ธนาคารแห่งประเทศไทย

สัมมนาวิชาการประจำปี 2551

พรมแดนของนโยบายการเงินในสภาวะแวดล้อมทางการเงินยุคใหม่

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กันยายน 2551

ข้อคิดเห็นที่ปรากฏในบทความนี้เป็นความเห็นของผู้เขียน
ซึ่งไม่จำเป็นต้องสอดคล้องกับความเห็นของธนาคารแห่งประเทศไทย

บทคัดย่อ

ในช่วงสองทศวรรษที่ผ่านมา ตลาดการเงินในประเทศต่างๆ ทั่วโลกได้เปลี่ยนแปลงไปมาก จากการศึกษาพบว่าการเปลี่ยนแปลงของโครงสร้างตลาด ผลิตภัณฑ์ทางการเงิน ผู้เล่นในตลาด กฎระเบียบ และภาวะเศรษฐกิจ ทำให้ราคาสินทรัพย์ทางการเงินปรับเปลี่ยนเร็วและแรงขึ้น รวมทั้งทำให้ความเชื่อมโยงของผลิตภัณฑ์ทางการเงินประเภทต่างๆ และความเชื่อมโยงระหว่างตลาดการเงินระหว่างประเทศเพิ่มขึ้น ตลอดจนทำให้การกู้ยืมผ่านการระดมทุนง่ายขึ้น สำหรับกรณีของสหรัฐฯ การศึกษาพบว่าสภาวะแวดล้อมทางการเงินเป็นปัจจัยที่ทำให้กลไกการส่งผ่านของนโยบายการเงินไปยังเศรษฐกิจเปลี่ยนแปลงไป โดยการตอบสนองต่อนโยบายการเงินลดลงต่อเนื่อง และดูเหมือนว่าการส่งผ่านของนโยบายการเงินไปยังช่องทางปกติ อาทิ สินเชื่อธนาคารพาณิชย์ ราคาบ้าน และอัตราแลกเปลี่ยน แผ่วลงในภาวะแวดล้อมทางการเงินยุคใหม่ อย่างไรก็ตาม นโยบายการเงินของสหรัฐฯ มีอิทธิพลต่อระดับอัตราดอกเบี้ยระยะสั้นในตลาดการเงินเพิ่มขึ้น ขณะที่การคาดการณ์ของตลาดเกี่ยวกับการดำเนินนโยบายการเงินในอนาคตมีบทบาทสำคัญในการกำหนดอัตราดอกเบี้ยระยะยาวในตลาดการเงินและอัตราดอกเบี้ยกู้ยืมเพื่อที่อยู่อาศัย นอกจากนี้ ผู้ศึกษามีความเห็นว่า อย่างน้อยควรหลีกเลี่ยงไม่ให้การดำเนินนโยบายการเงินนำไปสู่ปัญหาความไม่สมดุลทางการเงิน และในภาวะแวดล้อมทางการเงินที่ราคาสินทรัพย์เร่งขึ้นมาก การเพิ่มบทบาทของนโยบายการเงินเพื่อดูแลเสถียรภาพทางการเงินอาจเป็นทางเลือกที่ก่อให้เกิดประโยชน์ อย่างไรก็ดี การดำเนินนโยบายดังกล่าวอาจทำได้ยากในช่วงเวลาที่วัฏจักรของราคาสินทรัพย์ไม่สอดคล้องกับการขยายตัวของเศรษฐกิจและระดับราคา ในกรณีดังกล่าวนโยบายดูแลเสถียรภาพระบบสถาบันการเงินจะต้องเข้มงวดในการจัดการการฟองสบู่ของสินทรัพย์ทางการเงินต่างๆ ยิ่งขึ้น

บทสรุปผู้บริหาร

ในช่วงสองทศวรรษที่ผ่านมา ตลาดการเงินในประเทศต่างๆ ทั่วโลกได้เปลี่ยนแปลงไปเป็นอย่าง
มาก จากการผ่อนคลายกฎระเบียบทางการเงิน การเกิดขึ้นของผลิตภัณฑ์ทางการเงินใหม่ๆ และความ
เชื่อมโยงทางการเงินที่เพิ่มขึ้น ซึ่งก่อให้เกิดทั้งประโยชน์และความเสี่ยงควบคู่กันไป นอกจากนี้ พัฒนาการ
เหล่านี้ยังมีนัยสำคัญต่อกลไกการส่งผ่านของนโยบายการเงินไปยังเศรษฐกิจ

คำถามสำคัญท่ามกลางสภาพแวดล้อมทางการเงินที่เปลี่ยนแปลงอย่างต่อเนื่อง คือ ประสิทธิภาพ
ของนโยบายการเงินในดูแลเงินเฟ้อ และช่วยส่งเสริมให้เศรษฐกิจเติบโตอย่างยั่งยืนเปลี่ยนแปลงไปหรือไม่
และบทบาทของนโยบายการเงินที่เคยดูแลเสถียรภาพด้านราคาเป็นหลัก ควรเข้ามามีบทบาทในการช่วยดูแล
เสถียรภาพการเงินเพิ่มขึ้นหรือไม่ โดยเฉพาะในการช่วยจัดการกับราคาสินทรัพย์ที่เพิ่มขึ้นอย่างรวดเร็วใน
สภาพแวดล้อมทางการเงินยุคใหม่นี้

เพื่อตอบคำถามเหล่านี้ ผู้วิจัยได้เลือกประเทศสหรัฐอเมริกาเป็นตัวแทนในการวิเคราะห์ เนื่องจาก
ตลาดการเงินของสหรัฐฯ มีการพัฒนาในระดับสูง ทั้งในด้านขนาด ความลึก และความหลากหลายของนัก
ลงทุน และผลิตภัณฑ์ทางการเงิน ดังนั้น ผลที่ได้จากการศึกษาในกรณีของสหรัฐฯ น่าจะเป็นประโยชน์กับ
ประเทศอื่นที่ตลาดการเงินกำลังมีพัฒนาการอย่างต่อเนื่อง นอกจากนี้ ภาวะตลาดการเงินสหรัฐฯ มักส่งผล
กระทบสำคัญต่อตลาดการเงินโลก

ในส่วนแรก ผู้วิจัยได้วิเคราะห์ถึงปัจจัยผลักดันการเปลี่ยนแปลงในสภาวะการเงิน และลักษณะของ
การเปลี่ยนแปลงสภาวะการเงิน ซึ่งพบว่าการเปลี่ยนแปลงของโครงสร้างตลาด ผลิตภัณฑ์ทางการเงิน ผู้เล่น
ในตลาด กฎระเบียบ และภาวะเศรษฐกิจ เป็นปัจจัยที่ทำให้ราคาสินทรัพย์ทางการเงินปรับเปลี่ยนเร็วและแรง
ขึ้น รวมทั้งทำให้ความเชื่อมโยงของผลิตภัณฑ์ทางการเงินประเภทต่างๆ และความเชื่อมโยงระหว่างตลาด
การเงินระหว่างประเทศเพิ่มขึ้น ตลอดจนทำให้การกู้ยืมเพื่อนำไปลงทุนต่อ (Leverage) ทำได้ง่ายขึ้นและเพิ่ม
สูงขึ้นมาก

ในส่วนที่สอง ผู้วิจัยได้วิเคราะห์ถึงกลไกการส่งผ่านของนโยบายการเงินของสหรัฐฯ ว่ามีการ
เปลี่ยนแปลงในช่วงเวลาที่สภาพแวดล้อมทางการเงินเปลี่ยนแปลงไปหรือไม่ และบทบาทของ
สภาพแวดล้อมทางการเงินต่อกลไกการส่งผ่านเป็นอย่างไร โดยใช้แบบจำลอง Error Correction Model
(ECM) พบว่า การดำเนินนโยบายการเงินมีผลต่อการเปลี่ยนแปลงของอัตราดอกเบี้ยทั้งในแง่ของขนาดและ
ความเร็ว โดยนโยบายการเงินของสหรัฐฯ มีอิทธิพลต่อระดับอัตราดอกเบี้ยระยะสั้นในตลาดการเงินเพิ่มขึ้น
ในสภาพแวดล้อมทางการเงินยุคใหม่ ขณะที่การคาดการณ์ของตลาดเกี่ยวกับการดำเนินนโยบายการเงินใน
อนาคตมีบทบาทสำคัญในการกำหนดอัตราดอกเบี้ยระยะยาวในตลาดการเงินและอัตราดอกเบี้ยกู้ยืมเพื่อที่อยู่
อาศัย ซึ่งปัจจุบันพบว่าอัตราดอกเบี้ยระยะยาวปรับตัวก่อนการปรับอัตราดอกเบี้ยของธนาคารกลางสหรัฐฯ

(The Fed Funds rate) นอกจากนี้ จากการวิเคราะห์โดยใช้แบบจำลอง Vector Auto Regression พบว่า การตอบสนองของเศรษฐกิจสหรัฐฯ ต่อการดำเนินนโยบายการเงินลดลงต่อเนื่อง และการส่งผ่านของนโยบายการเงินไปยังช่องทางปกติ อาทิ สินเชื่อธนาคารพาณิชย์ ราคาบ้าน และอัตราแลกเปลี่ยน แผ่วลงในสภาพแวดล้อมทางการเงินยุคใหม่ นอกจากนี้ การแปลงหนี้เป็นทุน (Securitization) และสภาพคล่องในตลาดเงินที่อยู่ในระดับสูง เป็นปัจจัยสำคัญที่กระทบกลไกการส่งผ่านของนโยบายการเงิน

ในส่วนสุดท้าย ผู้วิจัยได้ศึกษาถึงศักยภาพของนโยบายการเงินในการบรรเทาความไม่มีเสถียรภาพทางการเงิน (Financial instability) โดยเฉพาะที่เกิดจากการที่ราคาสินทรัพย์เพิ่มขึ้นอย่างรวดเร็วจนทำให้เกิดภาวะฟองสบู่ ซึ่งจากการวิเคราะห์พบว่า การลดลงอย่างรวดเร็วของราคาบ้านในสหรัฐฯ เป็นภาวะที่น่าจะสามารถป้องกันได้ หากธนาคารกลางสหรัฐฯ ไม่คงอัตราดอกเบี้ยในระดับต่ำจนนานเกินไป ทั้งนี้การใช้นโยบายการเงินโดยการปรับขึ้นดอกเบี้ยบ้าง เพื่อดูแลราคาสินทรัพย์ไม่ให้อยู่ในระดับที่สูงเกินควร (The leaning against the wind strategy) น่าจะถูกนำมาพิจารณาเป็นทางเลือกภายใต้สภาพแวดล้อมทางการเงินดังกล่าว อย่างไรก็ตาม อาจไม่ง่ายนักที่จะนำแนวทางนี้มาใช้หากวัฏจักรของราคาสินทรัพย์ไม่สอดคล้องกับวัฏจักรของเศรษฐกิจ และวัฏจักรของราคา ซึ่งหากการใช้นโยบายการเงินเพื่อดูแลราคาสินทรัพย์มีข้อจำกัดดังกล่าว ดังนั้น นโยบายดูแลเสถียรภาพระบบสถาบันการเงิน จำเป็นต้องเข้มงวดในการจัดการกับภาวะฟองสบู่ของสินทรัพย์ทางการเงินต่าง ๆ

นัยต่อนโยบายการเงินที่สำคัญสองประการที่ได้จากการศึกษา คือ ประการแรกภายใต้สภาวะแวดล้อมทางการเงินยุคใหม่ การสื่อสารเกี่ยวกับนโยบายการเงินที่ช่วยชี้นำการคาดการณ์ของตลาดได้ดี จะสามารถช่วยเพิ่มประสิทธิภาพในการดำเนินนโยบายได้อย่างมีนัยสำคัญ รวมถึงมีความสำคัญเป็นอย่างมากเมื่อธนาคารกลางต้องเข้ามาให้ความช่วยเหลือในภาวะที่ตลาดการเงินมีปัญหา ประการที่สอง คือ นโยบายการเงินเองต้องระวังไม่ให้กลายเป็นปัจจัยสำคัญที่ทำให้ความไม่สมดุลทางการเงินก่อตัวขึ้น และการใช้วิธีการปรับขึ้นดอกเบี้ยบ้างเพื่อช่วยชะลอการเพิ่มขึ้นอย่างรวดเร็วของราคาสินทรัพย์ (The leaning against the wind strategy) เป็นแนวทางที่ธนาคารกลางและนักวิชาการควรศึกษาเพิ่มเติม นอกจากนี้ การใช้กลยุทธ์ดังกล่าวอาจมีนัยสำคัญมากขึ้นหากความผันผวนของราคาสินทรัพย์ส่งผลกระทบมากขึ้น ต่อราคาสินค้าโภคภัณฑ์ที่เกี่ยวข้องกับองค์ประกอบในตะกร้าเงินเฟ้อ ซึ่งประเด็นนี้ธนาคารกลางควรติดตามในระยะต่อไป

จากการที่ทั้งสภาพแวดล้อมทางเศรษฐกิจและทางการเงิน รวมถึงการเลือกใช้กรอบและวิธีการในการดำเนินนโยบายการเงินเป็นปัจจัยสำคัญที่กำหนดพรมแดนของนโยบายการเงิน ดังนั้น ผู้กำหนดนโยบายจึงจำเป็นต้องเข้าใจและติดตามพัฒนาการของตลาดการเงินที่เปลี่ยนไปในอนาคตอย่างใกล้ชิด และวิเคราะห์ผลกระทบดังกล่าวต่อเศรษฐกิจอย่างต่อเนื่อง เพื่อที่จะสามารถดำเนินนโยบายภายใต้สภาพแวดล้อมที่เปลี่ยนไปอย่างเหมาะสม

Introduction

The financial markets across the world have been through tremendous changes over the past couple of decades. In particular, financial deregulation and the growth in capital markets have had an enormous impact on the global economy through increasing efficiency in allocating funds to support the needs of consumers and firms. Along with those developments has come proliferation of new financial products through financial innovation as well as the increased role of traditional and new financial market players such as pension funds, mutual funds, hedge funds, and sovereign wealth funds. Relaxation of capital restrictions around the world has also led to increasing international portfolio diversification and an increased degree of international financial market integration. These developments have continued to affect and reshape the financial market structures in different parts of the world and demonstrated both welfare enhancing benefits as well as potential risks along the way.

The most progressive and rapid development in the financial market has undeniably occurred in the US where monetary policy has to be conducted in a world characterized by increasing financial complexity, widespread non-linearities, and ubiquitous information asymmetry among market players. These factors together with changing risk appetite, growing financial market liquidity, as well as increasing fluctuations of capital flows could all affect the mechanism and effectiveness of monetary policy in maintaining economic stability and growth. Especially, the various and increasingly confounding effects on monetary policy transmission mechanism could make it more difficult to comprehend the overall effects.

Moreover, the recent financial market turmoil has cast several criticisms related to not only sufficiency of regulations, prudential policy and bank supervision but also the accommodative stance of monetary policy during the period of fast rising house prices prior to the subprime problem.

Hence, two challenging questions have arisen for monetary policy makers in response to the changing financial environment. First, has the effectiveness of monetary policy in curbing inflation and helping to sustain economic growth altered? Second, apart from the main role on maintaining price stability, should the role of monetary policy be extended somewhat further to take care of financial stability especially as asset prices can increase at a faster pace in the new financial environment? The answers to these questions would help us demarcate the territory of monetary in the new financial environment.

This paper attempts to answer these two questions with the US as a candidate for the analysis. Although other economies may not share the same financial structure and developments in the financial market as in the US, we should be able to draw important and

relevant implications for the others as their financial markets continue to progress and as the impact from the US financial markets can be immense across the world.

The study starts by examining the drivers and characteristics of the changing financial environments since 1970s with a focus on the recent financial market development in Section I. Implications of the changing financial environment for monetary transmission mechanism are also discussed here. Section II of the study attempts to investigate whether the US monetary transmission mechanism has changed throughout the different financial environment periods by employing quantitative tools, namely the Error Correction Model (ECM) and the Vector Auto Regression (VAR). Section III examines the potential role of monetary policy in alleviating financial instability especially from asset price bubbles in terms of potency and feasibility. The paper ends with conclusion and policy implications in Section IV.

I. New Financial Environment and monetary transmission

I.1 Characteristics of a New Financial Environment

Over the past few decades, there have been a number of significant and fast changing developments in the financial market in the United States and around the world as depicted in Box 1.1. In order to answer the challenging questions mentioned earlier properly, we separate the financial environment into 3 periods: 1971-1982, 1983-1998, and 1999-2008. The division between periods is based on the Principal Component Analysis (PCA) results of key financial market characteristics, as illustrated in appendix A, in conjunction with anecdotal evidence on major financial events.

In the first episode (1971-1982), the most important financial factor is banking and mortgage deregulation in the 1980s. The Depository Institutions Deregulation and Monetary Control Act of 1980 which removed deposit interest rate ceilings and the requirement that all banks had to hold reserve requirements at the same level led to increased competitions amongst financial institutions. The development also changed the structure of the financial industry significantly.

In the second episode (1983-1998), the financial deregulation phase, growth of the capital market led to rising mortgage securitization and the increasingly blurred lines between activities of market players such as commercial banks, insurance companies and investment banks and the increased role of institutional investors such as pension and mutual funds. The usage of various derivatives instruments and the role of new types of investors also started to increase rapidly in the 1990s. One important example was a rapid expansion of loans via issuance of Collateralized Debt Obligations (CDOs). As credit risk transfer instruments, CDOs can facilitate the dispersion of the risk across a wide range of investors, and expose the financial and banking sectors as a whole to potential risks due to the difficulty in obtaining correct valuation.

The key event in the current episode (1999-2008) is the global financial imbalances driven by widening US current account deficits. The buildup of the US current account deficits has mirrored reserve accumulation by emerging market and oil producing economies. It has led to the emergence of new class of institutional investors that include central banks and sovereign wealth funds. It is also the period where bank credits have increasingly been extended through the Originate-to-Distribute (OD) model. Although this model has significantly helped increase banks' ability to expand credit, it has also elevated risks to holders of related financial instruments. Significantly, these imbalances pose risks to US economy as well as the global economy especially through rising capital flow volatility.

Throughout all the three periods, despite benefits that can be derived from financial market development, serious challenges have occurred in terms of increasing risk exposures and uncertainty in the financial system that have led to episodes of financial instability as shown in Box 1.1. Besides, there is also an important question about the impact of these developments on the transmission of monetary policy.

For the greater understandings about the increasingly complex financial market, this section examines the key elements of changes affecting the financial market environment related to market structure, players, instruments, rules and regulations, and economic conditions. Then we turn to the question of how these changes have effected monetary policy transmission. This part will be a background for further empirical investigation in Section II.

