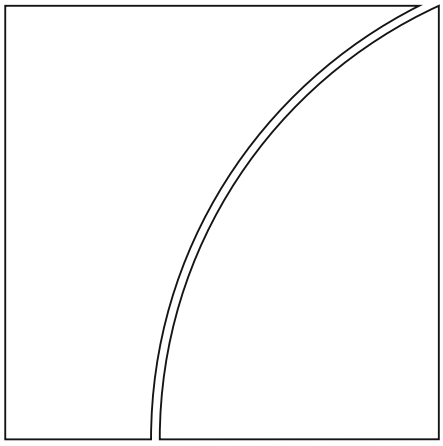
BANK FOR INTERNATIONAL SETTLEMENTS



# BIS Papers

No 95

# Frontiers of macrofinancial linkages

by Stijn Claessens and M Ayhan Kose

Monetary and Economic Department

January 2018

The views expressed are those of the authors and not necessarily the views of the BIS.

This publication is available on the BIS website (www.bis.org).



ISSN 1609-0381 (print)
ISBN 978-92-9259-123-6 (print)

ISSN 1682-7651 (online)
ISBN 978-92-9259-124-3 (online)

*"…They [economists] turned a blind eye to the limitations of human rationality that often lead to bubbles and busts; to the problems of institutions that run amok; to the imperfections of markets – especially financial markets – that can cause the economy's operating system to undergo sudden, unpredictable crashes …"*
Paul Krugman (2009a)

*""Hello, Paul, where have you been for the last 30 years?"… Pretty much all we have been doing for 30 years is introducing flaws, frictions and new behaviors… The long literature on financial crises and banking … has also been doing exactly the same…."*
John H. Cochrane (2011a)

*"I believe that during the last financial crisis, macroeconomists (and I include myself among them) failed the country, and indeed the world. In September 2008, central bankers were in desperate need of a playbook that offered a systematic plan of attack to deal with fast evolving circumstances. Macroeconomics should have been able to provide that playbook. It could not…"*
Narayana Kocherlakota (2010)

*"… What does concern me of my discipline, however, is that its current core – by which I mainly mean the so-called dynamic stochastic general equilibrium (DSGE) approach – has become so mesmerized with its own internal logic… This is dangerous for both methodological and policy reasons… To be fair to our field, an enormous amount of work at the intersection of macroeconomics and corporate finance has been chasing many of the issues that played a central role during the current crisis… However, much of this literature belongs to the periphery of macroeconomics rather than to its core…"*
Ricardo Caballero (2010)

*"One can safely argue that there is a hole in our knowledge of macro financial interactions; one might also argue more controversially that economists have filled this hole with rocks as opposed to diamonds; but it is harder to argue that the hole is empty."*
Ricardo Reis (2017)

*"The financial crisis … made it clear that the basic model, and even its DSGE cousins, had other serious problems, that the financial sector was much more central to macroeconomics than had been assumed…"*
Olivier Blanchard (2017a)

# Frontiers of macrofinancial linkages

Stijn Claessens and M Ayhan Kose*

## Foreword

The Great Financial Crisis (GFC) of 2007–09 confirmed the vital importance of advancing our understanding of macrofinancial linkages. The GFC was a bitter reminder of how sharp fluctuations in asset prices, credit and capital flows can have a dramatic impact on the financial position of households, corporations and sovereign nations. These fluctuations were amplified by macrofinancial linkages, bringing the global financial system to the brink of collapse and leading to the deepest contraction in world output in more than half a century. Moreover, these linkages resulted in unprecedented challenges for fiscal, monetary and financial regulatory policies.

Macrofinancial linkages centre on the two-way interactions between the real economy and the financial sector. Shocks arising in the real economy can be propagated through financial markets, thereby amplifying business cycles. Conversely, financial markets can be the source of shocks, which, in turn, can lead to more pronounced macroeconomic fluctuations. The global dimensions of these linkages can result in cross-border spillovers through both real and financial channels.

The GFC revived an old debate in the economics profession about the importance of macrofinancial linkages. Some argue that the crisis was a painful reminder of our limited knowledge of these linkages. Others claim that the profession had already made substantial progress in understanding them but that there was too much emphasis on narrow approaches and modelling choices. Yet, most also recognise that the absence of a unifying framework to study these two-way interactions has limited the practical applications of existing knowledge and impeded the formulation of policies.

