]

2. Stock prices and inflation

Theoretical links between stock prices and inflation are less direct and more complex than they are for stock prices and output. To the extent that a rise in the stock price signals a positive demand shock, one would expect such a rise to foretell higher inflation. Similarly, to the extent that stock price increases are fueled by "excess liquidity" (a question to be explored in section 3) that liquidity might also be expected to generate inflation. But if the underlying shock is on the *supply* side, then the impact on inflation would be precisely the opposite. At the same time, the conventional wisdom, reflecting a well-known empirical regularity (at least in the United States) is that inflation is bad for stocks.[132]

In the end, of course, the inflationary implications of stock price movements is an empirical question, and a methodology similar to the one used in section 1 can be used to assess the information content of these movements with regard to future inflation. The results presented in this section show that stock prices are even *less* informative for inflation than they are for real output. While this finding might disappoint a forecaster, it is at least consistent with the theoretical ambiguity sketched in the preceding paragraph.

The inflation and stock price fluctuations plotted in Figure reveal no consistent picture, although the 1997–98 financial crisis produced both a sharp drop in equity prices and a spike in the inflation rate. This pattern generates in a large, *negative* contemporaneous correlation between the two series in Korea, Thailand and Indonesia, where the coefficients are -0.39, -0.31, and -0.45.

Estimated forecasting equations analogous to those used for real output reveal any significant *predictive* power for stock prices with regard to inflation, however. As shown in Table 6, the stock price is generally insignificant in suitably modified equations (1) and (2) in which the output growth Δy has been replaced by the inflation rate π. The only exception is Malaysia, using specification (1), where the joint exclusion of the stock price terms is rejected. However, the small size and statistical insignificance of the sum of the coefficients, and the lack of a significant γ estimate in equation (2), all suggest that the rejection of the exclusion restriction may be spurious. In light of the weak results from the simple specifications involving only the stock price and inflation, there is little chance that expanded specifications with additional financial indicators would reveal a significant relationship – and this suspicion is confirmed by the (unreported) results from estimating suitably modified versions of (3) and (4).

[130] Interestingly, the stock price seems to have done a much better job of forecasting real output in the United States during this 2000–05 period than it did over the 1985–99 period analyzed in Stock and Watson (2001), where the comparable ratio of RMSEs is 2.06.

[131] A generic concern in this sort of analysis is that the measured forecasting power of stock prices can be quite sensitive to the choice of sample, as shown by Stock and Watson (2001) for the G7. Unfortunately, data constraints do not permit a comparably thorough sensitivity analysis for these five Asian economies.

[132] See, for example, Fama (1981).

Given the lack of a significant in-sample predictive relationship, it is no surprise that the inclusion of equity prices is of no help in improving out-of-sample forecasts. Table 7 reports the results of a number of forecasting exercises, similar to those reported earlier for real output growth. Again, the key measure of forecasting performance is the ratio of the forecast RMSE from a model that includes the stock price to that from one in which the stock price is omitted. Also reported is the ratio of the forecast RMSE relative to that from a naïve "no change" forecast. A cursory inspection of the table reveals that in no case does the inclusion of the stock price lead to a reduction in forecast RMSE, relative to the autoregressive model (i.e., a regression of future four-quarter inflation on the current four-quarter inflation rate). In fact, the RMSEs from the forecasting model with stock prices are almost uniformly greater than those from the "no change" forecast. The underlying reason for this finding is that the inflation rate is reasonably well approximated by a random walk; consequently, it is hard for *any* forecasting model to beat the "no change" forecast. Indonesia is the only exception (along with the United States), apparently because over the sample considered, there has been a distinct tendency for Indonesian inflation to revert to something close to an 8 percent annual rate.[133]

Overall, the results for inflation are quite similar qualitatively to those of Stock and Watson (2001) for the G7. This does not imply that stock prices bear *no* relation whatsoever to inflation, of course: it is clear from Figure that, especially during crises, large stock price declines have been associated with periods of sharply rising inflation. But purely as a matter of forecasting, today's stock price changes say little about *future* inflation.

3. Liquidity and stock price fluctuations

Discussions of stock price fluctuations, and what drives them, often focus on the role of monetary policy, and the related concept of "liquidity".[134] In particular, a widely-held view is that overly expansionary monetary policy and/or "excess liquidity" is an underlying cause of many episodes of asset price appreciation. Examples of this view are not hard to come by. Critics of Alan Greenspan, such as Fleckenstein (2005), blame expansionary Federal Reserve policy in the late 1990s for a boom in stock prices that appears, in retrospect, to have had some features of a bubble.[135] And, with the stock price as a key component of its proprietary financial conditions index, Goldman Sachs' assessment of the economy is significantly influenced by the strength of the equities market.[136] More recently, the business and financial press has been awash in articles linking excess liquidity – especially on a *global* scale – to a dangerous escalation in asset prices.[137]

The possible destabilizing effect of expansionary monetary and credit conditions on asset markets has also attracted the attention of policymakers in recent years. Borio and Lowe (2002), for example, hypothesized that an excessive buildup of credit will inflate asset prices, and

[133] In contrast with the findings of Stock and Watson (2001), and other studies looking at earlier periods, the model-based forecasts do somewhat better than the "no change" forecasts in the United States during this period, which suggests a greater degree of mean reversion in recent years.

[134] Note that this idea is only tangentially related to "liquidity" defined as the ease or speed of consummating transactions.

[135] Blinder and Reis (2005) provide a more sympathetic assessment of Greenspan's response (or lack thereof) to the stock market boom of the late 1990s.

[136] See, for example, Dudley and Hatzius (2000). As of June 2000, the year-ahead real GDP growth forecast from Goldman's financial conditions index was 3½ percent per year, due largely to the strength of the equity market. Instead, the economy and the stock market both contracted sharply in the first quarter of 2001.