A. KEY ELEMENTS OF CHANGES IN FINANCIAL ENVIRONMENT
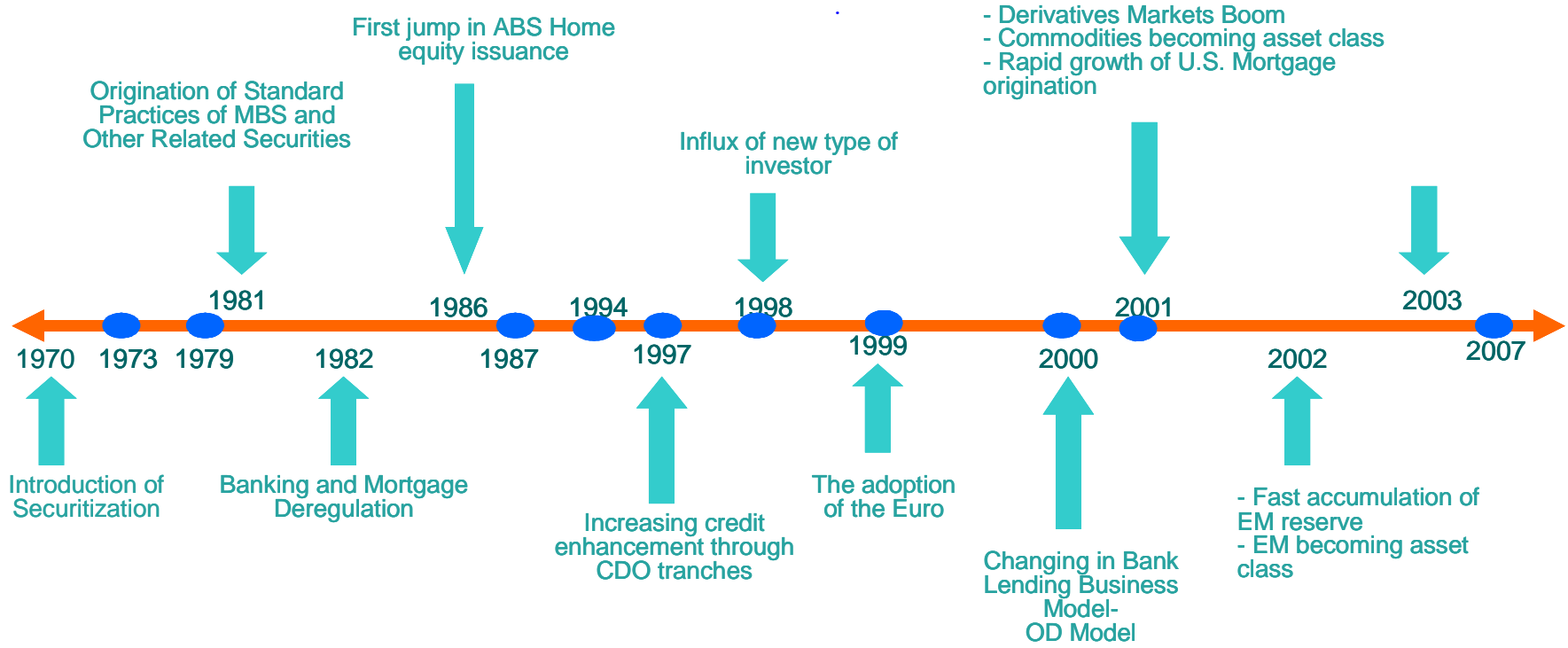
1. MARKET STRUCTURE

In term of market structure, two notable developments are changes in the lending structure and the degree of market integration.

1.1 New lending structure

One of the most crucial changes in the US is banks' lending practice. From the traditional framework of lending and holding on to the claims in the banks' balance sheet until maturity, there have been shifts towards a new lending structure called "Originate-to-distribute model" (OD model) since the early 2000s. In this model, the lender (or the originator), not limited to just banks, would sell loans to the structured investment vehicle (SIVs). The SIV would issue an Asset Back Securities (ABS), collateralized by pool of these loans, to investors. Therefore, under this model, the originating financial institutions could transfer risks to the rest of the economy.

The two key impacts on financial markets of this new lending structure are the rapid credit growth and the moral hazard problem from lower lending standard associated with the new loans. The former impact is because, commercials banks, acting as originator, are no longer constrained by regulatory balance sheet requirement. On the other hand, the latter can be because the originators do not have to accept responsibility for any losses from investor default. The reason is they have no incentive to maintain a high standard on par with lenders in the traditional lending model.

Box 1.1: Timeline of the Changing Global Financial Environment

Origination of Standard Practices of MBS and Other Related Securities

First jump in ABS Home equity issuance

- Derivatives Markets Boom
- Commodities becoming asset class
- Rapid growth of U.S. Mortgage origination

Influx of new type of investor

1981 — 1986 — 1994 — 1998 — 2001 — 2003

1970 1973 1979 1982 1987 1997 1999 2000 2002 2007

Introduction of Securitization

Banking and Mortgage Deregulation

Increasing credit enhancement through CDO tranches

The adoption of the Euro

Changing in Bank Lending Business Model-
OD Model

- Fast accumulation of EM reserve
- EM becoming asset class

List of major financial crises:
        1973 – 1st Oil Crisis
        1979 – 2nd Oil Crisis
        1987 – Black Monday: stock markets around the world crashed
        1994 – Mexican Peso Crisis
        1997 – Asian Financial Crisis

1998 – 1) Russian Financial Crisis
          2) LTCM Crisis
2000 – Bursting of the dot-com bubble
2001 – Argentina Crisis: Peso devalue, debt payment suspended
2007 – U.S. Subprime Crisis

1.2 Financial market integration

The pace of financial market integration has been astounding, as can be seen by the jump in cross border financial claims and direct foreign investment over the past three decades. Some of the factors that have been behind this rapid development include; 1) capital account and financial sector liberalization; 2) reducing costs of foreign investment as transaction costs have declined from technological innovation as well as financial innovation; 3) implementation of risk management at the global scale as investors can take advantage of diversification benefits both across asset classes and across economies and; 4) reducing home bias preference. Over the years, there has been growing convergence in asset price movements as a result of this increasing financial market integration.

2. INSTRUMENTS

The two most important financial instruments that have increasing effects on the financial markets are securitized/structured products and derivatives.

2.1 Securitized/Structured products

Securitization has become growingly important in the US since 1980s especially for mortgage loans. In 1980s, household mortgages stood at slightly less than 50 percent of household income but they rose to around 100 percent by the end of 2007. In the recent years, the growth of Asset-Backed Securities (ABS) was rapid, with the amount rising, from USD 425 billion in 1998 to USD 1,460 billion in 2007 globally. This rapid growth was largely supported by the growing issuances of 'private label' securitization[1]. Importantly, the growth in private label securities have been associated with worsening credit qualities of the underlying assets. Despite the fact that these instruments allow increasing access to borrowing, are welfare enhancing for households, they raise the borrowers' leverage. Hence, they could also raise a potential for systemic risk should a downturn occur as clearly shown by the subprime crisis that started in 2007.

Collateralized Debt Obligations (CDOs) which refer to unregulated asset-backed securities[2] are one of the most notable structured products. The market for CDOs grew remarkably quickly at an annual rate of around 63 percent, rising from USD 75 billion in

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[1] Private Label securities are mortgage backed securities (MBS) which do not conform to the loan limits set by the Government Sponsored Enterprises (GSEs) in terms of size, sufficient documentation or other certain lending criteria.

[2] Asset-Backed Securities (ABS) are debt securities issued with a pool of assets as collateral.

2005 to USD 200 billion in 2007. The use of CDOs adds an additional layer in the securitization process to an otherwise already complex system that began with the OD model. It also increases the opaqueness about the sources and utilization of funds. In particular, it raises two important issues: lending standard and dispersion of risk. Under such a system that operates through many layers, it has become more difficult for loan originators to maintain the lending standard. Risks are dispersed to other sectors beyond the traditional banking such as investment banks and insurance firms and hence create greater possibility for systemic risk.

2.2 Derivatives

The global derivative market has grown very rapidly, doubling in size every 3 years. The type of derivatives that has had a markedly increasing impact on the financial markets is credit derivatives namely Credit Defaults Swaps (CDSs)[3]. Debt owners can use the CDSs to hedge or insure against credit events (such as a default) on a credit asset. Such derivatives have been used to facilitate in the issuing of CDOs as risks can be displaced to the market. However, they also have an adverse implication on financial stability because credit default swaps have also been used for speculative purposes as there is no requirement to hold any assets or face a loss.

Figure 1.1 Outstanding levels of Derivatives

Source: BIS, as of Dec 07
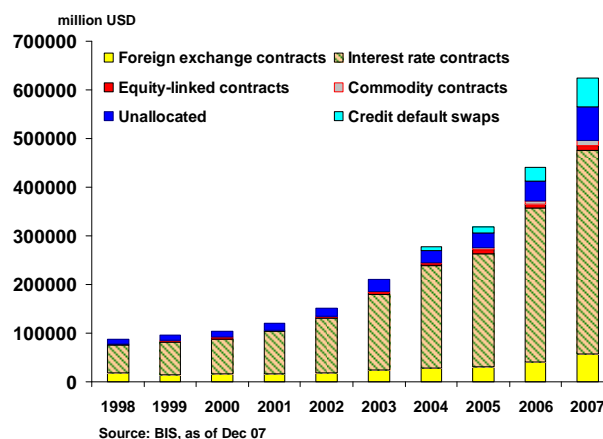
In general, large scale usage of derivatives can help enhance greater market efficiency through the transfer of a specific risk of the underlying security between the seller and the buyer, the decreasing costs of capital, the increasing volume of transactions from high leverage, and greater arbitrage opportunities between different assets.[4] In

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[3] Credit Defaults Swaps (CDSs) is a credit derivative that offers buyer protection against the default of underlying instrument in exchange for periodic premium payment.

[4] Vrolijk (1997)

contrast, the adverse effects on the capital market include amplified price movements that arise from dynamic hedging across multi asset classes and sectors, and a potential for systemic risks stemming from under collateralized counter parties in an event of margin call.

3. PLAYERS

The three main developments in the financial environments related to market participants are changes in composition of household portfolios, and growing importance of hedge funds/ Structured Investment Vehicle (SIVs) as well as Sovereign Wealth Funds (SWFs).

3.1 Households

In the US, roughly over 70 percent of household liquid financial assets are in stocks, bonds, and mutual funds, rising from under 50 percent in 1975.[5] Hence, the household financial conditions are increasingly linked with the financial markets. This crucially implies that households and their consumption could be more exposed to fluctuations in asset prices.[6]

Figure 1.2 Financial Assets of Households and Nonprofit Organizations
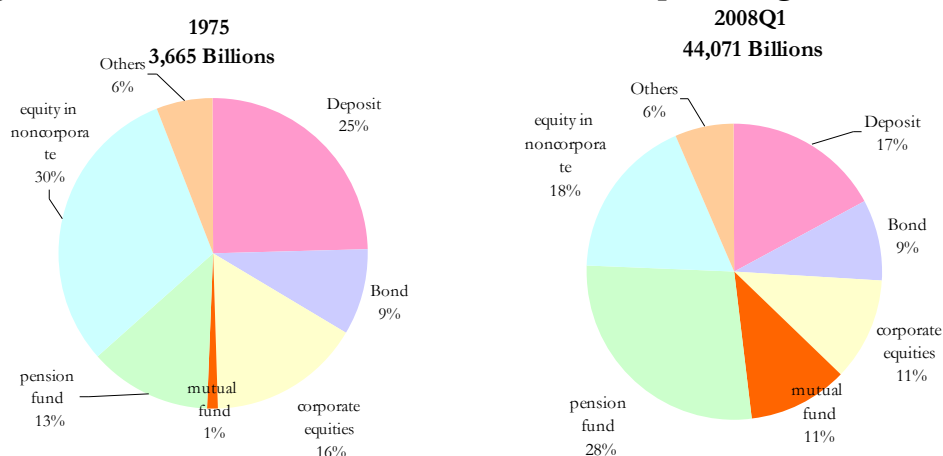
Sources: Flow of Funds Accounts of the United States, Board of Governors of the Federal Reserve System.

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[5] According to Federal Reserve data, nearly three-fourths of Americans' liquid financial assets today are securities-related products, such as stocks, bonds, and mutual funds (73 percent), with the balance in bank deposits and certificates of deposit accounting for the rest. In 1975, more than half of Americans' assets were in bank deposits (55 percent). Source: http://www.federalreserve.gov/releases/Z1/ and http://www.sifma.org/research/statistics/key_industry_trends.html

[6] The total value of households and nonprofit organizations financial assets grew from $3.7 trillion at year-end 1975 to a peak of $45.6 trillion in the third quarter of 2007, before falling back to $44 trillion in the first quarter of 2008

3.2 Hedge funds/SIVs

Given the diverse spectrum of activity in which hedge fund are engaged in, it is difficult to precisely define what it is. However, they may be defined loosely as "managers of private capital that use an active investment to play arbitrage opportunities that arise when mispricing of fundamental instruments emerge."[7] Under this guise, it can be said that hedge funds have added market liquidity in the situation of pricing anomalies. Although the size of assets under management (AUM), estimated to be only around USD 1.4 trillion in 2007[8], was relatively small compared to other groups', its share of trading was considerably larger. One important role of hedge fund has been an early adopter of credit risk transfer products[9] to an extent that, as a group, hedge funds could account for as much as a half of the trading volume in the structured credit markets.

Structured Investment Vehicles (SIVs) are entities established for raising funds through issuances of short term securities, such as Asset Backed Commercial Paper (ABCPs) and using the proceeds to purchase ABSs and MBSs. Typically, SIVs are usually linked with commercial banks but remain off balance sheet. It is "this linkage" that has been the source to some of the difficulties faced by banks in the recent financial market turmoil. SIVs have helped enhance liquidity in the financial markets and the economy, in particular, for residential mortgages. Nevertheless, at the same time, they have also contributed to rising systemic risk in the banking system. Another implication of the growing importance of SIVs as a channel for investment is the increase in foreign investment in the US ABS market. It is estimated that, currently, the gross foreign exposure is around USD 2.6 trillion or roughly 7 percent of global ex US equity market capitalization[10] and foreign MBS holdings grew from around USD 200 billion in 2003 to over USD 1 trillion by 2007.[11]

3.3 SWFs

The other important development in terms of market participants has been the rise of Sovereign Wealth Funds (SWFs) that has accompanied the growth in foreign

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[7] Blundell-Wignall (2007a), p. 41

[8] Blundell-Wignall (2007a), compared to mutual fund around USD 18 trillion

[9] Basel Committee on Banking Supervision: The Joint Forum on Credit risk transfer, July 2008

[10] Beltran, Pounder and Thomas (2008), p.6

[11] OFHEO Mortgage markets and the enterprises in 2007 (2008) / Board of Governors of the Federal Reserve System

reserve accumulation.[12] These funds are generally set up to increase diversification as well as returns, with varying investment objectives among countries and the set-up structures. It is estimated that the total size of SWFs was around USD 2.6 trillion as of 2006-2007.[13]

Two key implications of this large and growing pool of funds on the financial market are in terms of financial stability. Given its growing size, it could create global excessive liquidity effects that feed into asset price bubbles. Additionally, given its large size, it can lead to excessive concentration in particular markets which may result in excessive market swings as a result of portfolio adjustment.

4. RULES

In the US, two important big steps of banking legislations occurred during the past couple of decades with significant impact on the US financial landscape. The first group was related to the functioning of depository institutions and monetary control in 1980 whereas the second group was about deregulation of financial institutions between 1994 and 1999.

The most important substance of the Depository Institutions Deregulation and Monetary Control Act of 1980 was the removal interest rate ceilings. It also undid earlier segregation of key financial institutions namely traditional banking, insurance and securities underwriting. In the subsequent move, the Financial Services Modernization Act of 1999 (Gramm–Leach–Bliley)[14] allowed affiliation between those banks, insurance companies and securities firms through a Financial Holding Company (FHC) structure. The crucial impact of these changes on the financial landscape was the increased level of competitions.

An increasingly noteworthy issue in terms of rules is a change in accounting requirement namely the US Generally Accepted Accounting Principles (US GAAP) and the International Financial Reporting Standards (IFRS), aiming to improve the practice of financial asset valuation.[15] However, the shortcomings of this type of rules have been

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[12] In addition, the other large pool of funds that has arisen in recent years is Public Pension Reserve Funds (PPRFs). Blundell-Wignall, Hu and Yermo (2008) give definition of SWFs and PPRFs in more details, the latter of which include Sovereign Pension Reserve Funds (SPRFs) and Social Security Reserve Funds (SSRFs)

[13] Blundell-Wignall, Hu and Yermo (2008), p. 120

[14] For a good summary of Gramm-Leach-Bliley Act, see http://www.sifma.org/regulatory/glb/index.html

[15] The US GAAP classifies the reporting assumptions into 3 categories as; Level 1 those valuation containing quoted market prices as input; Level 2 those valuation containing observable information of

recently revealed since the recent financial turmoil. As market liquidity dried ups, banks and other financial institutions were forced to increase the usage of model base valuations rather than the market ones.[16] However, it is difficult for the model based valuation to correctly capture the various market factors such as market liquidity and counterparty credit risks[17]. Hence, the lack of confidence for model based valuation process, in particular during time of financial crisis, served to undermine efforts aiming at alleviating market liquidity and credit crunches. Instead, it tended to help prolong the burgeoning turmoil. In addition, the other drawback pertaining to this new methodology for valuation is the pro-cyclical nature of the approach. In period of economic upturn, the valuation would tend to be off the mark to the upside, creating larger-than-fundamental valuation and exposing the financial structure to excessive risk taking and the possible systemic risk[18]. On the other hand, during the downturn, valuation would be depressed and exacerbate the down cycle.

5. ECONOMIC CONDITIONS

Economic fluctuations have declined markedly in most economies since 1960s. For the US, from 1960 to 1990, the volatility of year-on-year quarterly real GDP was slightly over 2 percent, but, from 1990 to 2007, it approximately fell to 1 percent. In addition, we have witnessed an extended period of growth together with the low inflation environment in the past decade. Among important changes that have likely contributed to this favorable economic environment are changes to the conduct of monetary policy in the US towards increased transparency in the decision making that began in 1980s[19] and from an increase in globalization particularly from increasing international trade.

One plausible implication of such stable economic environment has been the complacency of investors as they believe that such an environment would be sustained.

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similar or related instrument as input; Level 3 those valuation whose computation is not based on observable market information.

[16] Basel committee on Banking Supervision: Fair value measurement and modeling: An assessment of challenges and lesions learned from the market stress, June 2008, p. 3

[17] Cited example is the counterparty risk of monocline insurers who sell protection on tranches of collateralized debt obligations (CDOs).

[18] Landsmans (2006) identify issues that need to be considered by regulators when implementing such measures.

[19] "The Federal Reserve's objective for open market operations has varied over the years. During the 1980s, the focus gradually shifted toward attaining a specified level of the federal funds rate, a process that was largely complete by the end of the decade. Beginning in 1994, the FOMC began announcing changes in its policy stance, and in 1995 it began to explicitly state its target level for the federal funds rate. Since February 2000, the statement issued by the FOMC shortly after each of its meetings usually has included the Committee's assessment of the risks to the attainment of its long-run goals of price stability and sustainable economic growth." http://www.federalreserve.gov/fomc/fundsrate.html

This could lead to a mispricing of risk by investors as they are willing to take on more risks, which can be seen through the sustained low level credit spreads particularly for high yielding instruments. In combination with a low interest rate environment, this, in turn, implies that investors may push up the risk curve in search for yields, raising systemic risks in the financial market.

I.2 Monetary transmission and impact of new financial environment

Before discussing how the new financial environment factors affect monetary policy transmission, we think it will be beneficial to start with the review of the mechanics of monetary policy transmission. Changes in monetary policy can affect the real sectors through various channels. The main channels include interest rate, credit, asset prices and exchange rate.