We present a systematic review of the rapidly expanding literature on macrofinancial linkages to shed light on these debates. Two critical observations inform our review. First, a good understanding of macrofinancial linkages requires a strong grasp of the links between asset prices and macroeconomic outcomes. Second, since macrofinancial linkages often arise because of financial market

* Claessens (Monetary and Economic Department, Bank for International Settlements; CEPR; Stijn.Claessens@bis.org); Kose (Development Prospects Group, World Bank; Brookings Institution; CEPR; CAMA; akose@worldbank.org). We are grateful to Olivier Blanchard for his helpful comments at the early stages of this project of surveying the literature on macrofinancial linkages when we were with the Research Department of the International Monetary Fund. We would like to thank Boragan Aruoba, Claudio Borio, Menzie Chinn, Ergys Islamaj, Jaime de Jesus Filho, Raju Huidrom, Atsushi Kawamoto, Seong Tae Kim, Grace Li, Raoul Minetti, Ezgi Ozturk, Eswar Prasad, Lucio Sarno, Hyun Song Shin, Kenneth Singleton, Naotaka Sugawara, Hui Tong, Kamil Yilmaz, Kei-Mu Yi, Boyang Zhang, Tianli Zhao, and many colleagues and participants at seminars and conferences for useful comments and inputs. Miyoko Asai, Ishita Dugar and Xinghao Gong provided excellent research assistance. Mark Felsenthal, Sonja Fritz, Krista Hughes, Serge Jeanneau, Graeme Littler, Tracey Lookadoo, Hazel Macadangdang and Rosalie Singson provided outstanding editorial help. The views expressed are those of the authors and do not necessarily represent those of the institutions they are affiliated with or have been affiliated with.

imperfections, it is necessary to understand the implications of such imperfections for macroeconomic outcomes.

With these observations in mind, we first survey the literature on the linkages between asset prices and macroeconomic outcomes. We then review the literature on the macroeconomic implications of financial imperfections. We also examine the global dimensions of macrofinancial linkages and document the main stylized facts about the linkages between the real economy and the financial sector. The topic of macrofinancial linkages promises to remain an exciting area of research, given the many open questions and significant policy interest. We conclude our survey with a discussion of possible directions for future research, stressing the need for richer theoretical models, more robust empirical work and better quality data so as to advance knowledge and help guide policymakers going forward.

## Table of contents

# 1. Introduction

The Great Financial Crisis (GFC) of 2007–09 confirmed the vital importance of advancing our understanding of macrofinancial linkages. The GFC was a bitter reminder of how sharp fluctuations in asset prices, credit and capital flows can have a dramatic impact on the financial position of households, corporations and sovereign nations.[1] These fluctuations were amplified by macrofinancial linkages, bringing the global financial system to the brink of collapse and leading to the deepest contraction in world output in more than half a century. Moreover, these linkages have resulted in unprecedented challenges for fiscal, monetary and financial sector policies.

Macrofinancial linkages centre on the two-way interactions between the real economy and the financial sector. Shocks arising in the real economy can be propagated through financial markets, thereby amplifying business cycles. Conversely, financial markets can be the source of shocks, which, in turn, can lead to more pronounced macroeconomic fluctuations. The global dimensions of these linkages can result in cross-border spillovers through both real and financial channels.

The crisis has led to a lively debate over the state of research on the role of financial market imperfections in explaining macroeconomic fluctuations. Some argue that the crisis showed that the profession did not pay sufficient attention to these linkages. Others, by contrast, claim that they have been recognised for a long time and that substantial progress has been made in understanding them. But most acknowledge that financial market imperfections can often intensify fluctuations in the financial and real sectors. Yet, the absence of a unifying framework to study the two-way interactions between the financial sector and the real economy has limited the practical applications of existing knowledge and impeded the formulation of policies.[2]

This debate can be seen as a natural extension of the long-standing discussion about the importance of financial market developments for the real economy.[3] In Box 1.1, we present a historical summary of research on macrofinancial linkages. The diverging paths followed by the fields of macroeconomics and finance are at the root of recent debates. Early studies often considered developments in the real economy

[1] A large literature documents the various macrofinancial linkages that have contributed to the devastating impact of the GFC. Some of the important books on the topic include Krugman (2009b), Sorkin (2009), Wessel (2009), Lewis (2010), Kose and Prasad (2010), Paulson (2010), Gorton (2012), Turner (2012), Bernanke (2013), Blinder (2013), Claessens et al (2014a), Geithner (2014), Mian and Sufi (2014a), Wolf (2014), Farmer (2016), King (2016) and Taylor (2016). Lo (2012) reviews a set of 21 books on the GFC.

[2] We presented some quotes reflecting the flavour of this debate at the beginning of the survey. Krugman (2009a) criticises the macroeconomics literature for its failure to recognise the strong relationship between the financial sector and the real economy, while Cochrane (2011a, 2017) responds critically to Krugman's views. Caballero (2010), Kocherlakota (2010), Taylor (2011), Romer (2016) and Reis (2017) provide varying assessments of research on macroeconomics. Blanchard (2017a) stresses the need for a broader class of macroeconomic models.