[137] See, for example, The Economist (2007), Lahart (2006), and Sender (2007); and in the Asian context, Liu (2007). Private-sector commentators, such as Wells Capital Management (2007), also often cite liquidity as a key driver of equity markets.

increase the likelihood of a financial crisis in the future.[138] More recently, strong concerns about a "global liquidity glut" and its possible stimulative effect on asset prices, consumption and investment have been raised by leading policymakers, such as former IMF research director Raghuram Rajan (2006). In a similar vein, Bank of England Governor Mervyn King (2006) speculated that buoyant asset markets are "…the result of rapid growth in money and credit which, in a "search for yield", drives asset prices up and interest rates down".

Establishing a theoretical link between monetary policy, narrowly defined, and stock prices is straightforward. Thinking of the price of a share as the discounted sum of future earnings or dividends, a monetary expansion would raise the value of shares through at least two channels: first, by reducing the interest rate at which those earnings are discounted; and second, by increasing firms' earnings. While these effects have yet to be modeled in the context of a modern New Keynesian framework, the impact of monetary policy on the stock market was described, using a dynamic version of the IS-LM model, by Blanchard (1981).[139] Besides its impact on profits and the risk-free rate, monetary policy may also affect the equity premium associated with the share price; indeed, Bernanke and Kuttner (2005) showed that policy-induced stock price fluctuations in the United States are largely attributable to movements in the equity premium.[140] Thus, a link between monetary policy and stock prices can be explained in terms of conventional asset pricing principles, without appealing to a distinct "liquidity" channel.

Discussions of "liquidity", and its economic effects, often refer to effects *other than* those associated with interest rates and earnings. Part of this involves a focus on *quantity* variables, such as money or credit aggregates, as suggested by the Rajan and King remarks. This point of view is reminiscent of that of monetarist writers, such as Patinkin (1965) and Meltzer (1995), who emphasized the direct effects of quantities on asset prices.[141] This channel can be described crudely in terms of supply and demand: as the central bank injects liquidity into the economy, agents will try to get rid of it, exchanging money for other assets (including equities), thus driving up the price of those assets.

While this mechanism has a certain intuitive appeal, several conceptual issues require closer scrutiny. First, it is not clear why quantity variables would contain more information than the interest rate about the impact of monetary policy on financial markets. Specifically: suppose expansionary monetary policy generated an outward shift in the money supply curve, facing a downward-sloping money demand curve. In this case, the monetary expansion would be evident in both the interest rate and the money supply, and nothing would be gained by focusing on the monetary aggregates.

Quantity variables can, however, reveal useful information about underlying aggregate demand shocks, to the extent that those shocks lead to shifts in money *demand*. As pointed out by Friedman (1977), this would be a case in which the quantity of money might appropriately be used as an information variable, even though there is no sense in which money was the underlying causal factor. Quantity variables could also be informative to the extent that the adjustment to the asset market was a gradual one, creating a situation in which some measure of monetary "overhang" (such as that implied by "p-star" style models) would have some predictive power.

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[138] Interestingly, Kumar et al. (2003) found no statistically significant role for "global liquidity" in a logit analysis of emerging market currency crises.

[139] In Blanchard's model, profits are a linear function of the level of output, and there is no equity premium. The main result is that, as expected, monetary expansions increase the stock price. Whether the stock price continues to rise, or subsequently declines, depends on the relative strength of the "profit" versus "discount rate" effects.

[140] That is, by reducing the equity premium, monetary expansions also raise equity prices.

[141] See Kuttner and Mosser (2002) for an overview of this "neo-monetarist" view of the transmission mechanism.

Another difficult conceptual issue is raised by the assertion that the relevant concept of "liquidity" is not adequately captured by conventional measures, such as interest rates and monetary aggregates. This view holds that "liquidity" is best defined in terms of investors' willingness to take risks.[142] Links from monetary conditions to this broader notion of "liquidity" are often hypothesized, but rarely made explicit. The IMF's *Global Financial Stability Report* (2005), for example, asserts that abundant liquidity encourages financial risk-taking, and creates unsustainable valuations. One attempt to model this link theoretically is that of Allen and Gale (2000), which shows how the expansion of credit (which is only partially under the central bank's control) can exacerbate the moral hazard issues associated with risky debt.[143] As a practical matter, however, the problem with this expansive definition of "liquidity" is that it can easily become circular: effectively, using rising asset prices (interpreted as a proxy for "excess liquidity") to "explain" rising asset prices.[144] At this point, "liquidity" becomes nothing more than a *deus ex machina* for rationalizing otherwise inexplicable asset price booms.

In light of these issues, it is worth examining empirically the extent to which increases in stock prices are symptomatic of expansionary monetary conditions. (Of necessity, the analysis is limited to observable liquidity measures, such as interest rates and money and credit aggregates.) Establishing such a link would have important implications for policy, as it would strengthen the case for taking into account gauges of financial conditions, such as the stock price, in assessing the stance of monetary policy. To anticipate: there is no clear statistical link between fluctuations in the various measures of "liquidity" and subsequent movements in either output or stock prices. In Korea and Malaysia, however, the evidence suggests a connection in the opposite direction, from stock prices to measures of narrow money – although this result is sensitive to the inclusion of observations from the 1997–98 crisis period.

One approach to characterizing the information content of liquidity measures is simply to determine the extent to which those measures help predict real output in a forecasting equation like that used in section 1,

$$\Delta y_t = \alpha + \sum_{i=1}^{4} \beta_i \Delta y_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta s_{t-i} + \sum_{i=1}^{4} \theta_i x_{t-i} + \sum_{i=2}^{4} \delta_i q_{i,t} + e_t, \tag{5}$$

in which the x variable now represents the proxy for "liquidity". Instead of the γs, the objects of interest are now the θ coefficients. The candidate liquidity proxies are the usual suspects, all but one of which appeared in the preceding analysis: the real short-term interest rate; and the real growth rates of reserve money, narrow money, broad money, and credit.[145] The new addition is the measure of "global excess liquidity" calculated by Rüffer and Stracca (2006), which is defined as the difference between broad money and nominal income growth for the G5. If expansionary policy (broadly defined) boosts real stock values through an expansion in output, as in Blanchard (1981), the impact should translate into significant positive estimates of the θs; the same would be true to the extent that liquidity fluctuations contained information about unobservable aggregate demand shocks.