In the interest rate channels, the two stages in the correspondence between monetary policy and interest rates are the changes in monetary policy to the changes in policy rate, and the changes in policy rate to the changes in interest rate charge to the financial and real sectors. For the latter, the changes in financing cost of capital cause a shift in aggregate demand as businesses and individuals alter their investment and consumption behavior. The transmission between policy rate and financing costs of capital or market interest rate depends on three features of the financial market[20]; 1) the structure of the banking system which affects the degree and speed that banks' costs of fund would be passed on to borrowers; 2) the market transmission mechanism of interest rate, such as 'portfolio substitution'[21] and; 3) the expectation of future interest rate. Given that long term rate is a combination of current short rate and expectation of future interest rates, any changes in this expectation going forward that are deemed permanent in nature would lead to a change in long term rate.

The Credit channels stem from asymmetric information in the credit markets and comprise the bank lending channel and the balance sheet channel. Both of these channels address the quantity issue of loan size available to businesses and consumers. As for the bank lending channel, expansionary monetary policy translate into a rise in bank's reserve and deposits and an increase in the amount of loanable funds available for

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[20] Sellon (2002) p. 7

[21] For example, an increase in Fed Funds rate leads to a portfolio substitution from long-term assets to short-term assets as the relative yield on short-term assets rise. This change will tend to lower the prices of long-term assets and increase the long-term yields and rates. The nature of the response of long term yield to changes in policy rate depends crucially on the institutional structure of the financial market.

borrowers. Therefore, it raises the amount of investment made by businesses. This channel will be particularly important for firms who do not have direct access to the financial markets and have to rely on banks for sources of funding such as SMEs. In the balance sheet channel, the amount of borrowing by firms as well as households is restricted by their net worth. An increase in policy rate could affect borrower's valuation of future cash flows and, in turn, affect borrower's creditworthiness and hence alter credit risk premium they are charged. The magnitude of this premium depends on the degree of adverse selection and moral hazard problem between banks and borrowers.

In the asset price channel, changes in interest rate alter the valuation of equity prices relative to acquisition costs of underlying asset, and therefore cause firms to alter their capital expenditure decision. As for consumers, an increase in the value of financial wealth may make them more willing to increase their personal spending.[22]

For the foreign exchange channel, monetary policy can cause the domestic real interest rate to change relative to those in other countries. All else equal, an increase in real interest rate differential would lead to an inflow of capital into the higher yielding real interest rate countries and hence stronger currencies. This will lead to worsening net exports and aggregate demand. How well this channel functions is determined by the degree of real exchange rate movement, as well as the pace to which businesses and consumers adjust to changes in exchange rates.

Base on these channels of monetary transmission, we attempt to identify the potential impact that the new financial environment may have in the various channels. As shown in table 1.1, there are several financial environment factors that will speed up or amplify the magnitude of the monetary transmission, and those that will reduce its speed and magnitude. Some factors such as the usage of the OD model and increasing securitization could both enhance and diminish impacts on the monetary policy transmission through different channels. However, the net overall effect is far from certain. We will therefore explore the implication on monetary transmission further in our empirical analysis in the next section.

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[22] Federal Reserve Governor Gramlich (2002) noted that in aggregate, this wealth effect channel is complicated and depends on the nature of equity price rises "whether they derive from changes in expected profits or from changes in discount rates". A rise in stock prices from increase in expected profits, possibly from increase productivity, would cause consumers to increase spending. On the other hand, a rise in equity prices from changes in the discount rate may not induce the same amount of consumption spending increase if the consumers are not really better off.

Table 1.1: Impact of new financial environment

Keys: 🡅 Increase effectiveness 🡇 Reduced effectiveness ⬌ Indeterminate
[MS] = Market structure, [I] = Instruments, [P] = Players, [R] = Rules and [EC] = Economic condition

Channels	Effectiveness	Impact of new financial environment
Interest rate channel	🡅	[MS] OD model allows for more rapid rate adjustment based on market conditions[1]
	🡅	[I] Increasing usage of Adjustable rate mortgage (ARMs) enhances feed through of rate to consumers
	🡅	[R] Lifting of ceiling on deposit interest rate allows for greater adjustments in response to change in policy
	🡇	[P] Excess liquidity from new players such as hedge funds & foreign investors render domestic rate ineffective
	🡇	[R] Increasing competition in financial industry means banks cannot pass on higher rate to customers[2]
Credit channel	🡅	[MS] OD model increases access to loans for a larger group of borrowers, and hence broaden the impact of a policy change
	🡇	[MS]/[I] OD model/securitzation reduce the role of bank's credits
Asset price channel	⬌	[MS] Increasing financial market integration may lead to increasing responsiveness in the domestic economy as investors can enter/exit market[3], but co-movements in asset prices lessen the interest rate feed through
	⬌	[I] Use of derivative increases the speed of price adjustment but the impact on interest rate is indeterminate as some agent hedge their positions which can delay the impact[4]
	🡇	[EC] Relatively stable economic conditions can lead to increasing risk seeking behavior and subsequently higher asset prices, thereby reducing the effects of changes in policy rate
Exchange rate channel	⬌	[MS] Exchange rate adjustment is inhibited through greater economic synchronization but enhanced from increasing international capital flows
	⬌	[I] Growing derivative usage may lead to delay on impact for some users, but others may face the adjustment sooner

Remarks: [1]Estrella (Forthcoming) studies the changes in response of mortgage rate changes in federal funds rate and found stronger respond with securitization. [2]Kuttner and Mosser (2002) pointed out that changes in regulation has resulted in increasing competition and increasing importance of price of credit in monetary transmission but the overall impact is an open question. [3]Mylonas, Schich and Wehinger (2000) noted that the gross foreign portfolio liabilities to GDP increased by 30 percent from 1985 to 1998 and this led to more price correlation between markets. [4]Vrolijk (1997) found no evidence that derivative usage had effected monetary transmission in the UK.

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[58] From the cross-country evidence, Cottarelli and Kourelis (1994) found that different degrees of pass-through were due to competitive structure of the market, individual bank' policies about market shares, deposit structure, business cycle, credit risk, as well as volatility of interest rates.

II. The Investigation about Monetary Policy Transmission Mechanisms under the New Financial Environment

As various financial environment factors could affect monetary policy transmission channels in different ways as discussed in Section I, the main question of this section is whether the overall effects of monetary policy on the US economy have increased or diminished in the new financial environments.

Our approach to analyze the dynamics of a change of the policy interest rate on macroeconomic variables relies on two main tools. Firstly, we employ *the Error-Correction model (ECM)* to investigate the interest rate pass-through from the Fed Funds rate to money market as well as retail interest rates. We attempt to investigate the potency of monetary policy in influencing interest rates in the new environment in terms of both the size and speed.

Secondly, we utilize *the Vector Auto-Regressions (VARs)* method to examine the other transmission channels, namely bank lending, asset price, balance sheet, and exchange rate, of the US monetary policy to output and inflation. We are interested in detecting the changing importance of these channels in the different financial environments and the impact of important financial environment factors on effectiveness of monetary policy.

A. Interest Rate Pass-through

The interest rate channel of monetary policy plays one of the key roles in determining how the economy would respond to monetary policy as discussed earlier. Monetary policy will be more effective in influencing economic activity when the pass through from the Fed Funds rate to other interest rates increases. However, the extent to which monetary policy influences different interest rates can vary across types of loans and securities. This implies varying effects of monetary policy on different components of GDP.

For retail interest rates, changing monetary policy actions affect the supply of bank reserves and the funding cost of banks, leading to a pass through from loan rates onto consumers and businesses. For market interest rates on securities, the transmission can be less straight forward especially through the aforementioned portfolio substitution from long-term assets to short-term assets as the relative yield on short-term assets changes. Market expectation is also an important way in which monetary policy can

affect market interest rates. As both current and future short-term rates determine long-term interest rates, monetary policy will have a larger effect when financial market participants view that a monetary policy action will persist for a certain period of time. In fact, such an expectation can be so powerful that money market interest rates adjust ahead of a change in the Fed Funds rate if market participants anticipate the future change in policy actions.

Several aspects of the changing financial environment have likely affected the pass through from monetary policy to the retail rates as summarized in Table 1.1. Increasing competition among banks and between banks and non-bank financial intermediaries can narrow banks lending margins and therefore make them more responsive to tightening monetary policy.[58] Increasing variable and adjustable interest rate loans and increasing refinancing can raise the response of loan rates to monetary policy as an increasing proportion of loans respond more automatically to changing monetary policy actions. Interest rates on securitized loans and those through the O-D model are likely to adjust more closely with market interest rates because mortgage backed securities are priced competitively with similar securities in the capital market. Therefore, the response of these interest rates will likely to be more in line with the response of market interest rates to monetary policy.

Credibility and greater transparency of monetary policy could also speed up the response of long-term market rates as they depend on the expectation of future policy actions. In addition, costs from adjusting loan rates which have prevented banks from quickly changing their rates in response to a change in policy rate could decline with more timely information about monetary policy.

On the other hand, rising financial market liquidity, choices of funding from the new breeds of financial market funds, and increasing international financial integration can reduce the speed and size of response of retail and money market interest rates to monetary policy.

With those potential effects in the background, to investigate the possibly changing potency of the interest rate channel in the US, we examine the speed of adjustment and the degree of pass-through of retail and money market rates from the Fed Funds rate in the different financial environment periods between 1971 and the first half of 2008. In addition, to capture different market segmentations, the money market interest rates in the investigation include the one-month commercial paper rate for non-financial

institution as well as the three-year and ten-year government bond rates whereas the retail rates include the prime rate, the personal loan rate, and the mortgage rate. The frequency of all of the interest rate data is monthly except the quarterly frequency for the personal loan rate.

We choose the ECM method as it is based on the underlying notion that non-stationary time series can be governed by a long-run stable relationship although they may drift apart in the short run. Even though interest rates are non-stationary, their long-run relationship can still be established through the ECM if they are cointegrated. This technique allows us to detect the long-run and short-run pass though altogether with the short-run speed of adjustment. Moreover, in this section, we investigate the lead-lag pattern between market interest rates and the Fed Funds rate employing the cross-correlation method.

In the study, we start the analysis by testing for unit roots for the Fed Funds rate and the other interest rates. It is found that all of them are non-stationary in the level but stationary for the first difference or they are integrated of order one I(1) except the one-month commercial paper rate which is I(0) as shows in Appendix B. The cointegration test between the Fed Funds rate and each of the other interest rates demonstrates an existence of cointegrating relationship as also shown in Appendix B. Therefore, we can estimate the ECM, employing the two-step Engel-Granger method.

For the ECM estimation, firstly, we estimate the long-run equation for the whole sample period with each of the retail and market interest rates as a dependent variable and the Fed Funds rate as a regressor. Then we perform unit root testing for the residual of the long-term regression. If the residual is stationary, the short-run equation can be estimated with the first difference of each of the above interest rate as a dependent variable and the first difference of the Fed Funds rate as well as the lagged residual of the long-term equation as regressors. The coefficient of this lagged residual term indicates the speed of adjustment in the short-run toward the long-term relationship.

To check if each of the long-term and short-term relationship has structural break points in 1983 and 1998, we carry out Chow Breakpoint test for each one of the questions. The null hypotheses of no breaks at the above specified break points are rejected in all cases as presented in Appendix C.

In order to investigate the pass through during different financial environment periods, we estimate both the long-run and short-run equations with the multiplicative

terms of the Fed Funds rate and two dummy variables representing the periods 1983-1998 and 1999-2008 as additional regressors. The coefficient of each multiplicative term indicates an incremental pass through from the Fed Funds to the respective interest rate from that of the whole sample period. The results of these ECM estimations are presented in table 2.1.

Table 2.1 Interest Rate Pass Through: ECM

ECM:Engel-Granger	Period	1971-2008	Dummy for 1983-1998	Dummy for 1999-2008	Speed of Adjustment
Prime rate	Long Run Pass-through	0.96	0.07	0.11	
	Short Run Pass-through	0.27	0.34	0.74	0.24
Personal loan rate	Long Run Pass-through	0.35	0.19	-0.02*	
	Short Run Pass-through	0.05*	0.25	0.36	0.16
One month commercial paper	Long Run Pass-through	0.97	0.03	-0.07	
(Non-financial institutions)	Short Run Pass-through	0.45	0.38	0.68	0.49
Three month treasury note rate	Long Run Pass-through	0.86	0.08	-0.07	
	Short Run Pass-through	0.39	0.34	0.51	0.24
Ten year treasury bond rate	Long Run Pass-through	0.61	0.11	-0.33	
	Short Run Pass-through	0.09	0.25	-0.08*	0.05
30 year average mortgage rate	Long Run Pass-through	0.68	0.11	-0.25	
	Short Run Pass-through	0.11	0.28	-0.08*	0.07
* Not significant at 95 percent confidence interval					

We find that during 1983-1999 the pass through from the Fed Funds rate to all of the interest rates in our study increased. However, in the subsequent period, only the pass through to the prime rate increased for the long-term one. The most distinct observation is the decline in the long-term pass through to ten-year Treasury and mortgage rates in this later period. These results indicate varying effects of monetary policy on borrowing costs for households, firms, and investors in the financial market and across the maturity of interest rates.

The interest rate pass through from the Fed Funds rate to the prime rate appears to be a complete one as shown by the close to one long-run pass through coefficient and an immediate one as demonstrated by an increase in the short-run pass through together with the relatively constant spread between the prime rate and the Fed Funds rate since the early 1990s as shown in figure 2.1. The complete and immediate pass though for the case of the prime rate is likely associated with increasing competition and greater transparency of monetary policy as discussed earlier.

For the personal loan rate, rising competition, a prominent shift from fixed to variable-rate loans during 1980s could be the main reasons for the increased pass through during 1983-1998. In particular, as several variable-rate loans are indexed to an index such as the prime rate, a rising pass through from the Fed Funds rate to the prime rate could directly contribute to the effect of the change in policy rate on the personal loan rate.

Figure 2.1 Prime and Personal Loan Rates and Spreads

Source:Bloomberg
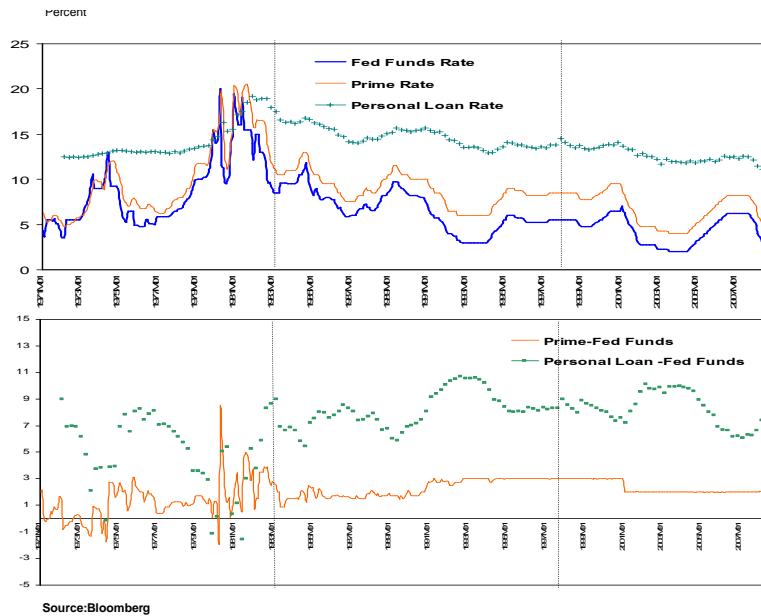
As for the money market rates, the two short-term interest rates, namely the one-month commercial paper rate for non-financial institution as well as the three-year and the long-term interest rate, exhibit the similar response to the policy rate. Their long-run pass through from the Fed Funds rate is high and their short-run pass through rose significantly in the above two subsequent periods. This increase of the short-run pass through has made the speed of the adjustment more immediate in response to the policy change.

Figure 2.2 Short-term Money Market Rates and Spreads
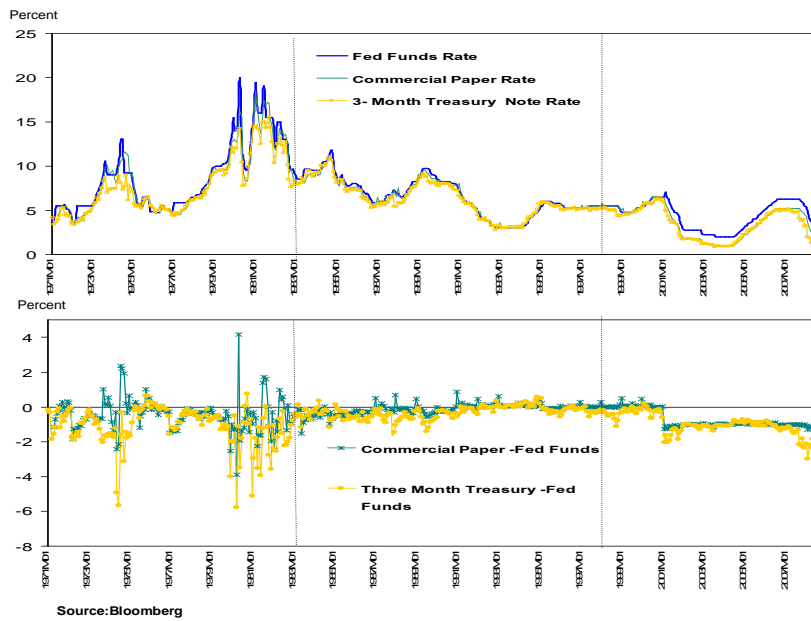
The pass through from the Fed Funds to the 10-year Treasury bond is far from being complete as the long-term pass though coefficient is 0.61 for the whole sample period. Closely similar to that of the 10-year Treasury is the pass-through coefficients of the mortgage rate. This largely reflects the changing structure of housing finance in the US including deregulation of mortgage markets in the late 1970s and early 1980s[59], increasing variable and adjustable rate mortgages, and most notably securitization of mortgage loans.

Figure 2.3 Long-term Money Market and Mortgage Rates and
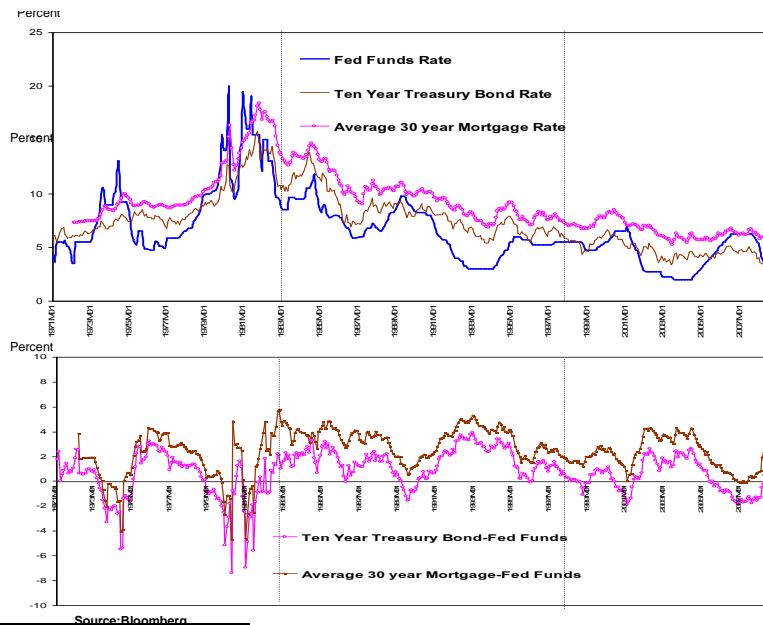
[59] One important change was the elimination of interest rate ceilings for deposit rates which were gradually done over a period of time.