[3] Gertler (1988), Bernanke (1993), Lowe and Rohling (1993) and Bernanke et al (1996) present early surveys of the literature on macrofinancial linkages. Mankiw (2006) and Blanchard (2000, 2009) offer more general reviews of the state of macroeconomics before the crisis. Recent (but more selective) updates on macrofinancial linkages include Gilchrist and Zakrajšek (2008), Matsuyama (2008), Solimano (2010), BCBS (2011, 2012), Caprio (2011), Gertler and Kiyotaki (2011), Quadrini (2011), Borio (2014) and Morley (2016), as well as papers in Friedman and Woodford (2011).

Box 1.1

## Research on macrofinancial linkages: a brief history

Research on macrofinancial linkages has a long history. The Great Depression created much interest in such linkages but this interest faded away over the next few decades. There has been a resurgence of interest since the early 1980s, with the introduction of rigorous general equilibrium models that have provided rich theoretical insights. Such insights have been complemented by the results of empirical studies at the macroeconomic and microeconomic levels. This Box provides a brief review of the evolution of this literature (see Figure 1.B1 for a schematic presentation).

The study of credit cycles, which precedes that of business cycles, goes back at least to Mills (1867) but, as just mentioned, the Great Depression was the primary motivation for the early qualitative work on the role of financial factors in shaping macroeconomic outcomes. Fisher (1933) provided a descriptive account of the relationship between the high leverage of borrowers and the severity of the downturn during the Great Depression. His "debt-deflation" mechanism was the first elegant narrative showing how a decline in net worth induced by a drop in prices, ie deflation, could lead borrowers to reduce their spending and investment, which, in turn, could cause activity to contract and result in a vicious cycle of falling output and deflation. Haberler (1937) reviewed early studies of business cycle fluctuations, focusing on the so-called monetary, over-investment, under-consumption, and psychological theories.

The literature that followed, however, turned its attention to the role of money, rather than credit, as the critical financial variable. While Keynes (1936) also brought out financial developments, eg as he discussed how the confidence of borrowers and lenders could changes in ways nor easily explained with economic models ('animal spirits"). He focussed more on the importance of money for the real economy. Armed with insights from the liquidity preference hypothesis, the early "Keynesian" models paid special attention to the mechanisms linking money to real activity, including the multiplier mechanism and the role of fiscal policy (Hicks (1937), Modigliani (1944) and Tobin (1958)). The "monetarist" school, on the other hand, insisted on the importance of monetary rather than real factors (Friedman (1956), Friedman and Schwartz (1963) and Tobin (1969)).

Later studies documented the critical role of financial intermediation in economic development and macroeconomic fluctuations but these did not lead to a fundamental shift in thinking. Gurley and Shaw (1955) showed that economic development and financial sophistication go hand in hand. Others, including Cameron (1961), Shaw (1973) and McKinnon (1973), also highlighted the importance of finance for development, contrasting among others the East Asian and Latin American experiences. Their main argument was that a country's overall "financial capacity," ie its financial system's ability to provide credit, was more relevant to the real economy than money. In the early stages of financial development, money could be important but it becomes less relevant in more developed systems, particularly as a measure of credit availability. Instead, banks increasingly use non-deposit sources of funding and non-bank intermediaries provide alternative sources of financing. This view, while also advanced by many financial historians (eg Goldsmith (1969)), did not prevail and research on finance and macroeconomics followed separate paths.

New analytical insights were gained during the 1950s with the applications of portfolio theory. A major breakthrough was the introduction of portfolio theory by Markowitz (1952), which inspired a large literature. However, it did not pay much attention to financial frictions. Tobin (1969) improved the understanding of how asset valuation, a key area of finance, affects investment. Through his concept of the "$q$" valuation ratio, he established a direct relationship between developments in equity markets and investment. With few exceptions, however, these contributions paid little attention to the various forms of financial intermediation or to their imperfections.

The separation of finance and macroeconomics became increasingly pronounced after the introduction of the "irrelevance of financing structure" theorem of Modigliani and Miller (1958). The theorem provided a case for the independence of firm valuation and investment from financing structures and suggested more generally a decoupling of real economic activity from financial intermediation. A number of developments accelerated this separation. First, the Arrow-Debreu theorem (which shows that, in the presence of contingent claims that span every possible state of the world, allowing agents to insure against any event, it becomes much easier for agents to make choices), upon which Modigliani and Miller based their work. Second the methodological advances of the 1970s, notably with respect to asset pricing (Merton (1973)) and derivatives modelling (Black and Scholes (1973)). And, lastly, the emergence of the rational expectations paradigm (see below). Together they gave traction to the concept of "efficient financial markets" (Fama (1970, 1991)). This work put less emphasis on the role of banks as markets were thought to be able to

efficiently provide most financial services (notably, of the twenty chapters in the Handbook of the Economics of Finance (Constantinides et al (2003)), only one was on financial intermediation).