[142] This view is nicely summarized by Dixon (2007): "…liquidity isn't just a function of interest rates. It is best thought of as a willingness to play the financial game – by lending, borrowing, and betting money. That willingness is only partly determined by the cost of money. A bigger part of the story is appetite for risk." Liu (2007) contains a similar definition.

[143] The Allen-Gale story lines up nicely with Dixon's (2007) description of the collateralized loan obligation market and hedge fund industry as enmeshed in a "cat's cradle of one-way bets".

[144] This point has been made by some astute observers, such as Lahart (2006).

[145] Although the distinction is not central to this paper's analysis, it is worth noting that some of these variables, such as the real interest rate or reserve money, are, at least in principle, under the central bank's control; while others, such as broad money or credit, are not.

The results in Table 8 uniformly fail to provide support for this view, however. In only one case (narrow money, for Korea) is there evidence of a liquidity measure having significant (at the 5 percent level) in-sample predictive power for real output. Only in the United States and Thailand is there even weak evidence (i.e., significant at the 10 percent level) for transmission from either the interest rate or reserve money to real output growth. The lack of a significant interest rate effect is somewhat surprising, as the short-term interest rate is generally viewed as the central bank's primary (if not its *only*) policy instrument. A critically important caveat, however, is that the interest rate is *endogenous* with respect to the state of the economy. While it may be true that, *ceteris paribus*, an increase in the real interest rate is contractionary, central banks tend to raise the rate as the economy expands.[146] Reduced-form regressions like (5) could therefore fail to capture the true impact of policy actions. For this reason, the results in Table 8 should be interpreted with caution.

Another simple way to characterize the links (if any) between "liquidity" and stock prices is simply to check for Granger causality between the two variables in a bivariate VAR system,

$$\begin{aligned}\Delta s_t &= \alpha^s + \sum_{i=1}^{2}\gamma_i^s \Delta s_{t-i} + \sum_{i=1}^{2}\theta_i^s x_{t-i} + \sum_{i=2}^{4}\delta_i^s q_{i,t} + e_t^s \\ \Delta x_t &= \alpha^x + \sum_{i=1}^{2}\gamma_i^x \Delta s_{t-i} + \sum_{i=1}^{2}\theta_i^x x_{t-i} + \sum_{i=2}^{4}\delta_i^x q_{i,t} + e_t^x .\end{aligned} \tag{6}$$

In this framework, one estimate of interest would be the influence (in a predictive sense) of "liquidity" on stock prices, as captured by the θ^s coefficients. Also interesting is the predictive power of stock prices for liquidity, as captured by the γ^s coefficients: non-zero estimates would be suggestive of some mechanism in which stock prices drove liquidity, rather than the other way around. As before, quarterly dummies are included to capture seasonal patterns.[147]

The Granger causality tests calculated from estimates of equation (6) appear in Table 9. Overall, there is no clear pattern of "liquidity" Granger-causing stock prices: the exclusion of the liquidity terms in the stock price equation is rejected at the 5 percent level only for credit in the United States, and the real interest rate in Thailand.[148] Nor is there any evidence for a role for "global excess liquidity" in driving stock prices, in either Asia or the United States.

Again, some caution is warranted in interpreting the results, since the Granger causality approach ignores the possibility of a *contemporaneous* impact on stock prices. In addition, to the extent that equity markets are efficient, surprise changes in policy are likely to have a larger effect on stock prices than the "old news" embodied in lagged liquidity measures.[149] The negative test results nonetheless indicate that run-ups in stock prices are not systematically preceded by increases in liquidity. In this regard, the results corroborate those of Posen (2003), who, using completely different methods, found no consistent tendency for asset price booms to be preceded by monetary easing.

The evidence is slightly stronger for causality running from stock prices *to* liquidity. Here, the exclusion restrictions corresponding to no causality are strongly rejected, at the 5 percent level or better, for reserve and narrow money in Korea and Malaysia – intriguingly, the two Asian countries in the sample in which stock prices had significant predictive power for real output. Stock prices also Granger-cause narrow money in the United States, and, with a

[146] See Kuttner and Mosser (2002) for a further discussion of this point.

[147] The lag length has been reduced from four to two on the assumption that there should be less of a lag in the response of "liquidity" to stock prices, and vice versa, than there would be for real output and inflation. The results are generally similar with four lags, but weaker in terms of statistical significance.

[148] This rejection rate of 0.055 is roughly what one would expect if the null hypothesis of no relationship were true, assuming the tests were independent of one another.

[149] For evidence supporting this view, see Bernanke and Kuttner (2005).

p-value of 0.055, the stock price terms are almost significant in the interest rate equation. In this regard, there would appear to be a similarity between Korea, Malaysia and the United States.

There is one critical difference, however. In the United States, the (unreported) coefficients on the stock price in the narrow money equation are negative, and those in the interest rate equation are positive, consistent with a contractionary response to rising stock prices.[150] In Korea and Malaysia, on the other hand, the coefficients on the stock price in the money equation are positive, which suggests an *expansionary* response to rising stock prices – or equivalently, a contractionary response to falling stock prices. This particular result turns out to be sensitive to the inclusion of the 1997–98 crisis period; the stock price terms are insignificant when that period is excluded. Presumably, this is because the crisis, which first precipitated a collapse in equity prices, also led central banks to conduct a more contractionary monetary policy in an effort to stabilize the currency.