Importantly, the significantly declining long-run pass through of the long-term money market and mortgage rates together with the somewhat declining long-run pass through as well as the considerably rising short-run pass of the short-term market rates could all be evidence indicating that money market players have frequently anticipated the monetary policy actions in the new environment. If so, we would witness a change in money market rate ahead of that of the Fed Funds rate.

To obtain a clearer picture about the responsiveness of those interest rates to monetary policy actions, we further investigate the lead-lag patterns between these interest rates and the Fed Funds rate by looking at the cross-correlation between each of the above interest rates and the Fed Funds rate during the different financial environment periods. The cross-correlation analysis shown in Table 2.2 demonstrates the correlation between the Fed Funds at time t±N and the other interest rate at time t. (When the highest correlation coefficient is at time t+N, the Fed Funds leads the other interest rate by N months) during the different financial environment periods. The information here provides an apparent indication about the changing adjustment of different interest rates compared with the Fed Funds movements.[60]

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[60] The cross correlation between the Fed Funds rate between T+ N to T-N and another interest rate at t could indicate the lead-lag relationship between them. The Fed Funds rate leads(lags) the other interest rate by N months if the correlation between the Fed Funds rate at T+N(T-N) and the other interest rate at T has the highest value.

Table 2.2 Cross correlation between Fed Funds Rate and Other Interest Rates (Monthly), except personal loan rate (Quarterly)

Cross correlation between Fed Funds rate and	Period	T-6	T-5	T-4	T-3	T-2	T-1	T	T+1	T+2	T+3	T+4	T+5	T+6
Prime rate	1971-1982	0.712	0.739	0.767	0.799	0.840	0.892	0.945	0.964	0.948	0.911	0.880	0.848	0.813
	1983-1998	0.828	0.860	0.890	0.914	0.936	0.955	0.968	0.960	0.944	0.923	0.897	0.869	0.840
	1999- Mid 2008	0.821	0.859	0.894	0.925	0.950	0.969	0.977	0.957	0.928	0.892	0.852	0.809	0.765
Personal loan rate	1971-1982	0.502	0.558	0.542	0.598	0.646	0.639	0.716	0.739	0.779	0.812	0.800	0.801	0.844
	1983-1998	0.686	0.721	0.756	0.785	0.798	0.835	0.861	0.834	0.857	0.861	0.834	0.841	0.840
	1999- Mid 2008	0.400	0.445	0.469	0.522	0.553	0.562	0.608	0.581	0.567	0.553	0.503	0.496	0.480
One month commercial paper (Non-financial institutions)	1971-1982	0.708	0.748	0.783	0.824	0.870	0.923	0.967	0.958	0.904	0.860	0.822	0.786	0.746
	1983-1998	0.871	0.899	0.925	0.949	0.969	0.985	0.994	0.984	0.967	0.945	0.921	0.898	0.873
	1999- Mid 2008	0.833	0.870	0.903	0.931	0.953	0.968	0.969	0.947	0.914	0.877	0.835	0.788	0.742
Three month treasury note rate	1971-1982	0.751	0.790	0.822	0.865	0.902	0.950	0.960	0.919	0.874	0.836	0.804	0.772	0.736
	1983-1998	0.874	0.903	0.930	0.952	0.972	0.985	0.987	0.973	0.954	0.931	0.910	0.887	0.860
	1999- Mid 2008	0.871	0.905	0.930	0.951	0.961	0.959	0.944	0.908	0.866	0.820	0.773	0.721	0.670
Ten year treasury bond rate	1971-1982	0.641	0.677	0.708	0.744	0.783	0.829	0.850	0.847	0.848	0.846	0.846	0.834	0.818
	1983-1998	0.746	0.772	0.797	0.814	0.827	0.834	0.833	0.817	0.801	0.784	0.771	0.758	0.744
	1999- Mid 2008	0.558	0.583	0.602	0.613	0.607	0.588	0.565	0.533	0.508	0.485	0.463	0.443	0.426
30 year average mortgage rate	1971-1982	0.591	0.618	0.653	0.687	0.725	0.768	0.824	0.852	0.854	0.853	0.855	0.854	0.838
	1983-1998	0.755	0.778	0.801	0.817	0.833	0.845	0.853	0.842	0.829	0.814	0.800	0.788	0.775
	1999- Mid 2008	0.476	0.509	0.536	0.555	0.568	0.572	0.566	0.555	0.547	0.541	0.533	0.528	0.523

Fed Funds lags   **Fed Funds leads**
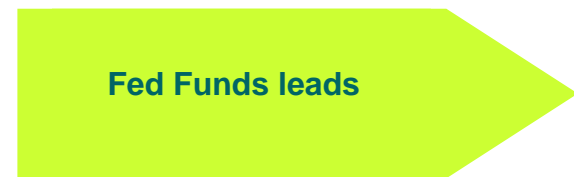
From our monthly data investigation, the Fed Funds rate led both the prime rate and the personal rate during 1971-1982. However, it moved contemporaneously with these two retail rates during 1999-mid 2008. Indeed, the Fed Funds rate no longer moves in advance of the other interest rates in this period. More importantly, the findings for the cases of the three-month Treasury note rate, ten-year Treasury bond rate and mortgage rate demonstrate that, in the current environment, these interest rates actually move prior to the policy rate. The most notable change is the case of the mortgage rate. Even though the mortgage rate lagged the policy rate by 4 months during 1971-1982, it moved simultaneously with the Fed Funds rate during 1983-1998 and preceded the movement of the Fed Funds rate in the latest period.

These findings from the cross-correlation analysis may help explain why we come across the declining long-run pass through of the Fed Funds to the ten-year Treasury bond rate and mortgage rates in the above ECM study. This is because it highlights the possible role of the rising significance of market expectation on the Fed Funds in monetary policy transmission. That is these interest rates might have adjusted in response to expectation about future monetary policy prior to the actual change in the policy rate. The essence is if the Fed can increasingly influence the market expectation about its policy actions, policy effectiveness may require a smaller magnitude of policy rate adjustment.

Therefore, we try to further examine the role of market expectation about future monetary policy in the interest rate transmission mechanism. In this investigation, we hypothesize that market expectation about policy plays an important role in the interest rate pass through. If so, a replacement of the Fed Funds rate with an indicator of market expectation about future monetary policy as a regressor in the ECM estimation would yield statistically significant and higher pass through coefficients. The indicator used in the analysis is the one-day forward rate two year ahead. We use this indicator because it could represent the market expectation about monetary policy in a two-year period (the commonly assumed operational time horizon of monetary policy framework) with a maturity close to the overnight Fed Funds rate. [61]

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[61] Forward interest rates can be extracted from the term structure as they are implied in the spot interest rates at any given time. The rationale behind this indicator is that the term structure provides not only information about interest rates from today until the maturity date, but also implied expected interest rates in the future. We construct this indicator by applying the linear interpolation between 2- and 3-year zero

We perform the ECM estimation for the pass through from the above forward rate to the ten-year Treasury bond rate and the mortgage rate to find out their pass through coefficients and compare them with those in which the regressor is the Fed Funds rate. With the readily available data for computing the forward rate from 1989, we re-estimate both the long-run and short-run equations for the period 1989-2008 with the Fed Funds rate and the multiplicative terms of the Fed Funds rate and the dummy variables representing 1999-2008 as regressors. We then estimate the long-run and short-run equations, replacing the Fed Funds with the forward rate. In this investigation, we are particularly interested in observing 1) if the long-run coefficient for the pass through from the forward rate will be higher than that from the Fed Funds rate and 2) if the coefficient of the multiplicative dummy for the period 1999-2008 will still be negative like the case of the earlier analysis. The results are shown in Table 2.3.

Table 2.3 Interest Rate Pass Through from Forward Rate: ECM

ECM:Engel-Granger	Period	1989-2008	Dummy for 1999-2008	Speed of Adjustment
Fed Funds rate =>Ten year treasury bond rate	Long Run Pass-through	**0.50**	**-0.36**	
	Short Run Pass-through	0.27	-0.40*	0.04*
Forward rate =>Ten year treasury bond rate	Long Run Pass-through	0.59	-0.22	
	Short Run Pass-through	-0.003*	-0.08*	0.19
Fed Funds rate =>30 year average mortgage rate	Long Run Pass-through	**0.50**	**-0.29**	
	Short Run Pass-through	0.41	-0.40	0.03*
Forward rate =>30 year average mortgage rate	Long Run Pass-through	0.55	-0.16	
	Short Run Pass-through	-0.02*	0.03*	0.07

* Not significant at 95 percent confidence interval

We find that, for both the ten-year treasury bond and mortgage rates, the whole period pass through from the forward rate is higher than that from the Fed Funds rate. Moreover, it declined less significantly than in the case of the Fed Funds rate for the period 1999-2008. The higher pass through for the case of this market expectation indicator substantiates the role of expectation on monetary policy transmission in the new environment. Nevertheless, the pass through is not close to one and still declined during 1999-2008. Hence, monetary policy likely affected the long-term interest rate more significantly through influencing market expectation about future policy. However,

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rates to find 2.003-year zero rate (equivalent to 2 year and 1 day zero rate). We, then, calculate the 1-day implied forward rates 2 year ahead from these zero rates.

we can not conclude that monetary policy has been substantially more effective in influencing the long-term interest rates.

The reason behind the still declining pass through to these two interest rates in the recent period is likely attributable to an inverted yield curve phenomenon which happened in during the end of 2005 to mid 2007. Although, economists agree that the causes of the inverted yield curves are difficult to entangle, the three main contenders have been the following economic and financial factors. First, the moderation of inflation in the current era due to cheaper products from low-cost economies and the success of US monetary policy in anchoring inflation expectation made market players anticipate low future inflation. Hence, they expected that, with the low future inflation, the Fed would allow the interest rates to stay at the low levels. Second, high demand for Treasuries and other U.S. debt might keep bond prices high. When demand was high, issuers such as the government could attract a lot of buyers despite the offered low yields. Several factors had an effect on demand for US Treasuries especially the demand from emerging market economy central banks associated with the rapid accumulation of foreign reserves and rising global financial liquidity. Third, short-term yields could rise due to an expectation of further tightening monetary policy while the concerns about the possibly continued rising Fed Fund rate undermined the outlook of the economy and suppressed the long-term yields.

Figure 2.4 Long-term Interest Rate and Forward Rate
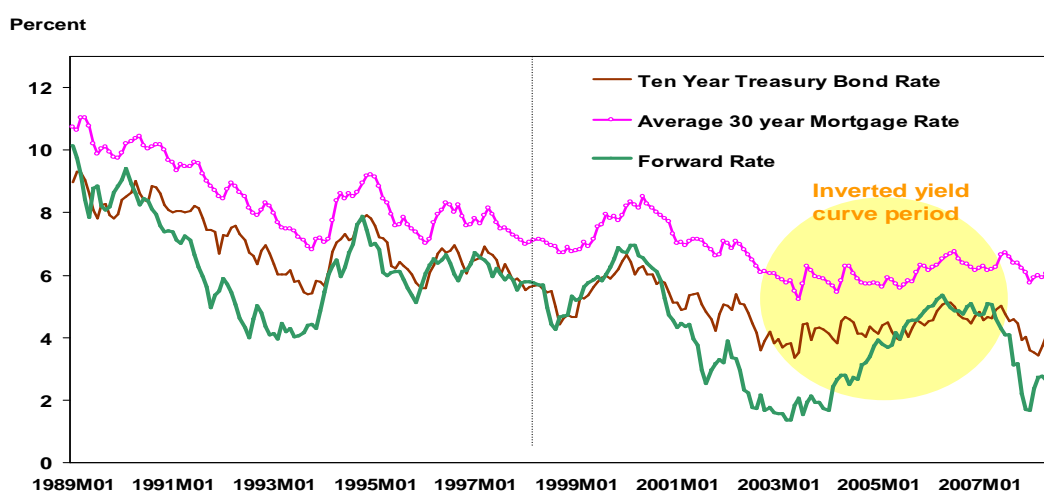
Source: Bloomberg

To summarize, this section of the paper has pointed out that the US monetary policy has been more contemporaneously effective in influencing the retail and short-

term market interest rates in the new financial environment. On the other hand, the long-term money market and mortgage rates have indeed moved in advance of the Fed Funds rate in the recent environment. That is likely because market expectation about future monetary policy has an important role in determining these interest rates. The main implication here is that monetary policy could impact the economy through a smaller change in policy rate if it can increasingly influence market expectation. However, the pass through of monetary policy to long-term market and mortgage interest rates when market expectation is already accounted for is still not at a high level.

B. VAR Investigation

Several studies have employed the VAR to analyze monetary policy effectiveness.[62] The main advantage in employing the VAR is that it can help us examine monetary policy transmission through different channels in the dynamic system of macroeconomic variables with minimal assumptions about the structure of the economy. In doing so, we employ the reduced form VAR rather than the Structural form VAR as, with no theoretical restrictions, the reduced form VAR allows us to study the feedback interactions between various variables in the system. In this section, we start by constructing the basic VAR model. Then, to evaluate the key aspects of monetary transmission overtime, it is expanded to the summary VAR model. The summary model is compared with their counterfactual cases to find out the importance of each monetary transmission channel. Moreover, we extend the summary model by including variables representing new financial innovations to analyze the changing transmission across periods. In addition, we are interested in not only the changing monetary transmission mechanisms but also the reactions of monetary policy to asset price innovations as presented in the next section.

Basic Model

We start with the basic VAR model with four quarterly endogenous variables, namely, GDP, GDP Deflator, commodity price and the Fed Funds rate. The Fed Funds rate is an indicator of US monetary policy in this VAR study.[63] Commodity price (the Commodity Research Bureau spot index for all commodities, 1967=100) is included here

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[62] Movements in the policy rate reflect both the central banks' response to the changing state of economy and their actions that are independent, or exogenous, from the changes. The VAR methodology is particularly useful for investigating an effect of monetary policy shock to the economy

[63] Bernanke and Blinder (1992), Sims (1992), Christiano, Eichenbaum, and Evans (1996) showed that the Fed Funds rate is significantly more superior to money supply as a monetary policy indicator.
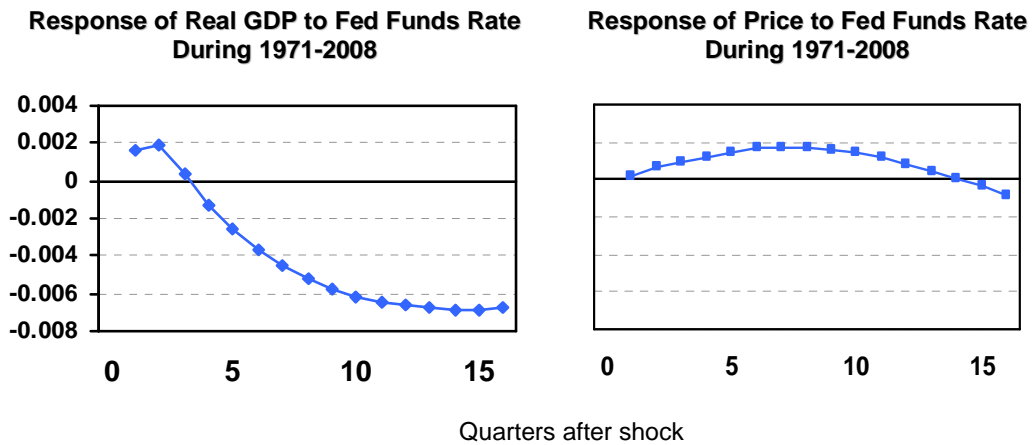
because it was found to help reduce the price puzzle, the positive comovement between Fed Funds rate and subsequent increases in prices which commonly occurs in the studies using VAR.[64] All the variables are in a logarithmic scale and seasonally adjusted with the exception of the Fed Funds Rate. The estimation is performed using the data from 1971Q1 to 2008Q2. Like in other studies, different lag length selection criteria could provide different optimal lag results. However, we choose the optimal lag length of two quarters according to the Akaike, Schwarz, and Hannan-Quinn information criteria as they are most common in other studies and for the parsimonious reason (not to include too many lagged terms). We also utilize Block exogeneity Wald tests to assess whether a variable of interest should be treated as an endogenous or exogenous variable. Moreover, we identify shocks by a standard Choleski-decomposition where the order of the variables in the VAR is suggested by Granger Causality test. In our case, the order which starts with the one being the least responsive is as follows: commodity price, Fed Funds rate, GDP, and GDP deflator.

The impulse responses of GDP and price to the innovations in the Fed Funds rate are illustrated in Figure 2.4. It should be noted that the price puzzle still exists here. The possible reason for this existing puzzle could be that the set of variables is still not enough to describe the dynamics of variables affecting the price in the US.[65] However, the inclusion of additional variables and the estimations of different subsamples for the different financial environment periods in the following parts provide the improved results.

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[64] The possible explanation of this puzzle in most studies using the VAR as suggested by Sims (1992) is that the simple VARs are unable to capture all the Federal Reserve's information about future inflation. Christiano, Eichenbaum, and Evans (1996) have showed that an inclusion of commodity prices in the basic VAR model would solve the price puzzle as they would provide significantly more information about future inflation.

[65] Like other econometric methodologies, the VARs have some limitations. Common issues concerning this empirical model are as followed. First, the standard VAR approach addresses only the effects of unanticipated monetary shocks, but not either the effects of the systematic portion of monetary policy or the choice of monetary rule (Sims and Zha 1998, and Bernanke, Gertler and Watson 1997). Second, the measurement of policy innovations is likely to be contaminated by the set of available information in the economy that is not reflected in the VARs. Moreover, impulse responses can be observed only for the variables included in the model, which generally account for only a small subset of the variables of interest. There are many attempts to investigate the solution to these limitations. One of them is the Factor Augmented FAVAR which tries to incorporate a larger set of information into the VAR. See Bernanke, Boivin, and Eliasz (2004) for further discussion. However, it is not the focus of our paper.

Figure 2.4 Basic VAR Model

| Response of Real GDP to Fed Funds Rate During 1971-2008 | Response of Price to Fed Funds Rate During 1971-2008 |

Quarters after shock

Source: Bloomberg, Commodity Research Bureau, authors' calculations.

Summary Model

After exploring the basic VAR model, we construct the summary VAR model which includes the key aspects of the transmission mechanism in the US. The candidate variables for the summary model apart from the ones in the basic model are representatives from the main monetary transmission channels, namely, bank lending (bank credit), balance sheet (business and household net worth), asset price (house and stock prices), exchange rate (dollar index).

There is a contemporaneous impact of household net worth on the other endogenous variables as shown in Appendix D. However, there is no significant feedback. Therefore, household net worth should be treated as an exogenous variable in our summary model. Moreover, stock prices and business net worth do not appear to be affected by the other endogenous variables. Thus, we do not include these two variables in our summary model. As a result, we are left with three channels of transmission for the investigation: bank lending, house price, and exchange rate. The Choleski ordering on the basis of the level of the responsiveness to the shocks is commodity prices, followed by exchange rate, Fed Funds rate, GDP, bank credit, GDP Deflator, and house prices, with household net worth being an exogenous variable.

Figure 2.5 Summary Model

Response of Real GDP to Fed Funds Rate
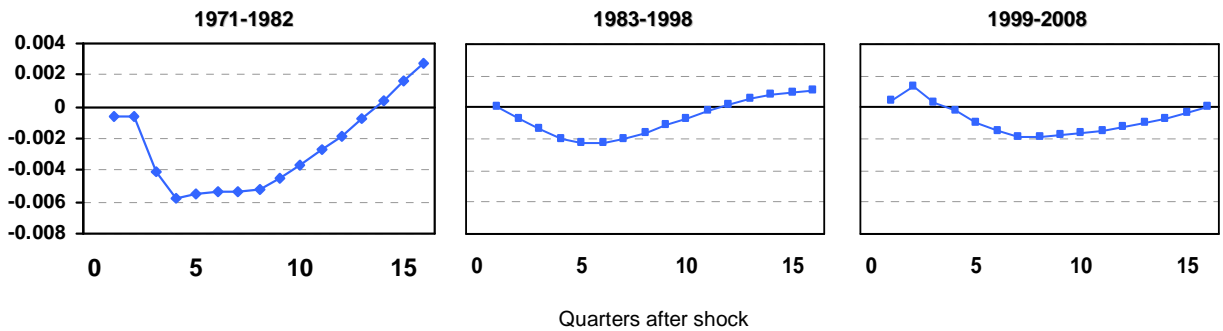
Quarters after shock

Response of Price to Fed Funds Rate

Quarters after shock
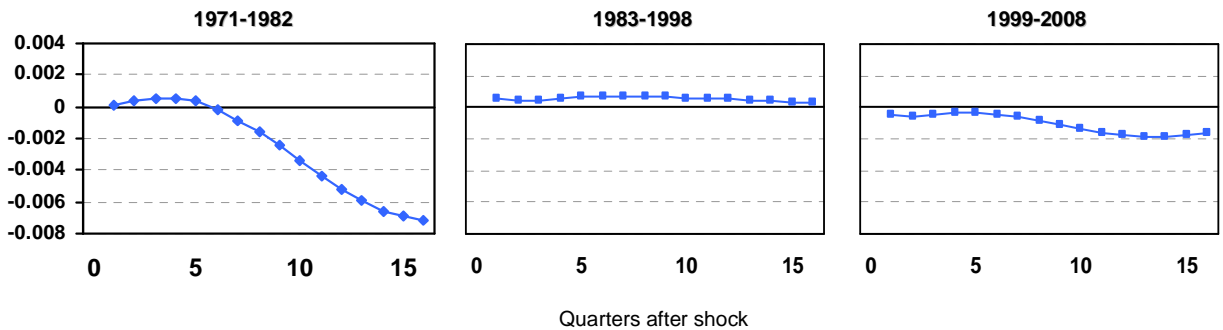
Source: Bloomberg, Commodity Research Bureau, authors' calculations.

Figure 2.5 presents the impulse response of GDP and GDP deflator to a monetary shock in the three different financial environment periods between 1971 and the first half of 2008. [66] However, before proceeding further, it is important to note that the new financial environment is not the only cause of the possible different response results in different periods. The other main factors include changing economic structure, evolving dynamic of shock to the economy, and varying conduct of monetary policy especially greater transparency in the 1990s. So we will not claim that the changing responses are mainly due to the financial environment. Nevertheless, the changing financial environment is believed to be very important. Therefore, we will also investigate the effects of certain important financial environment factors on the transmission by incorporating them into the VAR in the last part of our VAR analysis below.

The key result from the comparison across subsamples is that the response of output to the Fed Funds rate is much less pronounced and persistent in the 1983-1998

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66 The estimated break dates follow the finding about the date at which there were significant shifts in financial landscape from the first section.

and the 1999-2008 periods. This confirms the findings in other research works (Leeper, Sims and Zha 1996, Bernanke and Mihov 1998, Barth and Ramey 2001, and Boivin and Giannoni 2002, 2006). An unexpected tightening of monetary policy, corresponding to one standard deviation innovations in the Fed Funds rate, contributes to the output response which bottoms out after 4 quarters at 0.57% below baseline for the first period (1971-1982). The response reaches its trough after 5 and 8 quarters at 0.23% and 0.19% below the baseline for the second (1983-1998) and third (1999-2008) periods respectively. In addition, the output response dissipates faster in the earlier period.

Table 2.4 Variance Decomposition of GDP

1971-1982

Period	Fed Funds Rate	GDP	GDP Deflator
4	26.89	36.03	2.94
8	44.54	22.88	3.27
12	44.57	18.34	4.12
16	35.55	16.24	3.41

1983-1998

Period	Fed Funds Rate	GDP	GDP Deflator
4	8.22	41.99	0.40
8	14.02	22.01	0.31
12	13.39	20.15	0.73
16	14.14	19.50	1.37

1999-2008

| Period	Fed Funds Rate	GDP	GDP Deflator
4	7.49	68.59	4.92
8	27.47	50.74	4.20
12	23.91	26.62	2.45
16	11.41	12.32	2.36

Source: Bloomberg, Commodity Research Bureau, authors' calculations

To further investigate the changing dynamics of output response to monetary shocks, we examine the variance decomposition of GDP in the summary model across periods as illustrated in Table 2.4. We find that, in the more recent periods, the fraction of variance of output due to Fed Funds rate shocks has decreased dramatically. While more than 40 percent of output variance is attributable to monetary policy shocks in the 1971-1982 sample, this proportion has fallen to around 20 percent in the post-1983 sample.

In deed, the decline in the response of GDP to the policy rate could be due to abating effectiveness of monetary policy or an increasing role of macroeconomic policies in stabilizing the economy. We do not argue which one is more likely in this paper but provides the arguments from both sides as follows. Kuttner and Mosser (2002) suggest that monetary policy has lost some of its influence on the economy. One of the possible interpretations for the weaker effects of the monetary policy is that various innovations in economic agents' behaviors might have allowed them to shelter themselves better from the interest-rate fluctuation (McConnell and Perez-Quiros 2000, Kahn, McConnell, and Perez-Quiros 2002). Moreover, this could be the results of smaller and less frequent disturbances and changes in the propagation of the shocks (Boivin and Giannoni 2002). However, Boivin and Giannoni (2006) argue that the alternative explanation is the way monetary policy is conducted. Monetary policy might stabilize the economy more effectively not only in response to its own shocks, but also in response to other shocks. In addition, Clarida, Gali, and Gertler (2000) suggest that monetary policy has been more successful at ruling out undesired non-fundamental fluctuations.

The above declining response of GDP in the more recent environments raises one question of whether it occurs similarly among different components of GDP. The summary VAR model is then extended to analyze the impact of monetary shocks on the most crucial components of US aggregate demand, consumption and investment. The procedure is the same as the above summary VAR model but GDP is segregated into the specific component being examined and the remainder. For example, to study the response of consumption, the VAR model would include commodity prices, then exchange rate, Fed Funds rate, GDP less consumptions, consumptions, bank credit, GDP deflator, and finally, house prices, with household net worth being an exogenous variable.

Figure 2.6 Extended Summary Model with GDP Component Variables

Response of Consumption to Fed Funds Rate

Quarters after shock

Response of Investment to Fed Funds Rate

Quarters after shock
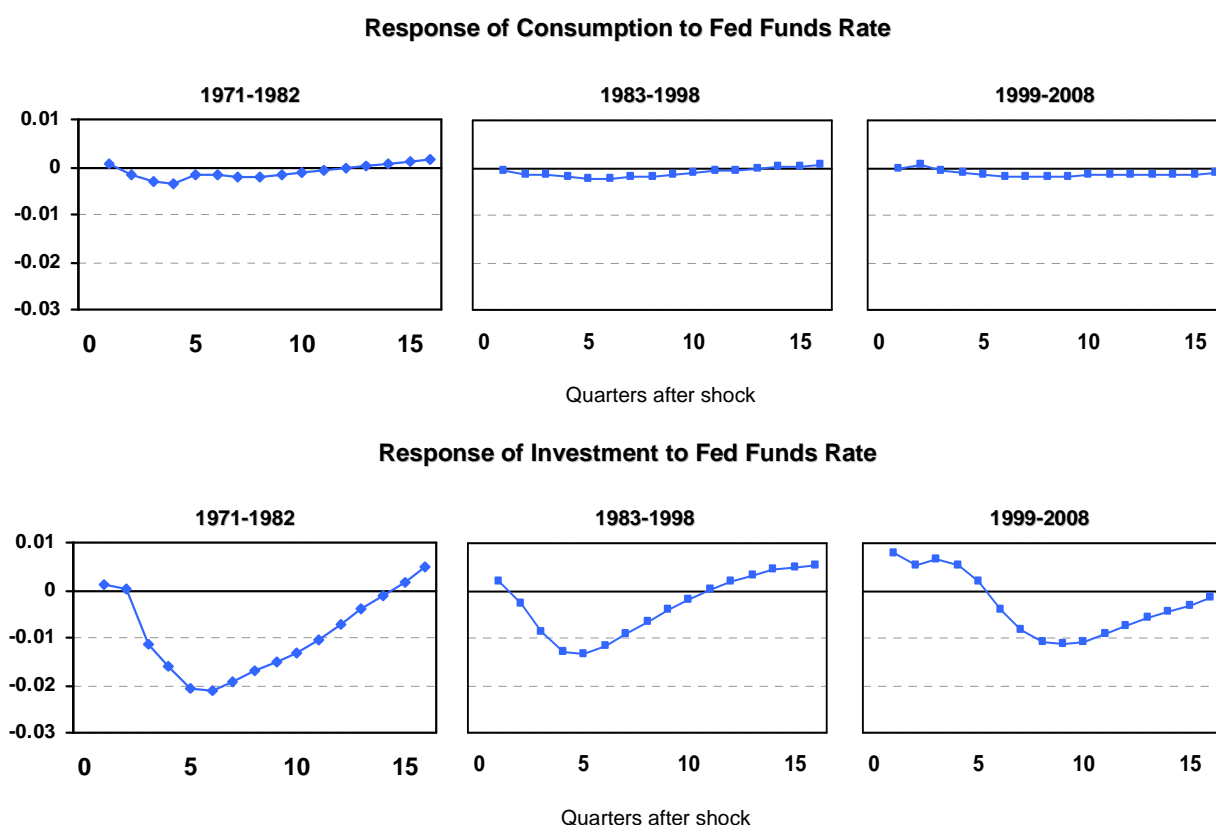
Source: Bloomberg, Commodity Research Bureau, authors' calculations

We find that the impulse responses of both of the main components of US aggregate demand have shown different behaviors of responsiveness to monetary shocks across periods. The slightly increased response of consumption to monetary shocks could reflect the broadening impact of market rates to households and greater household access to financial markets especially the mortgage and consumer credit markets due to financial liberalization and innovation.[67] On the other hand, the response of investment has plummeted considerably over time as shown in Figure 2.6 and Table 2.5. This could be a result of firms' attempt to better cushion themselves against the impact of interest rate fluctuations by improving technology, fostering better inventory management, and taking advantage of financial innovations to hedge against interest rate risks (McConnell and Perez-Quiros 2000, Kahn, McConnell, and Perez-Quiros 2002, and Weber, Gerke and Worms 2008).

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[67] Visco (2007) suggests that the more complex financial system in the US partly explains why monetary policy effects via consumption (and residential construction) has played a more prominent role in the US than in continental Europe.

Table 2.5 Accumulated Impulse Response of GDP Components
to Fed Funds Rate Shocks (16 Quarters)

	1971-1982	1983-1998	1999-2008
Consumption	-0.01564	-0.01716	-0.02057
Difference from Previous Period (%)		9.74	19.88
Investment	-0.14924	-0.04969	-0.04972
Difference from Previous Period (%)		-66.71	0.08

Source: Bloomberg, Commodity Research Bureau, authors' calculations

Channels of Monetary Transmission

In order to determine the importance of each monetary transmission channel as a conduit for monetary policy in affecting the real economy, we apply a similar methodology as Bayoumi and Morsink (2001), and Disyatat and Vongsinsirikul (2002) by comparing two sets of impulse responses; one with the variable representing the channel as an endogenous variable as opposed to the other where the same variable is treated as an exogenous variable. The latter estimation would present a result which blocks off any responses within the VAR system through that channel. Each channel is important if the output response for the endogenized case is significantly more pronounced than the output response for the exogenized case.

Figure 2.7 Summary Model and the Counterfactual Cases

Response of Real GDP to Fed Funds Rate during 1971-2008

Quarters after shock
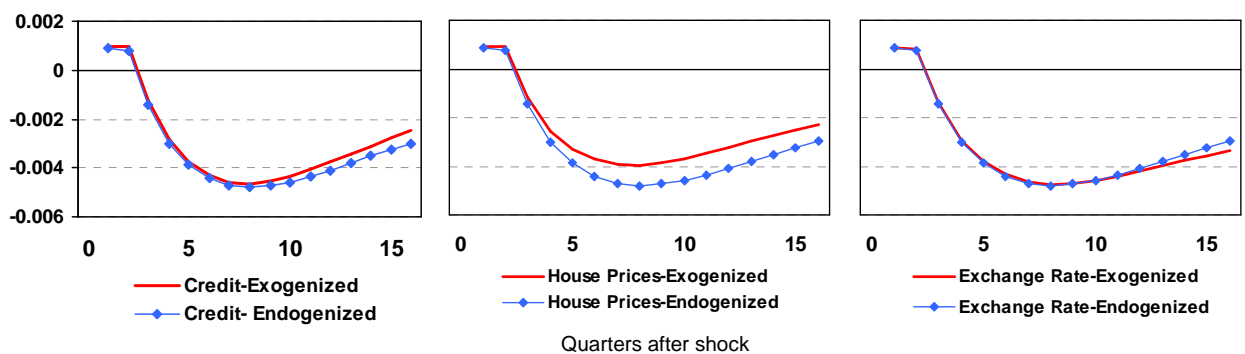
Source: Bloomberg, Commodity Research Bureau, Flow of Funds Accounts of the United States, Board
of the Governors of the Federal Reserve System, authors' calculations.

To examine the importance of bank credit, house price, and exchange rate channels, we exogenize bank credit, home price, and exchange rate, one at a time, in the summary model. These results are then compared with the response where they ar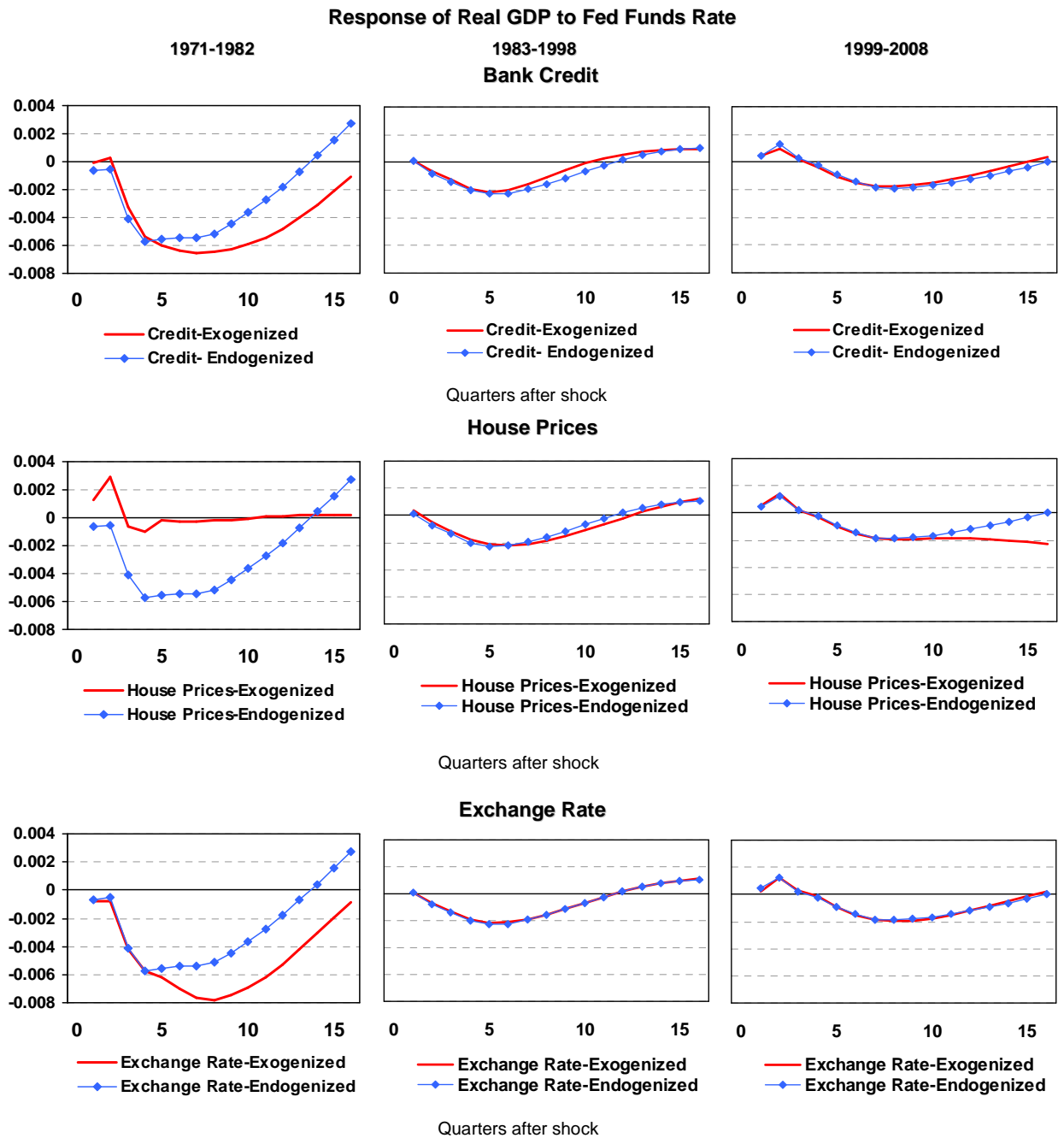e endogenous variables in the summary model. Figure 2.7 shows that, throughout the year 1971-2008, the bank credit and house price channels have appeared to play a significant role in the US economy. The accumulated output response for 16 periods is significantly larger when each variable representing the channel is endogenized. In contrast, for the exchange rate channel, there appears only a very minute difference of the impulse responses between the exogenized and endogenized cases. This indicates that the exchange rate channel is not so important as a transmission mechanism. This is not a surprising result as the size of the US external sector is quite small relative to the domestic sector.

Next, to investigate the relative importance of each channel in different financial environment periods, we employ the same method to examine the output response as opposed to their counterfactual cases where each of the channels of interest is blocked off. As depicted in Figure 2.8 below, the output responses to a Fed Funds rate shock with and without each of the variables of interest endogenized exhibit several interesting points.

Figure 2.8 Summary Model and the Counterfactual Cases

Response of Real GDP to Fed Funds Rate

1971-1982   **1983-1998**   **1999-2008**

Bank Credit

Credit-Exogenized
Credit- Endogenized

Quarters after shock

House Prices

House Prices-Exogenized
House Prices-Endogenized

Quarters after shock

Exchange Rate

Exchange Rate-Exogenized
Exchange Rate-Endogenized

Quarters after shock

Source: Bloomberg, Commodity Research Bureau, Flow of Funds Accounts of the United States, Board of the Governors of the Federal Reserve System, authors' calculations.