Overall, the results presented in this section fail to clearly establish a consistent link in either direction between stock prices and observable measures of "liquidity". Needless to say, these results do not imply that there is *no* connection with monetary policy: for all the reasons discussed above, there is good reason to believe that, *ceteris paribus*, an (unexpected) change in the interest rate set by the monetary authority will have an impact on the prices of assets, including equities. But it is going to take more than just a series of surprise interest rate cuts for monetary policy to generate a sustained, bubble-like rise in equity prices – that would require a change in the perceived *rule* being used to conduct policy, which, in turn, should manifest itself in the behavior of interest rates and/or quantity variables. No such relationship is evident in the data.

Conclusions

The main purpose of this study has been to discuss the possible role for equity prices as a leading economic indicator, and to assess empirically the usefulness of stock price data in an Asian emerging market context. One broad conclusion from the analysis in the paper is that the information content of stock prices varies a great deal across countries. Equity prices in Korea, Malaysia, and to a somewhat lesser extent, Thailand, seem to be closely linked to the macroeconomy – but much less so in the Philippines and Indonesia.

Even for Korea, Malaysia and Thailand, where the stock price is a good in-sample predictor of output, including the stock price yields only modest improvements in out-of-sample forecasting performance. The results for these three countries are very similar to those for the United States, where the stock price is a useful – but somewhat unreliable – leading indicator.

The key finding of section 2 is that Asian equity prices fail to display a systematic relationship, either in sample or out of sample, with inflation. In large part this is because, over the sample used in the analysis, inflation resembles a random walk, and consequently it is hard to do better than a naïve "no change" forecast. Again, the results for Asia are similar to those for the United States presented in this paper, and in other published research.

The relationship between "liquidity", stock prices, and the economy, discussed at length in section 3, is a complex one. The main conclusion from that discussion is that, while there are sound theoretical reasons for monetary policy to have an effect on equity valuations, the role of broader and more nebulous "liquidity" concepts is not well motivated; nor is it clear exactly how "excess liquidity" promotes financial risk-taking. As a practical matter, it turns out none of the liquidity measures considered in the analysis has any significant predictive power for

[150] This does not necessarily imply that the Federal Reserve is responding to stock prices *per se*, as the specification omits other macroeconomic variables that are likely to be correlated with stock price movements.

either real output or stock prices, calling into question the popular view that “liquidity” (or at least observable proxies for it) is an important driving force in either financial markets or the real economy.

Appendix: Data sources

Industrial production. For Korea, Malaysia, the Philippines and Indonesia, the source is the International Monetary Fund's International Financial Statistics (IFS) database. For Thailand, the source is the Bank of Thailand, and US data were obtained from the Federal Reserve Bank of Saint Louis FRED database. Adjustments were made to correct for the discontinuities in the series for Malaysia in May 1988 and January 1991, and in the series for Indonesia in January 2003.

Consumer prices. For the five Asian countries, the source is the IFS database. US data were obtained from the FRED database.

Money and credit. For all countries, the money and credit series are from the IFS database. Reserve money is from the data on Monetary Authorities (line 14). For every country except Malaysia, data from the Monetary Survey is used for narrow money, broad money, and credit (lines 34, 35 and 32). National definitions of money are used for Malaysia. Adjustments were made to correct for the discontinuities in the series for Malaysia in January 1990 and January 1992, and in the series for the Philippines in 2003Q3. Y2K-related spikes were removed from the money series for Malaysia and Thailand.

Interest rates. For the five Asian countries, short-term interest rates (typically the money market rate) are taken from the IFS database. The short-term rate for the United States is the federal funds rate, obtained from the FRED database.

Stock prices. All stock price indexes are from MSCI/Barra, and obtained from http://www.mscibarra.com/.

Global excess liquidity. The data, as described in Rüffer and Stracca (2006), were obtained directly from the authors.

Table 3

In-sample predictive power of stock price for real output, no controls

	Number of observations	One-quarter-ahead model		Stock price coefficient, four-quarter-ahead model
		Sum of coeffs	Exclusion test	
Korea	72	0.133	3.949	0.152
		0.007	***0.007***	***0.002***
Malaysia	72	0.206	5.791	0.226
		0.000	***0.001***	***0.000***
Philippines	72	0.015	0.836	0.031
		0.849	*0.508*	*0.716*
Thailand	72	0.140	2.003	0.109
		0.009	*0.106*	***0.026***
Indonesia	53	0.056	0.241	0.093
		0.445	*0.914*	*0.342*
United States	72	0.081	5.990	0.200
		0.003	***0.000***	***0.006***

Notes: the one-quarter-ahead forecasting model is given by equation (1) in the text, and the four-quarter-ahead model is given by equation (2). For each country, the number in the first row under the "Sum of coeffs" column gives the sum of the estimated γ coefficients, and the number under the "Exclusion test" column gives the F-statistic for the exclusion of the four coefficients. P-values for the hypotheses that the sum equals zero, and that the γs are jointly zero, appear below, in italics. For the four-quarter-ahead model, the table gives the estimated γ, and the p-value for the hypothesis that it is equal to zero; standard errors are corrected for MA(3) errors. Boldface type is used to highlight results that are significant at the 5 percent level or better.