Overall, the pass through via these monetary transmission channels has changed with a tendency to decline in the new environment. For **the bank credit channel**, improved access to diversified sources of credit and the emergence of the new financial instruments have provided alternatives funding sources for households and firms. Therefore, those factors should reduce the importance of this channel as discussed in

section 1. Here, the less responsive output to monetary shock can be observed between the second and third periods. However, an unexpected result in which the output response is more prominent in the exogenized bank credit case than in the endogenized bank credit case is observed in the first period. This observation will be further investigated in the following part. In the case of the **house price channel**, the discussion in the first section of the paper gives an inconclusive implication of the new financial environment for it. However, the investigation here shows the significantly larger impulse response in the first period relative to the rest, suggesting the weaker effect of the house price channel overtime.[68] Lastly, for the **exchange rate channel** in which its significance depends on the degree of the openness of the economy, the output response in each period has confirmed the result in figure 2.7 above that it plays a relatively small role in the US context.

Due to the unexpected response of bank credit to the Fed Funds rate shock in the above part, we now explore this channel of transmission further by looking explicitly at the response of each important component, including household, mortgage, and business credit in the summary model. This investigation clearly shows that the unexpected and atypical response of bank credit to innovations in the Fed Funds rate is likely due mainly to the positive response of bank credit to businesses as depicted in the third row in Figure 2.9. The explanations for this finding would require a thorough analysis about the behavior and conditions of banks and corporate who rely mostly on bank borrowing (most of SMEs). Further studies would be very useful in understanding the transmission but they would likely require research efforts at the micro level. . However, we offer one possible factor. During the tightening path, businesses may expect further interest rate hikes. So they (especially those without other sources of funding) would prefer to lock in their cost of funding at the current rate and therefore borrow more even when the interest rates are on the rise.

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[68] We do not investigate the importance of financial asset prices here as the Block-exogeneity test indicates that stock prices are not an endogenous in the period of study. However, it should be worthwhile to investigate the potency of this channel in further studies along with the growing proportion of financial assets in household balance sheets and the vulnerable nature of the financial system to sudden increases in uncertainty or shifts in market sentiment.

Figure 2.9 Extended Summary Model with Bank Credit Components

Response of Bank Household Credit to Fed Funds Rate

Quarters after shock

Response of Bank Mortgage Credit to Fed Funds Rate

Quarters after shock

Response of Bank Business Credit to Fed Funds Rate

Quarters after shock

Source: Bloomberg, Commodity Research Bureau, Flow of Funds Accounts of the United States, Board of the Governors of the Federal Reserve System, authors' calculations.
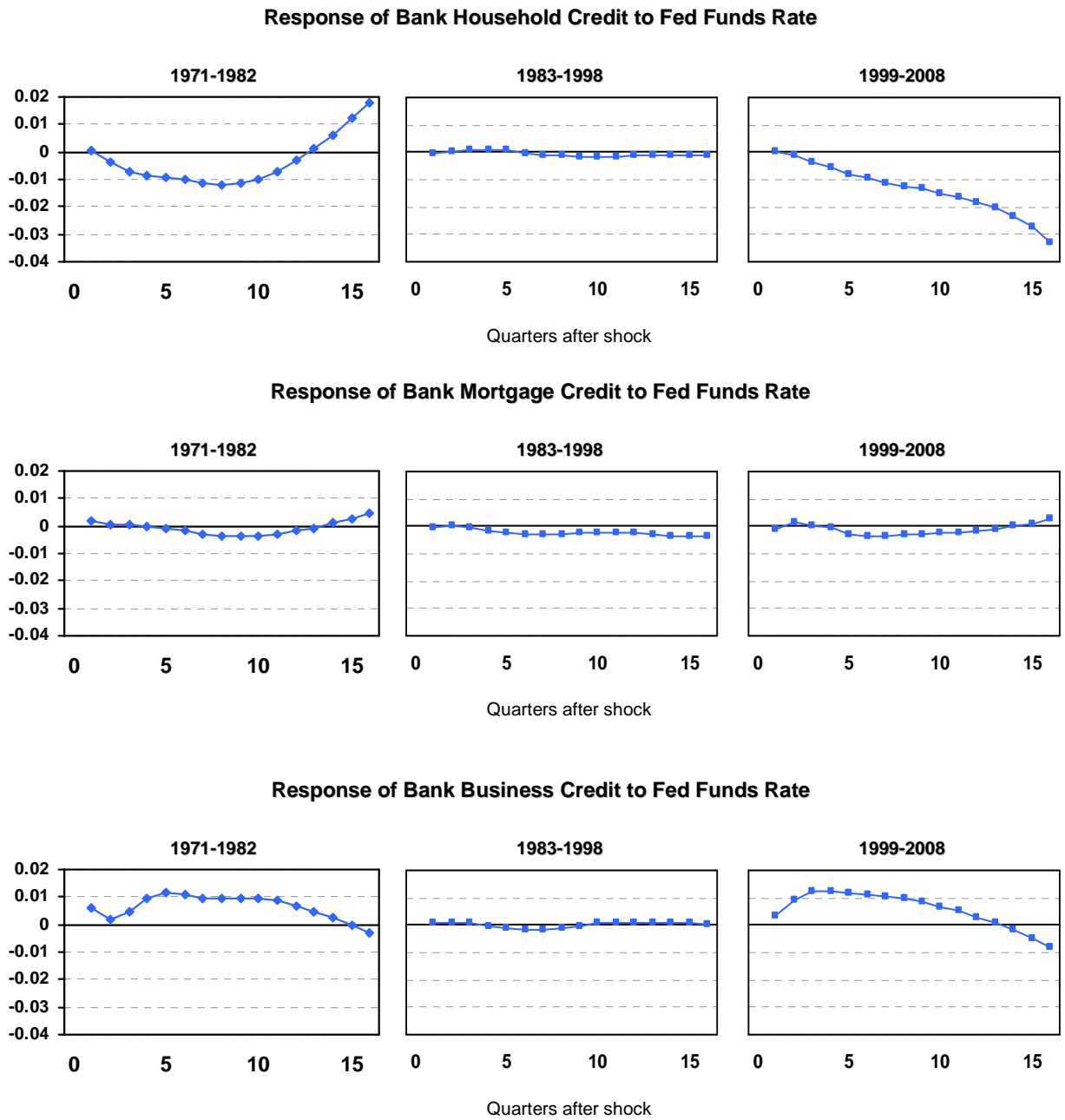
Extended Summary Model with New Financial Innovation Variables

Figure 2.10 Extended Summary Model with New Financial Innovation Variables
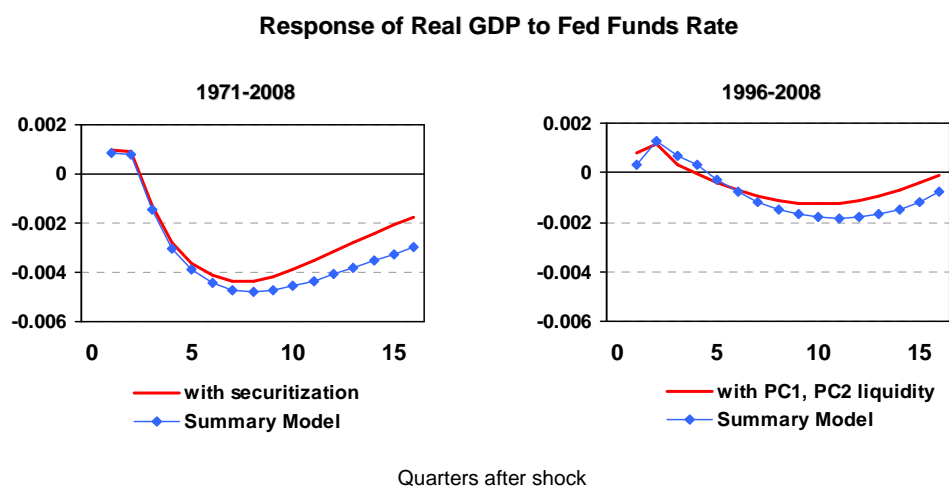
Response of Real GDP to Fed Funds Rate

Quarters after shock

Source: Bloomberg, Commodity Research Bureau, Flow of Funds Accounts of the United States, Board of the Governors of the Federal Reserve System, BIS, authors' calculations.

In addition to analyzing the changing transmission across the different financial environment periods, in this part, we attempt to investigate the effect of the important factors affecting the development of the financial market on the response of output to monetary policy. The two candidates for this investigation are securitization and excess financial market liquidity.

We choose securitization for the investigation here since it has had a substantial consequence on the US financial system with potentially both positive and negative effects on the transmission of monetary policy. The first important implication for the monetary policy transmission mechanism is that securitization allows banks and other depository institutions access to an additional source of funding. Therefore, they are less likely to be constrained by the cost and availability of funds when monetary policy is tightened. This implies reduced effectiveness of monetary policy through the bank credit channel. Additionally, the existence of variable-rate mortgages may serve to cushion the effects of tightening monetary policy.

On the other hand, those interest rates on loans eligible for securitization have been more closely tied to other market interest rates. Hence, with the rising speed and magnitude of the effects of monetary through the interest rate channel (as analyzed in the earlier part), securitization could also lead to the rising response of output to monetary policy innovations.

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However, we have mentioned in the first section that the more potent impact of securitization on effectiveness of monetary policy may lie in the bank credit channel rather than the direct interest rate effects.[69] So we would expect the reduced output response to monetary policy innovations when securitization is introduced to the extended summary model.

Here, we include mortgage securitization as an endogenous variable in our summary model[70]. Not surprisingly, the output response of the extended summary model with mortgage securitization relative to the one of the summary model appears to be much less pronounced during 1971 to 2008. The accumulated response of the former one (-0.04256) is around 18 percent lower than the latter one (-0.05189) over 16 quarters. This result clearly demonstrates the significance of this financial environment factor on the transmission of monetary policy.

The other key attribute of the changing financial environment as evidently observed throughout the global financial markets in the recent years, before mid-2007, is excess financial market liquidity. This factor is believed to reduce the effectiveness of monetary policy as discussed in the first section. This is because excess financial market liquidity implies the ability of banks to leverage and seek their funding outside their balance sheets.

To test about the significance of this financial environment variable, we include the liquidity indicator derived from the PCA in Appendix A in the model. [71] We also expect the impulse response of the extended summary model with this liquidity indicator to exhibit the similar direction of behavior as in the extended summary model with mortgage securitization[72]. The result shown in Figure 2.10 above (data for this indicator is available during 1996-2008) indicates that the output response to Fed Funds rate turns out to be less pronounced than in the summary model as expected with 10 percent lower in terms of the size of the accumulated response (-0.008031 compared to -0.008919).

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[69] Estrella (2002) finds that the interest rate elasticity of output which is very close to zero is the main reason why the effect through the credit channel is more significant than that of the interest rate channel.

[70] According to Block exogeneity Wald Test, securitization should be treated as an endogenous variable and it is the last variable in the Choleski ordering.

[71] We choose the first two components, which explained up to 80 percent of the common variation of liquidity.

[72] According to Block exogeneity Wald Test, the excess liquidity variable should be treated as an exogenous variable in the extended summary model.

Specification Issues and Robustness

In order to be certain whether the results are justified, we vary the econometric setup of our empirical exercise and check for robustness. First, we estimate VAR using monthly data with industrial production as the proxy for real GDP. The results indicate that both the shape and the timing of the impulse responses are broadly similar with the results from the quarterly data. Moreover, varying the order of the endogenous variables does not appear to provide us any diverged results from the earlier part either. In terms of stability, we conduct the stability test by employing the cumulative sum of squares (CUSUM) tests for parameter stability as well as the recursive residuals for each equation of the VAR in the summary model. It is found that, despite some minor episodes of instability, the residual variance of each equation is generally stable (the test statistics generally remain within the critical band). Furthermore, the autocorrelation LM test for serial correlation up to 2 lags suggests that we could not reject the null of no serial correlation in all cases.

To summarize, the key findings in this sections are as follows. First, the output response to monetary shocks has decreased overtime. This is the evidence that the effect of monetary policy on the economy has changed in an important way. Second, traditional transmission channels seem to lose strength over the new financial environment periods. The pass through of the three traditional transmission channels investigated in this section, bank credit, house price, and exchange rate channels has exhibited a tendency to decline overtime. Third, certain financial market environment factors namely securitization and excess financial market liquidity have demonstratedly affected the transmission mechanism.

III. Role of monetary policy in maintaining financial stability in the new environment

The main objective of monetary policy is to maintain price and economic stability.[73] However, risks to financial instability especially in the form of asset price bubbles can increase easily in the new financial environment with enlarging opportunities for greater leverage. As empirical evidence shows that about one-fourth of equity booms and 40 per cent of housing booms are followed by a bust and it can lead to significant output losses[74], one progressively more relevant question for monetary policy is often raised. That is if monetary policy should have a role in helping to deal with asset price bubbles on top of prudential and supervisory policies.

By the first half of the 2000s, the conventional thinking of most central banks was that financial stability should be addressed by only prudential and supervisory policies. Monetary policy should not be adopted as a tool for dealing with rising asset price bubbles. Its role should be only in softening the economic downturn during the burst of bubbles.

In the speech by the Fed Chairman in October, 2002 on *"Asset-Price Bubbles and Monetary Policy",* he concluded that *"Understandably, as a society, we would like to find ways to mitigate the potential instabilities associated with asset price booms and busts. Monetary policy is not a useful tool for achieving this objective, however. Even putting aside the great difficulty of identifying bubbles in asset prices, monetary policy cannot be directed finely enough to guide asset prices without risking severe collateral damage to the economy".*

The same view was echoed by the President of the European Central Bank(ECB) in his speech in June, 2005, *" The ECB's strategy permanently and comprehensively captures longer-run risks to price stability within its monetary analysis. In the inflation targeting framework, on the contrary, reacting to potential asset price booms will always give the impression that an exceptional escape clause has been introduced in the strategy. Proponents of inflation targeting have recommended simply extending the horizon of the inflation forecast beyond the standard one-two-year policy horizon. I doubt*

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[73] An increasing number of economies have adhered to price stability as the main target whereas, for the US, the targets are both price stability and full employment.

[74] The international stylized facts about asset price cycles are summarized in Ahuja, Mallikamas, and Poonpatpibul (2003). About one-fourth of equity booms and 40 per cent of housing booms are followed by a bust. (WEO(2002)) Equity busts lead real GDP bust by roughly 3 quarters, while housing bust coincides roughly with real GDP bust. Even as the output decline is deeper after a housing bust, output recovers 9 quarters after a bust in each asset class. (WEO(2000) and ECB (2003))

that serious inflation forecasts can be derived at the horizon given the uncertainty surrounding asset price boom periods".

The above consensus of central banks has been recently challenged by the tumble of house prices since the end of 2005 which led to the subprime episode. It should be highlighted here that the period of negative real Fed Funds rate from an accommodative monetary policy during mid 2002 to 2005 (after the Dot-com recession in 2001) highly corresponded to the period of the sharply rising up-cycle of the US house prices between 2003 and 2005 as shown in Figure 3.1. [75] This coinciding period of prolonged negative real interest rates and sharply rising house prices implies that the US monetary policy may have contributed to the latest episode of US house price bubbles. [76]

Figure 3.1 Real House Cycles and Real Fed Funds Rate
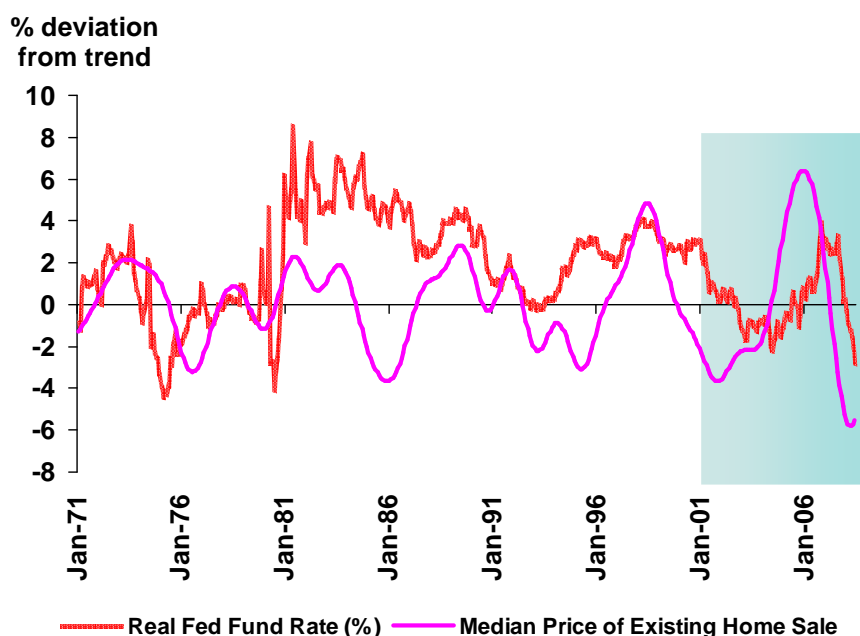
Source: Bloomberg, authors' calculation

Although lax prudential policies leading up to the subprime problem are largely cited as the main culprit, one of the most frequently asked questions that have arisen among economists recently is whether the house price bust could have been prevented or ameliorated, had the Fed not kept the Fed Funds rate at the very low level. We answer this question ex-post here by performing simulations with an additional 50 and 100 basis

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[75] The cycles are the detrended series computed using Christiano-Fitzgerald Band Pass filter with the cycles being in the range between 8 and 40 quarters.

[76] For the case of stock price, it reached the peak in April, 2007 when the policy rate was hiked to curb inflation, indicating that monetary policy likely helped restrain rising stock prices during that up-cycle.

point higher of the Fed Funds rate than the baseline scenario since 2003 using the summary VAR model in Section II of the paper[77]. The simulated results demonstrate that the house price level could have been quite significantly lowered whereas GDP growth would have been marginally affected as depicted in Figure 3.2 as the pass through from increasing interest rate to the house price is higher than to GDP as demonstrated in Figure 3.3[78]. Hence, the problem may have been alleviated if not totally avoided.