Table 4

In-sample predictive power of stock price for real output, including other financial variables

	Real rate		Real depreciation		Reserve money		Narrow money		Broad money		Credit	
	Sum	**Excl.**	**Sum**	**Excl.**	**Sum**	**Excl.**	**Sum**	**Excl.**	**Sum**	**Excl.**	**Sum**	**Excl.**
Korea	0.181	6.421	0.127	4.295	0.117	3.753	0.122	3.872	0.141	4.115	0.118	3.121
	0.001	***0.000***	***0.008***	***0.004***	***0.030***	***0.009***	***0.013***	***0.008***	***0.005***	***0.005***	***0.028***	***0.022***
Malaysia	0.216	5.076	0.172	3.699	0.213	4.715	0.254	5.121	0.208	5.179	0.195	4.747
	0.001	***0.002***	***0.004***	***0.010***	***0.000***	***0.002***	***0.000***	***0.001***	***0.000***	***0.001***	***0.001***	***0.002***
Philippines	–0.012	0.413	–0.047	0.601	0.001	1.011	–0.022	1.518	0.011	0.534	0.039	0.526
	0.879	*0.798*	*0.651*	*0.664*	*0.994*	*0.409*	*0.766*	*0.209*	*0.887*	*0.711*	*0.656*	*0.717*
Thailand	0.113	1.137	0.121	1.778	0.138	1.771	0.107	1.787	0.144	1.928	0.140	1.869
	0.043	*0.349*	***0.015***	*0.146*	***0.012***	*0.148*	*0.056*	*0.144*	***0.010***	*0.118*	***0.011***	*0.129*
Indonesia	0.099	0.703	0.056	0.316	0.053	0.299	0.043	0.073	0.040	0.187	0.026	0.101
	0.265	*0.595*	*0.460*	*0.865*	*0.470*	*0.877*	*0.683*	*0.990*	*0.640*	*0.944*	*0.777*	*0.981*
United States	0.102	6.215	0.079	5.362	0.107	7.423	0.089	6.094	0.078	4.679	0.027	1.271
	0.001	***0.000***	***0.008***	***0.001***	***0.000***	***0.000***	***0.002***	***0.000***	***0.005***	***0.002***	*0.443*	*0.292*

Notes: the results are based on the one-quarter-ahead forecasting model given by equation (3) in the text. For each country, the number in the first row under the "Sum" column gives the sum of the estimated γ coefficients, and the number under the "Excl." column gives the F-statistic for the exclusion of the four coefficients. P-values for the hypotheses that the sum equals zero, and that the γs are jointly zero, appear below, in italics. Boldface type is used to highlight results that are significant at the 5 percent level or better.

Table 5

Out-of-sample forecasting performance for real output

	End of estimation period	Forecasting period		RMSE	RMSE relative to:	
		Start	End		"No change"	No stock price
Korea	1996Q2	1996Q3	2005Q4	7.94	**0.61**	**0.99**
	1999Q4	2000Q1	2005Q4	3.38	**0.39**	**0.95**
	1996Q2	2000Q1	2005Q4	3.18	**0.37**	**0.98**
Malaysia	1996Q2	1996Q3	2005Q4	9.14	**0.70**	**0.96**
	1999Q4	2000Q1	2005Q4	6.61	**0.60**	**0.93**
	1996Q2	2000Q1	2005Q4	7.92	**0.72**	**0.97**
Philippines	1996Q2	1996Q3	2005Q4	10.74	**0.90**	1.04
	1999Q4	2000Q1	2005Q4	8.39	**0.71**	1.00
	1996Q2	2000Q1	2005Q4	10.37	**0.88**	1.01
Thailand	1996Q2	1996Q3	2005Q4	7.76	**0.78**	**0.99**
	1999Q4	2000Q1	2005Q4	3.60	**0.73**	**0.94**
	1996Q2	2000Q1	2005Q4	3.81	**0.77**	**0.99**
Indonesia	1996Q2	2001Q2	2005Q1	16.56	2.13	1.00
United States	1996Q2	1996Q3	2005Q4	3.21	**0.87**	1.08
	1999Q4	2000Q1	2005Q4	3.10	**0.71**	**0.88**
	1996Q2	2000Q1	2005Q4	3.24	**0.74**	**0.98**

Notes: the results are based on equation (2), estimated from 1988Q1 to the indicated periods. RMSE denotes the forecast root mean squared error. The ratios of this RMSE to that of the naïve "no change" forecast, and to that of the model with no stock price, appear in the final two columns. Boldface type is used to highlight reductions in forecast RMSE.

Table 6

In-sample predictive power of stock price for inflation, no controls

	Number of observations	One-quarter-ahead model		Stock price coefficient, four-quarter-ahead model
		Sum of coeffs	Exclusion test	
Korea	72	–0.006	1.161	–0.012
		0.440	0.337	0.089
Malaysia	72	–0.003	4.547	–0.007
		0.179	**0.003**	0.200
Philippines	72	–0.005	1.407	–0.009
		0.121	0.242	0.095
Thailand	72	–0.001	0.152	–0.002
		0.845	0.961	0.812
Indonesia	72	–0.002	1.005	–0.012
		0.338	0.412	0.270
United States	75	0.002	1.211	0.006
		0.253	0.315	0.255

Notes: see notes to Table 3.

Table 7

Out-of-sample forecasting performance for inflation

	End of estimation period	Forecasting period		RMSE	RMSE relative to:	
		Start	End		"No change"	No stock price
Korea	1996Q2	1996Q3	2005Q4	2.67	1.01	1.01
	1999Q4	2000Q1	2005Q4	1.84	1.43	1.10
	1996Q2	2000Q1	2005Q4	2.18	1.70	1.04
Malaysia	1996Q2	1996Q3	2005Q4	1.50	1.00	1.00
	1999Q4	2000Q1	2005Q4	1.76	2.02	1.06
	1996Q2	2000Q1	2005Q4	1.46	1.68	1.04
Philippines	1996Q2	1996Q3	2005Q4	4.93	1.19	1.11
	1999Q4	2000Q1	2005Q4	2.56	**0.71**	1.00
	1996Q2	2000Q1	2005Q4	4.25	1.17	1.13
Thailand	1996Q2	1996Q3	2005Q4	3.20	1.00	1.01
	1999Q4	2000Q1	2005Q4	2.61	1.68	1.03
	1996Q2	2000Q1	2005Q4	2.86	1.84	1.01
Indonesia	1996Q2	1996Q3	2005Q4	15.33	**0.74**	1.01
	1999Q4	2000Q1	2005Q4	4.49	**0.80**	1.09
	1996Q2	2000Q1	2005Q4	3.76	**0.67**	1.00
United States	1996Q2	1996Q3	2005Q4	0.94	**0.91**	1.03
	1999Q4	2000Q1	2005Q4	0.97	**0.91**	1.06
	1996Q2	2000Q1	2005Q4	0.99	**0.92**	1.05

Notes: see notes to Table 5.