Figure 3.2 Simulated Variables under Different Fed Funds Rate
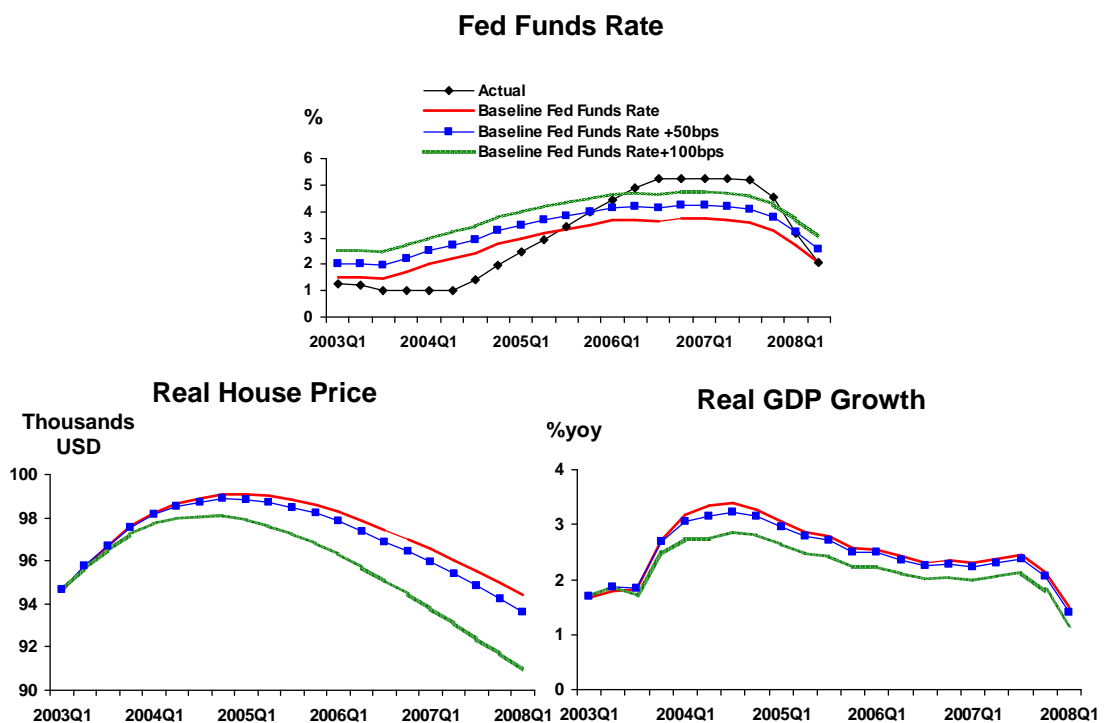
Source: Bloomberg, authors' calculations.

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[77] Variance decompositions of real GDP and real house prices are examined to justify the results from the summary model. The standard errors of the baseline forecast for 16 periods range between 0.04197 and 0.14192 for real GDP and between 0.03359 and 0.11143 for real house prices with the diminishing rate of increase towards the end. Thus, the simulations from the summary model are proved to be within reasonable ranges and valid.

[78] WEO (2007) also performed the similar simulation. It is found that the increase in house prices and residential investment in the US over the past six years would have been much more contained had Fed Funds Rate were 100 bps higher.

Figure 3.3 Summary Model

Response of Real House Price to Fed Funds Rate During 1999-2008 | **Response of Real GDP to Fed Funds Rate During 1999-2008**

Quarters after shock
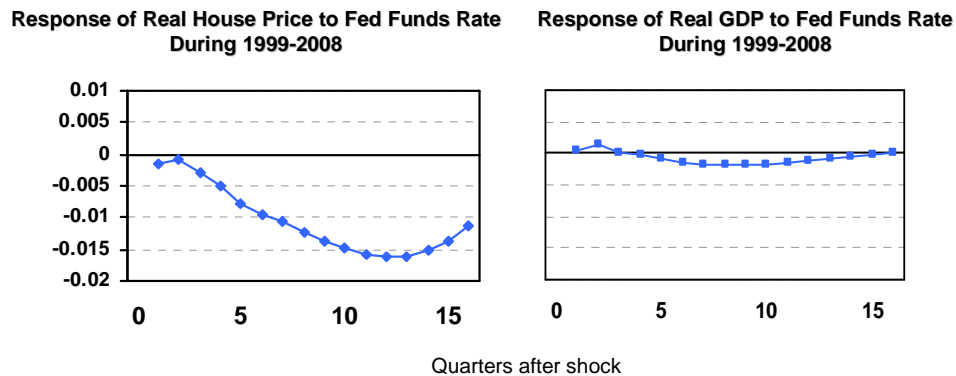
Source: Bloomberg, authors' calculations.

The implication from this scenario analysis is that monetary policy could avoid becoming a contributor for financial imbalances. It might also take some role in helping to keep asset prices in check when the official targets of monetary policy are still attainable. In literature, this kind of monetary policy strategy is called "leaning against the wind". The basic principle of this strategy is that positive and negative asset price shocks have asymmetric effects where a negative shock is likely to have a more substantial effect on the economy. Therefore, hiking the policy rate slightly is equivalent to buying insurance against a potentially destabilizing boom-bust cycle. In doing so, the central bank pays the insurance premium in terms of an additional tightening monetary policy stance albeit at a cost of possibly attaining lower level of GDP and inflation than required by an otherwise conventional strategy.

The typical arguments against the leaning against the wind strategy are difficulties in identifying asset price bubbles ex-ante, possible public confusion regarding objectives of monetary policy, loss of central bank credibility from possible uncertain policy results, and bluntness of interest rate as a policy tool.[79] However, we hypothesize that one of the most important obstacles is the asynchronous movements between asset price cycles and GDP and price cycles. If the asset price cycles are different from the GDP and price (CPI) cycles in the similar period, employing the same tool to deal additionally with the asset prices can become difficult or infeasible.

We then analyze the synchronization patterns between the cycles of each asset price (house price and stock price) and those of inflation as well as GDP. To be consistent with the analysis in Section 2, we compare the above patterns among the

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[79] For a small open economy, there is also an argument that it is infeasible for the central bank to affect the equity prices against a global trend.

periods during 1971-1982, 1983-1998, and 1999-2008. It is found that the house price cycles correlated with the GDP only during the first period as demonstrated in Figure 3.4. In addition, the amplitude of house price cycles from peak to trough has considerably increased in the 2000s whereas those of the GDP as well as price cycles have dampened since the 1980s. Moreover, the house price cycles have always been quite opposite to the price cycles throughout the presented periods as depicted in Figure 3.5. With the starkly different amplitudes and increasingly asynchronous cyclical movements between the house price cycles and the GDP and price cycles, calibrating the policy rate according to the "lean against the wind" strategy to address an escalation of house prices could be a daunting task for the case of the US.

Figure 3.4 House Price and GDP Cycles

Period	1971-1982	1983-1998	1999-2008
Correlation	0.91	0.22	0.29
Standard deviation of house price cycle	2.81	2.42	4.25
Standard deviation of GDP cycles	2.51	1.03	1.08
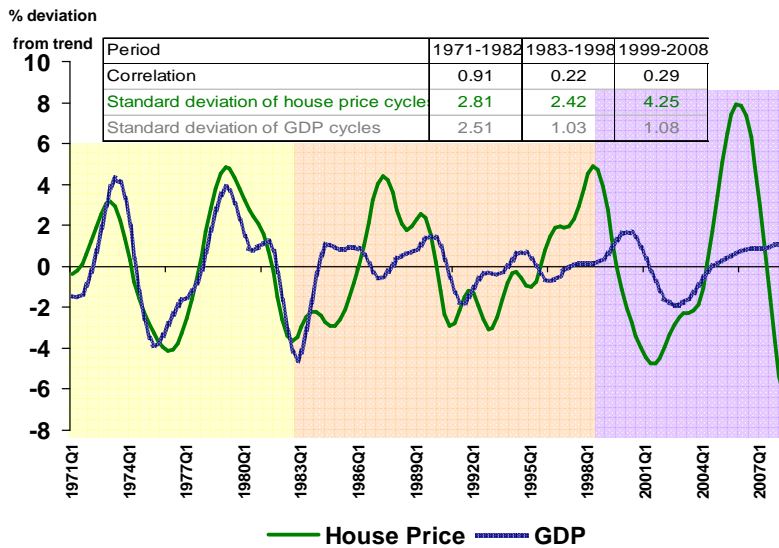
Source: Bloomberg, authors' calculations.

Figure 3.5 House Price and Price Cycles

Period	1971-1982	1983-1998	1999-2008
Correlation	-0.70	-0.54	-0.70
Standard deviation of house price cycles	2.81	2.42	4.25
Standard deviation of price cycles	2.79	0.92	0.90
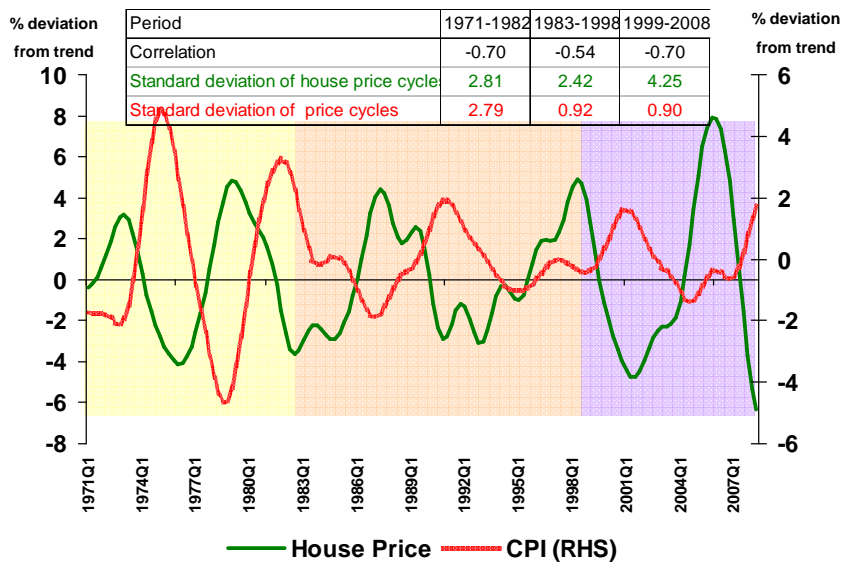
Source: Bloomberg, authors' calculations.

The natural question is whether this lean against the wind strategy will be also difficult to adopt for the case of equity prices in the US. From our analysis, the cycles of stock prices have become highly in sync with the GDP cycles during 1999-2008 as depicted in Figure 3.6. However, Figure 3.7 demonstrates that the synchronization with the stock price and price cycles is nil.

Figure 3.6 Stock Price and GDP Cycles

Period	1971-1982	1983-1998	1999-2008
Correlation	0.63	-0.34	0.96
Standard deviation of stock price cycles	11.28	7.34	13.23
Standard deviation of GDP cycles	2.51	1.03	1.08
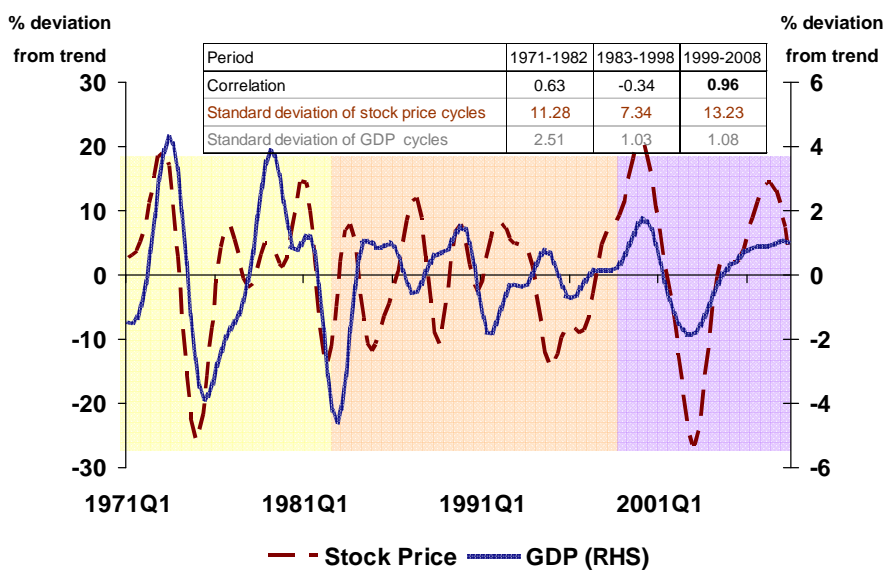
Source: Bloomberg, authors' calculations.

Figure 3.7 Stock Price and Price Cycles

Period	1971-1982	1983-1998	1999-2008
Correlation	-0.58	0.15	0.16
Standard deviation of stock price cycles	11.28	7.34	13.23
Standard deviation of price cycles	2.79	0.92	0.90
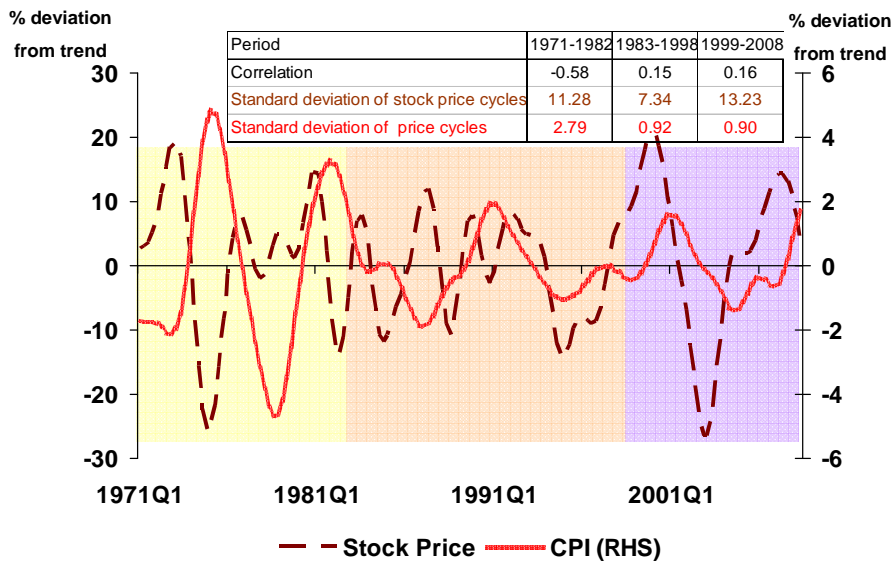
Source: Bloomberg, authors' calculations.

Hence, when monetary policy addressed output and inflation in the recent GDP cycle, it likely assisted in containing rising stock prices but not rising house prices during the recent cycle. The limitation in using monetary policy for curbing house price bubbles implies that prudential and supervisory policies need to vigilantly deal with the arising house price bubbles. Our analysis here stresses the importance of the understanding about the behaviors of asset prices and the synchronization patterns of their cycles with those of the major macroeconomic variables.

Aside from the role of monetary policy in helping to deal with asset price bubbles, it should be noted that the other issue that may become more relevant is the role of asset price changes on inflation via commodity prices. As commodities have increasingly become an asset class, fluctuations in commodity prices can increase in relation to asset price volatility. Hence, as commodities especially oil and several crops are directly related to important items in the CPI basket, inflation can be increasingly affected by asset price fluctuations through the corresponding fluctuations in commodity prices. This implies that the role of monetary policy in taking care of financial stability may indeed become more relevant to price stability as well. Although, it is not in the scope of this study, we believe that this issue certainly warrants further research investigation.

Contrary to the highly debated argument about the preventive role of monetary policy in maintaining financial stability, the role of monetary policy as a shock

absorbance tool during the period of financial market and economic downturn has continued to be advocated. However, the recent financial market turmoil has also revealed an intricate interaction between monetary policy and financial stability and a short-term conflict in using monetary policy to help mopping up the problem in the financial market. The particular case was when financial and credit market turmoil had heightened stress in money markets. Under these circumstances, the aims of liquidity provision and the aims of interest rates setting which are normally not a cumbersome task can become more difficult. Firstly, monetary policy signals may become unclear when some liquidity providing actions are undertaken to ensure an orderly functioning of the money market.[80] Secondly, decisions on the policy rate could be sensitively interpreted as revealing major information unknown to the market players and could hamper its effectiveness. Policy communication is also vital for the role of monetary policy at times of market stress. Not only actions but also communication on the resolution of the financial stability problems is required for bolstering market confidence during the period of elevated uncertainty.

In sum, although prudential and supervisory policies should take a leading role in dealing with financial imbalances, we think that the role of monetary policy in this area is the next avenue that central banks and the academics should explore further. At the minimum, monetary policy should avoid becoming a main contributor to financial imbalances. We have also stressed the importance of understanding about the relative patterns between the asset price cycles and those of GDP and price which may become even more complex along the further progressive financial environment. The role of monetary policy during the financial turmoil period has become more intricate and policy communication is essential for the successful assistance from the central bank. On the other hand, prudential and supervisory policies need to be more vigilant in dealing with the arising house price bubbles in the country where monetary policy can not be used to help curb asset price bubbles due to the asynchronous patterns between asset price cycles and those of GDP and price.

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[80] See A. Cukierman (2007) for detail discussions.

Conclusion and Policy Implications

Our study examines the drivers and characteristics of the changing financial environment in the US and finds out that the driving factors including changes in market structure, instruments, players, rules and economic conditions have rendered the significant increases in speed, size, and complexity of financial price adjustment, dispersion of risk amongst various investors, convergence across asset classes and amongst financial markets in different economies, size of overall capital market, and competitions within the financial industry. In addition, all of these developments have also contributed to an increased possibility of rising leverage.

Our investigation about the interest rate pass through reveals that there have been striking changes in both the size and speed of the response to monetary policy. The US monetary policy has been more effective in influencing the retail and short-term market interest rates in the new financial environment. Market expectation about future monetary policy appears to have an important role in determining the long-term money market and mortgage rates which moved in advance of the Fed Funds rate in the recent period. However, the pass through of monetary policy to long-term market and mortgage interest rates which increased significantly in the 1980s and 1990s tended to subside in a certain period in the 2000s. This decline could likely be due to the economic and financial environment factors that are associated with the inverted yield curve phenomenon including the moderation of inflation, increasing external demand for safe assets, rising global financial liquidity, and rising concerns about tightening monetary policy on the long-term macroeconomic outlook.

From the VAR investigation, we find that output response to monetary shocks in the US has decreased overtime. Traditional transmission channels including bank credit, house prices, and exchange rate, seem to lose strength over the new financial environment period. On the other hand, we find that certain factors such as securitization and excess financial liquidity, have had an important impact on the transmission mechanism.

As for the role on financial stability, our analysis shows that the recent US house price bust could likely have been prevented or ameliorated, had the Fed not kept the Fed Funds rate at the very low level for a lengthy period. The strategy in which monetary policy takes some role in helping to keep asset prices in check namely "leaning against the wind" could become more beneficial in the financial environment conducive to fast

rising asset prices. However, it could be difficult to adopt this strategy if the asset price cycles move asynchronously with the GDP and price cycles.

Crucial policy implications can be drawn from the different sections as follows. First, the evidence that the interest rate pass through has become faster and larger for the retail interest rates indicates that monetary policy could impact the economy through a smaller change in policy rate. However, the greater role of market expectation about future monetary policy in influencing long-term market and mortgage interest rates renders both advantages and concerns for monetary policy conduct.[81]

On the plus side, if the central bank can increasingly influence market expectation about its future policy, policy effectiveness could increase. However, if the market is wrong about the forthcoming policy action, market interest rates may also experience unnecessary volatility. This is because the market may need to unwind the positions, causing a reserve of their prior movement. Hence, it is crucial that the policy makers and the markets are on the same wavelength.

As effectiveness of monetary policy reckons more on the degree to which it can influence market expectation, policy communication needs to play an essential role in guiding and coordinating with market expectation.[82] The recent experience from the financial market turmoil also shows that the role of monetary policy could become more intricate at times of market stress and this renders effective policy communication very important for the successful assistance from the central bank.

Second, monetary policy should avoid becoming a contributor to financial imbalances. Although prudential and supervisory policies are most crucial is maintaining financial stability, the "leaning against the wind" strategy of monetary policy is the next avenue that central banks and the academics should explore further. The possibility of using this strategy depends on the understanding about the relative patterns between the asset price cycles and those of GDP and price which could vary among different economies along their further progressive economic financial environments. In turn, prudential and supervisory policies need to be more vigilant in dealing with the arising house price bubbles in the country where monetary policy can not be used to help curb

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[81] Guthrie and Wright (2000) offers a more extreme view is that in the new environment central banks can influence market interest rates by policy statements, without any associated changes in policy rate.