Table 8

In-sample predictive power of liquidity measures for real output

	Real rate		Reserve money		Narrow money		Broad money		Credit		Global liquidity	
	Sum	**Excl.**	**Sum**	**Excl.**	**Sum**	**Excl.**	**Sum**	**Excl.**	**Sum**	**Excl.**	**Sum**	**Excl.**
Korea	0.113	1.868	0.000	0.526	0.000	**3.447**	0.000	1.655	–0.000	1.621	0.767	0.603
	0.312	*0.129*	*0.388*	*0.717*	*0.738*	***0.014***	*0.297*	*0.173*	*0.567*	*0.182*	*0.408*	*0.662*
Malaysia	0.146	1.041	–0.000	1.123	–0.000	0.654	–0.000	0.470	–0.000	1.623	–0.063	0.568
	0.523	*0.394*	*0.217*	*0.355*	*0.183*	*0.627*	*0.253*	*0.758*	*0.271*	*0.181*	*0.944*	*0.687*
Philippines	0.073	0.396	0.078	0.896	0.120	0.659	0.039	0.438	0.009	0.224	–2.792	0.995
	0.737	*0.811*	*0.454*	*0.473*	*0.346*	*0.623*	*0.268*	*0.781*	*0.586*	*0.924*	*0.113*	*0.418*
Thailand	–0.069	2.085	–0.029	2.276	0.041	0.851	0.006	0.187	–0.003	0.613	1.636	1.232
	0.562	*0.095*	*0.478*	*0.072*	*0.469*	*0.499*	*0.596*	*0.944*	*0.252*	*0.655*	*0.080*	*0.308*
Indonesia	0.160	0.439	0.000	0.707	–0.000	0.211	0.000	0.480	0.000	0.180	–3.341	1.412
	0.572	*0.780*	*0.782*	*0.592*	*0.866*	*0.931*	*0.553*	*0.751*	*0.746*	*0.947*	*0.164*	*0.249*
United States	–0.093	0.761	0.072	2.049	0.013	0.477	0.001	0.604	0.002	1.458	–0.265	1.592
	0.102	*0.555*	*0.055*	*0.099*	*0.273*	*0.753*	*0.811*	*0.661*	*0.185*	*0.227*	*0.337*	*0.188*

Notes: see notes to Table 2.

Table 9

Granger causality tests for real stock prices and liquidity

	***x* = Real rate**		***x* = Reserve money**		***x* = Narrow money**		***x* = Broad money**		***x* = Credit**		***x* = "Global liquidity"**	
	s* → *x	***x* → *s***	***s* → *x***	***x* → *s***	***s* → *x***	***x* → *s***	***s* → *x***	***x* → *s***	***s* → *x***	***x* → *s***	***s* → *x***	***x* → *s***
Korea	0.011	2.042	**4.040**	0.051	**4.620**	0.672	1.446	0.025	1.094	0.022	2.226	1.100
	0.989	*0.138*	***0.022***	*0.950*	***0.013***	*0.514*	*0.243*	*0.975*	*0.341*	*0.979*	*0.116*	*0.339*
Malaysia	2.063	1.094	**7.744**	0.330	**5.558**	0.248	0.678	1.836	1.229	2.518	**3.394**	0.981
	0.135	*0.341*	***0.001***	*0.720*	***0.006***	*0.781*	*0.511*	*0.167*	*0.299*	*0.088*	***0.040***	*0.380*
Philippines	1.458	1.477	0.476	0.397	0.320	0.126	1.219	0.009	3.031	0.802	2.108	0.018
	0.240	*0.236*	*0.624*	*0.674*	*0.727*	*0.882*	*0.302*	*0.991*	*0.055*	*0.453*	*0.130*	*0.982*
Thailand	0.912	**3.407**	0.248	0.835	0.002	0.495	2.541	0.128	1.109	0.402	0.424	0.338
	0.407	***0.039***	*0.781*	*0.438*	*0.998*	*0.612*	*0.087*	*0.880*	*0.336*	*0.670*	*0.656*	*0.715*
Indonesia	0.560	1.683	0.342	0.958	1.460	1.485	0.641	1.573	0.440	1.457	0.060	0.639
	0.574	*0.194*	*0.712*	*0.389*	*0.240*	*0.234*	*0.530*	*0.215*	*0.646*	*0.240*	*0.942*	*0.531*
United States	3.022	0.428	0.539	0.084	**3.720**	0.456	2.822	1.028	1.920	**3.208**	**4.547**	0.784
	0.055	*0.654*	*0.586*	*0.920*	***0.029***	*0.635*	*0.066*	*0.363*	*0.154*	***0.047***	***0.014***	*0.461*

Notes: the results are based on the VAR given by equation (6) in the text. For each country, the number in the first row under the "$s \rightarrow x$" column gives the F-statistic for the exclusion of the four stock price coefficients in the "liquidity" equation; the numbers in the "$x \rightarrow s$" columns are those for the exclusion of the "liquidity" proxy in the stock price equation. P-values associated with the F-statistics appear below, in italics. Boldface type is used to highlight results that are significant at the 5 percent level or better.

Figure 1

Real stock prices in emerging Asia

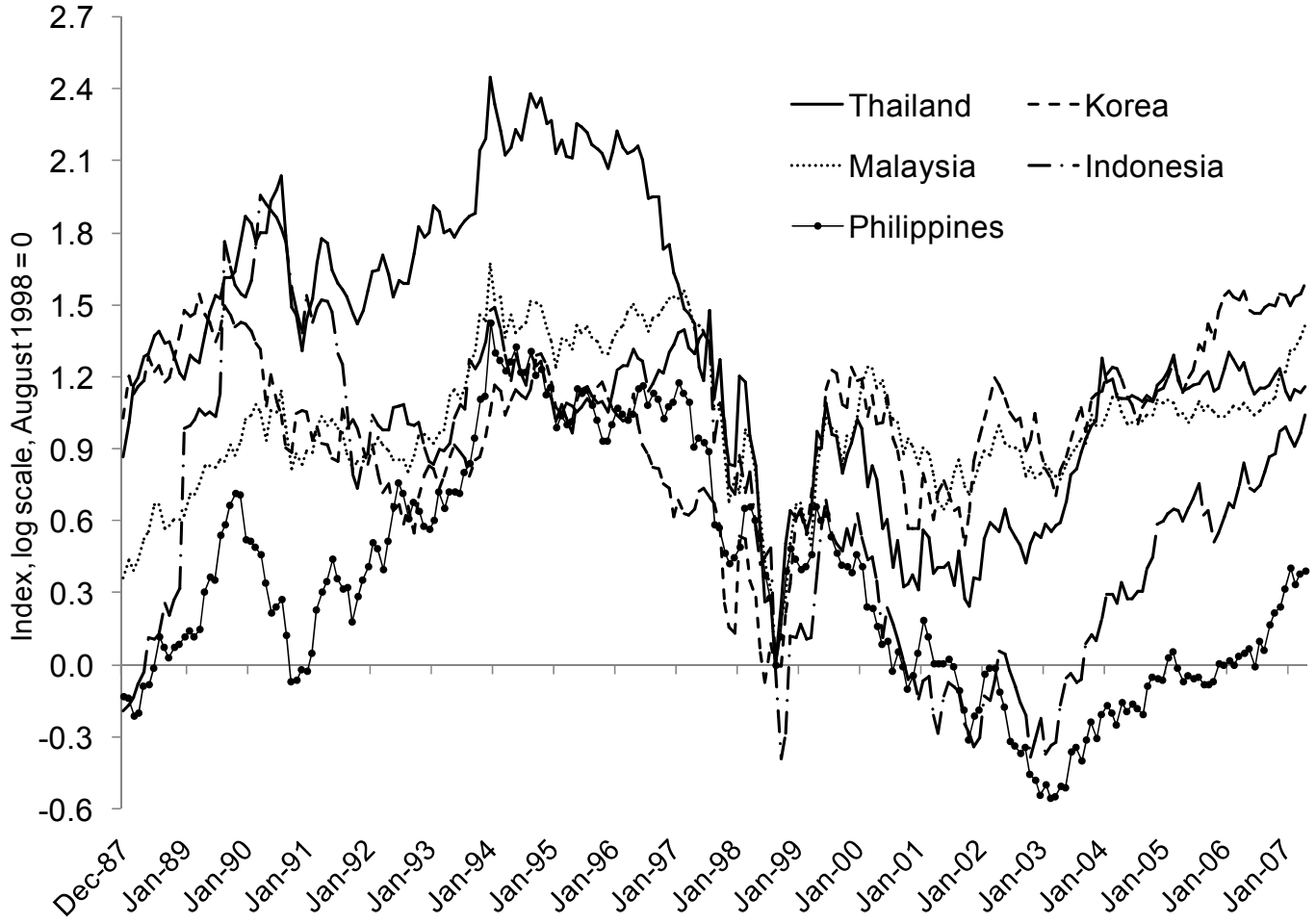


Figure 2

Stock price and industrial production growth