[82] Effective monetary policy communication depends on central bank transparency and predictability of policy. See Blinder (1998) for the former and Woodford (1999) for the latter.

asset price bubbles due to the asynchronous patterns between asset price cycles and those of GDP and price.

In addition, this strategy may become more relevant if commodities would increasingly become an asset class. If so, asset price volatility could lead to fluctuations in commodity prices and inevitably affect commodity price related components in the CPI. This is the new issue that policy makers likely need to monitor going forward.

Third, although policy makers may often be behind the markets in terms of knowledge about financial market innovations and strategies, it is important to understand and keep abreast of these developments. The key is to closely monitor excess leverage and potential systemic risks that could undermine the financial system, bearing in mind that non-linear outcome could arise more easily in the environment with increasingly asymmetric information among market players and sophisticated instruments.

Undeniably, the territory of monetary policy is determined by both the economic and financial environments as well as the design of monetary policy framework and conduct. Hence, policy makers need to understand and keep abreast of the ongoing developments in the financial system and their impact on the functioning of the economy and design the policy most appropriate for the ever changing environment.

Appendix A: Identification of phases of financial environment

In this appendix, we will attempt to identify the phases of financial environment. As discussed earlier, the new financial environment is characterized by five key changes: market structure, instruments, players, rules, and economic conditions. Therefore, given different combinations of these changes overtime, it would be misleading to identify the beginning of a new financial environment with just a single key change. Instead, we looked at various observable impacts of these changes to obtain three key attributes: excess liquidity, financial convergence and changing risk appetites.

I. Key changes of the financial environment and the observable attributes

Plentiful *liquidity* in the global financial markets has been facilitated directly by all five key changes discussed in the paper. In terms of the market structures, shifting patterns of bank lending towards the OD model is one important facilitator. The OD model relaxes bank balance sheet constraints and thus induces banks to lower their lending standards, leading to rapid credit expansion and an increase in household leverage particularly those of low income families. Like the market structures, new financial instruments such as securitization have led to increasing leverage among financial institutions. Consequently, rising bank and household leverage has contributed to more liquidity in the financial markets. Besides, the long run above-average economic growth as well as the historically low levels of policy interest rates[83] in many developed countries have promoted investors to seek higher yields and fuel demands for these new instruments, helping to elevate the level of liquidity in the system.

Financial co-movements have risen across economies. In particular, it has been observed that shocks can transmit rapidly across the global financial markets. These imply that domestic financial markets have been more sensitive to external shocks.

The rises in international financial market linkages have been driven by many forces. One is the changes in financial market structures. Undoubtedly, increasing financial integration has fostered linkages across borders. The more integrated markets are, the higher the co-movements exist between their assets[84]. The financial innovations, such as derivatives, have also helped increase an international financial convergence by

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[83] The US and the UK adopted a period of expansionary monetary policy by keeping their policy rates at their 40-year-low from 2003 to 2007.

[84] Ayuso, Juan and Blanco, Roberto, "Has financial market integration increased during the 1990s?", BIS (1999).

making investors indifferent between investing or raising capital in the international markets and domestic markets. Derivatives make it possible for international investors to hedge against various risks e.g. exchange rate risk, country risk, sovereign risk; hence investors' home biases are reduced. Furthermore, the cross-border financial ties have been promoted by the presence of cross-over investors as they diversify their portfolios globally.

Risk appetite or investor's willingness to bear risks rose over recent years. The main driving forces behind this increase were excess liquidity, financial innovations, new players in financial markets, and economic conditions. The excess liquidity in the global financial markets and the above-average global growth led investors to trade lower risks for higher yields. While financial innovations induced more investors to take on more risks without sufficient understanding of complex financial products. For example, CDS and MBS, allow investors to reap higher returns while maintaining a "pseudo" or perceived low risk exposure. Finally, a number of new players such as hedge funds have rapidly increased. They have increasingly employed new financial instruments and sophisticated investment strategies. Besides, they have different risk profile from other institutional investors.

II. Measures of each attribute

These three observable attributes represent a cross-dimensional analysis of the five key changes in the aforementioned financial environment. Table A1 below identifies measures for each attribute.

Table A1: Measurement of attributes

Market liquidity
Market liquidity refers to how one can quickly and easily buy or sell financial assets without leading to a significant movement in their prices. It can be characterized by tightness, immediacy, breadth, depth and resiliency[85]. As data for all those characteristics cannot be obtained for each market, different indicators will be employed to measure liquidity in the bond, equity, foreign exchange, and derivatives markets.
Measures:
➢ Market efficiency ratio (MEC) is a measure of liquidity in the bond market introduced by Hasbrouck and Schwartz (1988). Market efficiency ratio (MEC) equals the ratio of volatility of

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[85] See Sarr and Lybek (2002) for further details.

bond market returns for a long horizon divided by the volatility of short horizon return multiplied by the length of the horizon[86]. This indicator would be close to 1 in liquid markets. In addition, in resilient markets, the ratio would also tend to be close but slightly below one because a minimum of short term volatility could be expected.[87]

➢ Ratio of the price change to the simple traded volume, ($|\%\Delta P|/V$) is a measure of liquidity in the equity market[88]. This ratio aims to capture two dimensions of market liquidity; breadth and resiliency. A downward trend suggests that the market ability to absorb larger amount of transaction is rising and the price is less influenced by changes in volume than before. This also implies increased liquidity in equity market.

➢ The bid-ask spread reflects a liquidity condition in foreign exchange markets. This is due to the fact that transaction cost can be measured by the bid-ask spread.

➢ Turnovers of derivative financial instruments traded on organized exchanges are a rough proxy of liquidity in the derivative market as information on OTC derivative is scarce.

Financial co-movements

We examined co-movements of returns in the bond markets and stock markets in the US, the UK, and Germany during 1992- mid 2008.

Measures:

➢ Correlation coefficient between various markets (altogether 6 pairs). The international linkages have increased in both the stock and bond markets.

In the equity markets, the average correlations of stock index returns during 1992-1998 were around 0.4-0.5, but those during 1999 – mid 2008 rose to 0.7-0.8. Similar to the equity markets, the correlations of US, UK and German bond market returns showed stronger linkages from 1998 onward. One possible explanation for such major changes starting in 1998 was the introduction of the Euro currency.

Risk appetite

We assessed the development of investors' risk appetite over time.

Measures:

➢ Spread between long-term investment grade corporate bond yield and a risk-free rate is a measure of the credit risk.

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[86] IMF (2007)

[87] Sarr and Lybek(2002)

[88] The impact of the traded volume on asset price depends on how large the volume is relative to the total market value; thus, the Hui-Heubel's liquidity ratio,($|\%\Delta P|/$(Traded Volume/Total Value of asset)), is more appropriate. (Sarr and Lybek(2002)) However, due to data limitation, we used the conventional ratio instead.

> ➤ Implied volatility on the S&P 500 option (VIX) is a measure of the volatility risk. Investors are willing to take additional risks when the economy is booming, while risk appetite tends to decrease when it is in a recession. Accordingly, if the economy is in a downturn and the risk appetite is lower, the VIX and the spread would be larger.

III. Consolidation into a single measure

Given that there are a few measures for each attribute, we applied Principal Component Analysis (PCA) to construct one common indicator for each of the attributes, if it exists. The main underlying assumption for this approach is that indicators share at least one common factor. For example, for the liquidity attribute, the technique extracts 'commonality' of liquidity variations across all markets.[89]

Market liquidity (January 1996 to March 2008)

Figure A1: the First Component of Liquidity indicators from the PCA
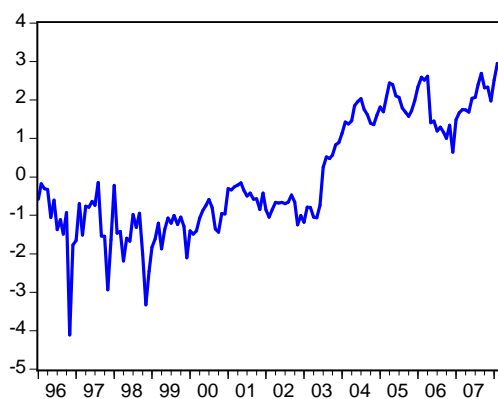
Remarks: Bond market: MEC ratio, Stock market: (|%ΔP|/V) for DowJones index, FX market: Bid-Ask spread of 3M forward of GBP, Derivatives market: Turnover of Derivative instruments traded on organized exchanges.
Sources: morganmarket, Bloomberg, BIS, authors' calculations

The first component explains 57% of the common variation of liquidity and the correlation of each of the liquidity indicator with the first component is positive. The common component demonstrates that liquidity in the US financial markets increased over time. It should be noted that it has a significant upward shift around 2003-2004 when monetary policy was significantly eased.

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[89] To determine how many components would be picked up, the widely used Kaiser criterion retains only components with eigenvalues greater than 1 in the correlation matrix. An intuition for keeping such component is that it should generate variation equivalent to the original variables.

Financial co-movements (January 1992 to July 2008)

Figure A2 the First Component of financial co-movements from the PCA
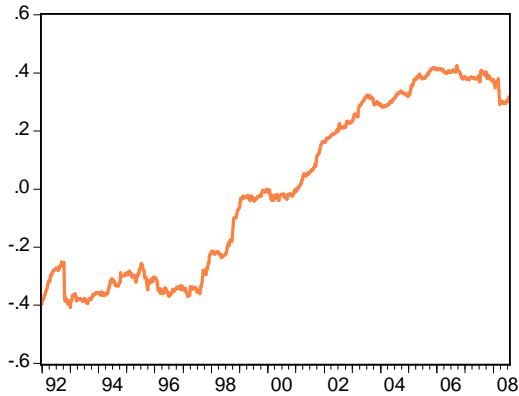
Source: Bloomberg, authors' calculations.

The first component of financial co-movement indicators explains almost 90% of the common variation of correlations and all correlation coefficients have positive relationship with the first component. An increase in the first component implies an increase in co-movements of correlation coefficients across countries. Apparently, it indicates that financial linkages among countries increased considerably follow the Russian crisis in 1998 and the Dot-com crisis in 2001

Risk appetite

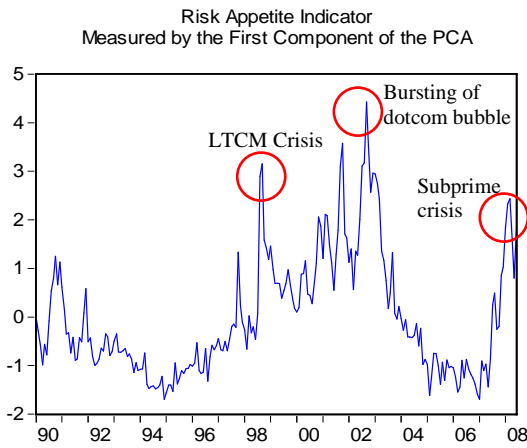**Figure A3 the First Component of Risk Appetite Indicators**

Sources: Bloomberg, authors' calculations.

The first component of the risk appetite indicators explains 80% of the common variation of VIX and the spread. The relationship of each of the risk appetite indicator with this first component is positive. The depicted peaks in the figure correspond to the episodes of the major market pressure from economic and financial crises. During 4 years prior to the subprime crisis, it stayed at low levels due to the favorable economic environment with the period of extended growth with low inflation. However, it spiked up again in the subprime crisis period.

The review of all observable key attributes of the financial markets shows that around 1998, both the financial co-movement and liquidity indicators started to show a

rising trend, while the risk appetitive indicator began to shift downward in 2002. In addition, during 1997-1998, the financial system faced an influx of new types of investors, insurers, and institutional investors who stepped in and bought lower grade tranches of CDOs. Therefore, based on a set of evidences from key attributes and the occurrences of significant events in financial markets, it is possible to believe that the beginning of new financial environment should be in about 1998.

Due to the limitation of data before 1990s, we could not investigate observable key attributes by applying the PCA; however, many important events which affected financial market structure occurred during this previous period. Nevertheless, there were significant changes in legislations during 1980s onward such as Depositary Institutions Deregulation and Monetary control Act of 1980, which lifted interest rate ceilings and leveled the financial playing field by setting similar level of reserve requirement for all banks. More importantly, we believed that the major effect of these changes on financial market structure is approximately in 1982 which was the same period as when the mortgage deregulation came into effect.

Hence, in order to examine the changing of monetary policy effectiveness in section II, we separate the period into 3 parts: 1971-1982, 1983-1998, and 1999-2008.

Appendix B Unit Root and Cointegration

Interest rate	Augmented Dicky-Fuller Test		Johansen Cointegration Test with Fed Fund Rate		
	Level	First Difference	Unrestricted Cointegration Rank Test (Trace)		
			No. of Cointegrating Vector	Trace Statistics	0.05 Critical Value
Fed Funds rate	-3.27	-23.42			
Prime rate	-2.98	-6.12	None *	16.34	15.49
			At most 1 *	5.86	3.84
Personal loan rate	-2.98	-4.38	None *	15.97	15.49
			At most 1 *	5.21	3.84
One month commercial paper	-3.54	-14.55	None *	57.84	15.49
			At most 1 *	4.63	3.84
Three month treasury note rate	-3.11	-18.69	None *	41.66	15.49
			At most 1 *	4.05	3.84
Ten year treasury bond rate	-2.43	-18.64	None *	27.71	18.40
			At most 1 *	7.27	3.84
30 year average mortgage rate	-2.26	-15.97	None *	15.97	15.49
			At most 1 *	5.21	3.84

Critical values with time trend at 5% level with 12 lags(level) =-3.42   * denotes rejection of the hypothesis at the 0.05 level

Critical values with time trend at 5% level with 12 lags(first-difference) =-1.94

Critical values with time trend at 5% level with 4 lags(level) (Perosonal loan rate) =-2.88

Critical values with time trend at 5% level with 4 lags (first-difference) (Perosonal loan rate) =-1.94

Appendix C Chow's Break Point Test for 1983-1998

Interest rate	Long-term equation				Short-term equation			
Fed Funds rate	F-statistic	74.68	Prob. F(4,444)	0.00	F-statistic	2.34	Prob. F(4,443)	0.05
	Log likelihood ratio	231.53	Prob. Chi-Square(4)	0.00	Log likelihood ratio	9.38	Prob. Chi-Square(4)	0.05
	Wald Statistic	298.73	Prob. Chi-Square(4)	0.00	Wald Statistic	9.35	Prob. Chi-Square(4)	0.05
Prime rate	F-statistic	43.79	Prob. F(4,444)	0.00	F-statistic	18.76	Prob. F(4,443)	0.00
	Log likelihood ratio	149.65	Prob. Chi-Square(4)	0.00	Log likelihood ratio	70.26	Prob. Chi-Square(4)	0.00
	Wald Statistic	175.16	Prob. Chi-Square(4)	0.00	Wald Statistic	75.04	Prob. Chi-Square(4)	0.00
Personal loan rate	F-statistic	19.56	Prob. F(4,140)	0.00	F-statistic	6.63	Prob. F(4,139)	0.00
	Log likelihood ratio	64.83	Prob. Chi-Square(4)	0.00	Log likelihood ratio	25.31	Prob. Chi-Square(4)	0.00
	Wald Statistic	78.26	Prob. Chi-Square(4)	0.00	Wald Statistic	26.50	Prob. Chi-Square(4)	0.00
One month commercial paper	F-statistic	30.43	Prob. F(4,441)	0.00	F-statistic	21.96	Prob. F(4,440)	0.00
	Log likelihood ratio	108.93	Prob. Chi-Square(4)	0.00	Log likelihood ratio	81.18	Prob. Chi-Square(4)	0.00
	Wald Statistic	121.70	Prob. Chi-Square(4)	0.00	Wald Statistic	87.84	Prob. Chi-Square(4)	0.00
Three month treasury note rate	F-statistic	297.18	Prob. F(4,438)	0.00	F-statistic	6.33	Prob. F(4,443)	0.00
	Log likelihood ratio	582.57	Prob. Chi-Square(4)	0.00	Log likelihood ratio	24.94	Prob. Chi-Square(4)	0.00
	Wald Statistic	1188.71	Prob. Chi-Square(4)	0.00	Wald Statistic	25.31	Prob. Chi-Square(4)	0.00
Ten year treasury bond rate	F-statistic	74.68	Prob. F(4,444)	0.00	F-statistic	2.34	Prob. F(4,443)	0.05
	Log likelihood ratio	231.53	Prob. Chi-Square(4)	0.00	Log likelihood ratio	9.38	Prob. Chi-Square(4)	0.05
	Wald Statistic	298.73	Prob. Chi-Square(4)	0.00	Wald Statistic	9.35	Prob. Chi-Square(4)	0.05
30 year average mortgage rate	F-statistic	42.32	Prob. F(4,431)	0.00	F-statistic	7.27	Prob. F(4,430)	0.00
	Log likelihood ratio	144.78	Prob. Chi-Square(4)	0.00	Log likelihood ratio	28.53	Prob. Chi-Square(4)	0.00
	Wald Statistic	169.29	Prob. Chi-Square(4)	0.00	Wald Statistic	29.08	Prob. Chi-Square(4)	0.00

Appendix D VAR Granger Causality/ Block Exogeneity Wald Tests.

Dependent Variables	Regressors									
	Bank Credit	Business Net worth	Commodity Prices	Exchange Rate	Fed Funds Rate	GDP	GDP Deflator	House Prices	Household Net Worth	Stock Prices
Bank Credit		0.816	0.5522	0.0402*	0.011*	0.4844	0.0329*	0.0235*	0.2888	0.8744
Business Net worth	0.0032*		0.0039*	0.2282	0.0352*	0.168	0.7517	0.101	0.2838	0.4592
Commodity Prices	0.7131	0.5533		0.5614	0.0045*	0.9365	0.0536	0.2125	0.2064	0.0981
Exchange Rate	0.0174*	0.116	0.4499		0.7583	0.9424	0.4772	0.5295	0.2631	0.0569
Fed Funds Rate	0.0002*	0.8679	0.0000*	0.6658		0.7743	0.0596	0.8632	0.0023*	0.0733
GDP	0.1027	0.4897	0.0266*	0.5751	0.0000*		0.0053*	0.244	0.4911	0.2153
GDP Deflator	0.0085*	0.2562	0.0426*	0.0166*	0.0612	0.0488*		0.0323*	0.7511	0.1244
House Prices	0.0253*	0.2185	0.0048*	0.9544	0.0021*	0.0132*	0.0094*		0.9696	0.3712
Household Net Worth	0.4275	0.8246	0.1917	0.2662	0.1201	0.1536	0.5289	0.536		0.456
Stock Prices	0.8271	0.8597	0.3341	0.6706	0.1191	0.852	0.3002	0.3451	0.0059*	

Source: Bloomberg, Commodity Research Bureau, Flow of Funds Accounts of the United States, Board of the Governors of the Federal Reserve System, authors' calculations.

Notes: The figures are the p-value for Granger Causality/ Block Exogeneity Wald tests under the null hypothesis that each variable can be treated as an exogenous variable.
* indicates rejection of the null hypothesis at the 95% confidence level.

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