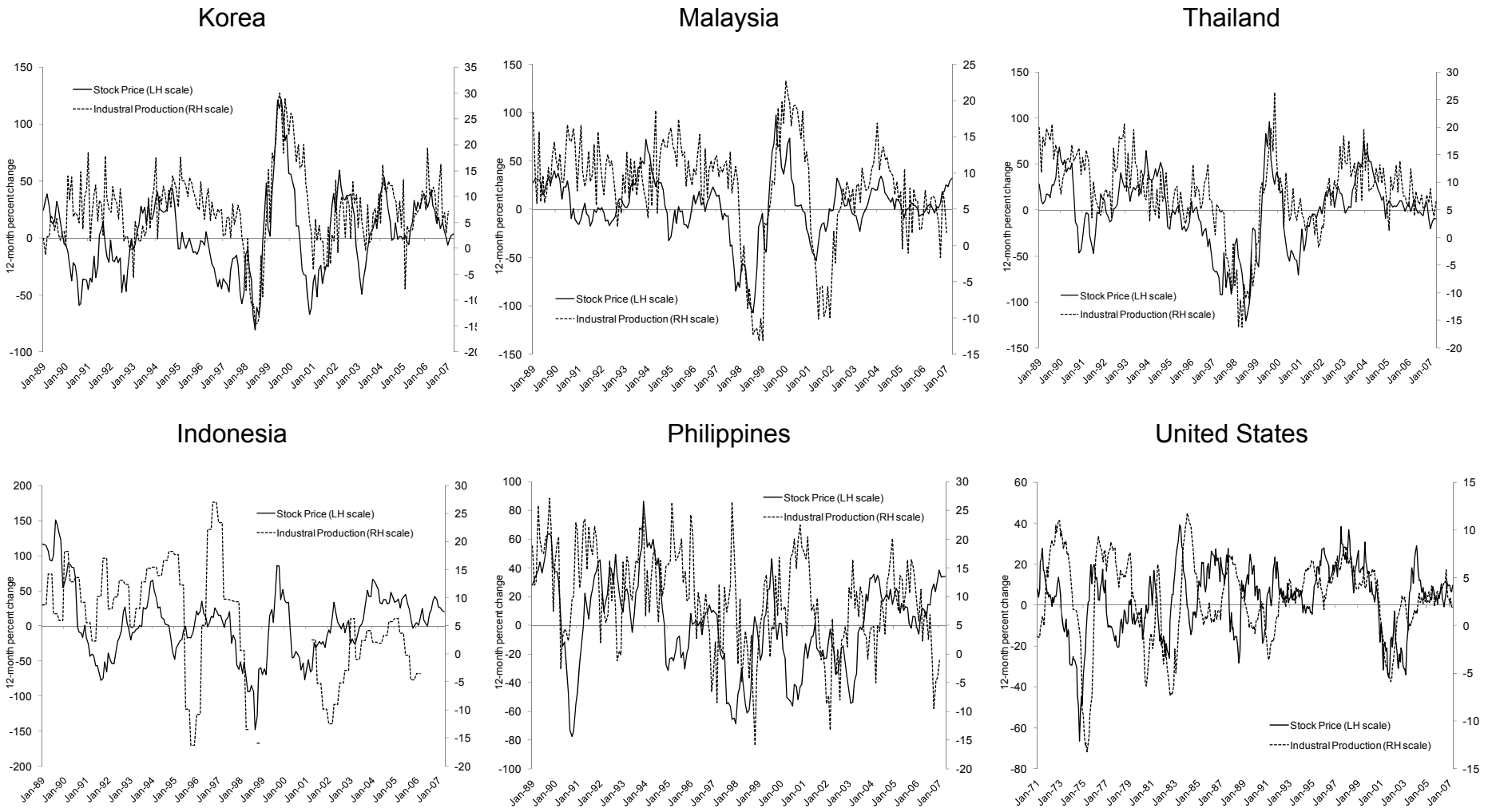
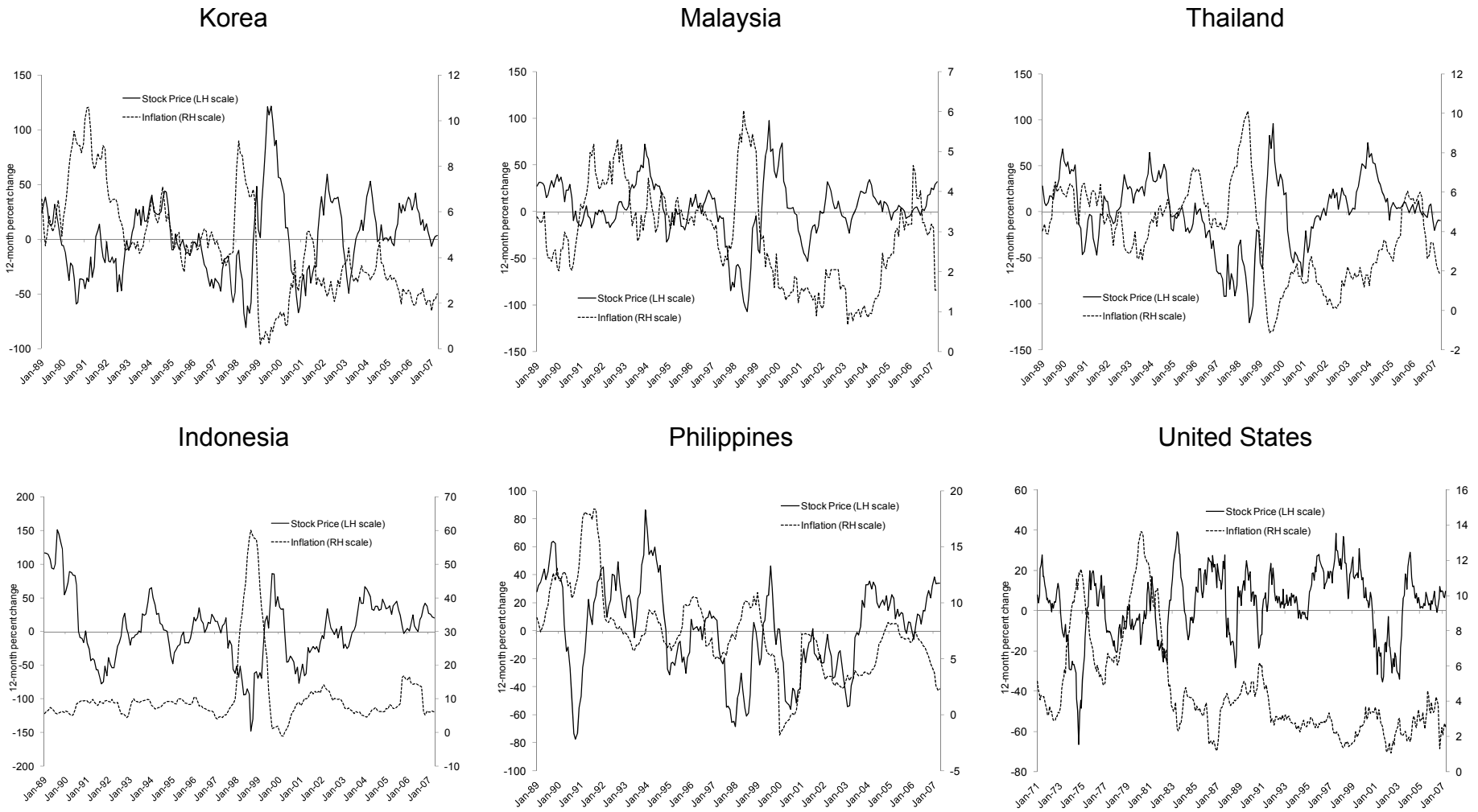


Figure 3

Stock price growth and inflation



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