The growing popularity of work based on the assumption of efficient and frictionless financial markets coincided with a shift in the macroeconomic literature. Researchers focused increasingly on the real side of the economy, using models with little role for financial variables (see Chari and Kehoe (2006) for a review). The precursor in macroeconomics to efficient financial markets was the rational expectations paradigm (Muth (1961) and Lucas (1976)), which assumes agent make choices consistent with models involving uncertainty and full information. It further reinforced the drive for quantitative models with fully optimising agents acting mostly in frictionless worlds. Although the widely used vector autoregression (VAR) models, first proposed by Sims (1972), partially shifted attention back to money as a key financial aggregate, at least in applied policy work, the broader literature concentrated mainly on real variables (Lucas (1975) and Kydland and Prescott (1982)). Research on monetary policy stressed the importance of central bank independence (Sargent and Wallace (1976)) and focused on inflation targeting (Bernanke and Mishkin (1997) and Clarida et al (1999)).

Contributions to the macroeconomic literature over this period paid little attention to financial intermediation. The class of so-called New Keynesian macroeconomic models (ie using microeconomic foundations that assume some price or wage "stickiness", leading to a slow adjustment of real variables to shocks) that emerged included various real and nominal frictions but did not properly account for financial imperfections (Smets and Wouters (2003)). Indeed, Gertler (1988) began his overview of the subject with a powerful observation: "most of macroeconomic theory presumes that the financial system functions smoothly and smoothly enough to justify abstracting from financial considerations. This dictum applies to modern theory" (see also Blanchard (1990)).

Some authors paid attention to the banking system, but mostly because it issued money, not because of its financial intermediation function. Bank runs (Diamond and Dybvig (1983)) and asset price bubbles (Blanchard and Watson (1982)) were studied but these did not become central to macroeconomic research. Minsky (1982, 1986) drew attention to the endogenous build-up of financial vulnerabilities. However, his work was largely qualitative and remained peripheral (see also Kindleberger (1996) and Borio and Lowe (2004)). Overall, the lack of interest in banking and finance seems to have been related to the less volatile nature of business cycle, especially after the mid-1980s, the era of the "Great Moderation" (Blanchard (2009)).

That said, interest in macrofinancial linkages slowly picked up in the early 1970s. On the microeconomic theory front, research on the effects of asymmetric information and incentives, building on earlier work, notably Akerlof (1970), provided new insights. Many authors analysed the nature of optimal contracts with unobservable information, principal-agent problems or other imperfections (Jensen and Meckling (1976), Townsend (1979), Stiglitz and Weiss (1981), Williamson (1987)); including specifically for financial institutions (Gale and Hellwig (1985), Calomiris and Kahn (1991) and Holmström and Tirole (1997)). Following Shiller (1981), some researchers focused on deviations from the efficient markets hypothesis. Fazzari et al (1988) documented how corporate cash flows correlate with investment decisions, contradicting the q theory and providing evidence of financial imperfections.

Following work by pioneers in behavioural economics (eg Kahneman and Tversky (1979)), Thaler in a series of influential papers (eg De Bondt and Thaler (1985)) started the field of behavioural finance. This branch analyses how investor psychology, in conjunction with limits to arbitrage, can affect prices in financial markets. Building on Thaler's insights, Shleifer and Vishny (1997), drew attention to the limits to arbitrage in asset markets. Many contributions since then have showed how individuals' behaviour deviates from the standard paradigm (see Barberis and Thaler (2003), Thaler (2005) and Hirshleifer (2015) for reviews).

New empirical work also studied the importance of macrofinancial linkages. Notably, Mishkin (1978) and Bernanke (1983b) documented the critical role of financial factors in explaining the severity and persistence of the Great Depression. Mishkin argued that household balance sheet positions significantly impact consumer demand and Bernanke showed that a worsening of bank and corporate balance sheet positions leads to a more severe debt crisis. Other empirical studies put greater emphasis on the role of financial markets and institutions in shaping aggregate economic outcomes (Eckstein and Sinai (1986) and Brunner and Meltzer (1988)). Bernanke and Blinder (1988), Kashyap et al (1993) and others demonstrated the importance of the bank lending channel. A number of studies considered specific episodes of credit crunches in the United States and other countries and analysed the role of financial institutions in driving business cycles (Sinai (1992)). Importantly, with better data, the (causal) links between financial development and longer-term macroeconomic outcomes were documented (Goldsmith (1987), Fry (1988) and King and Levine (1993)).

Figure 1.B1. Evolution of research on macrofinancial linkages

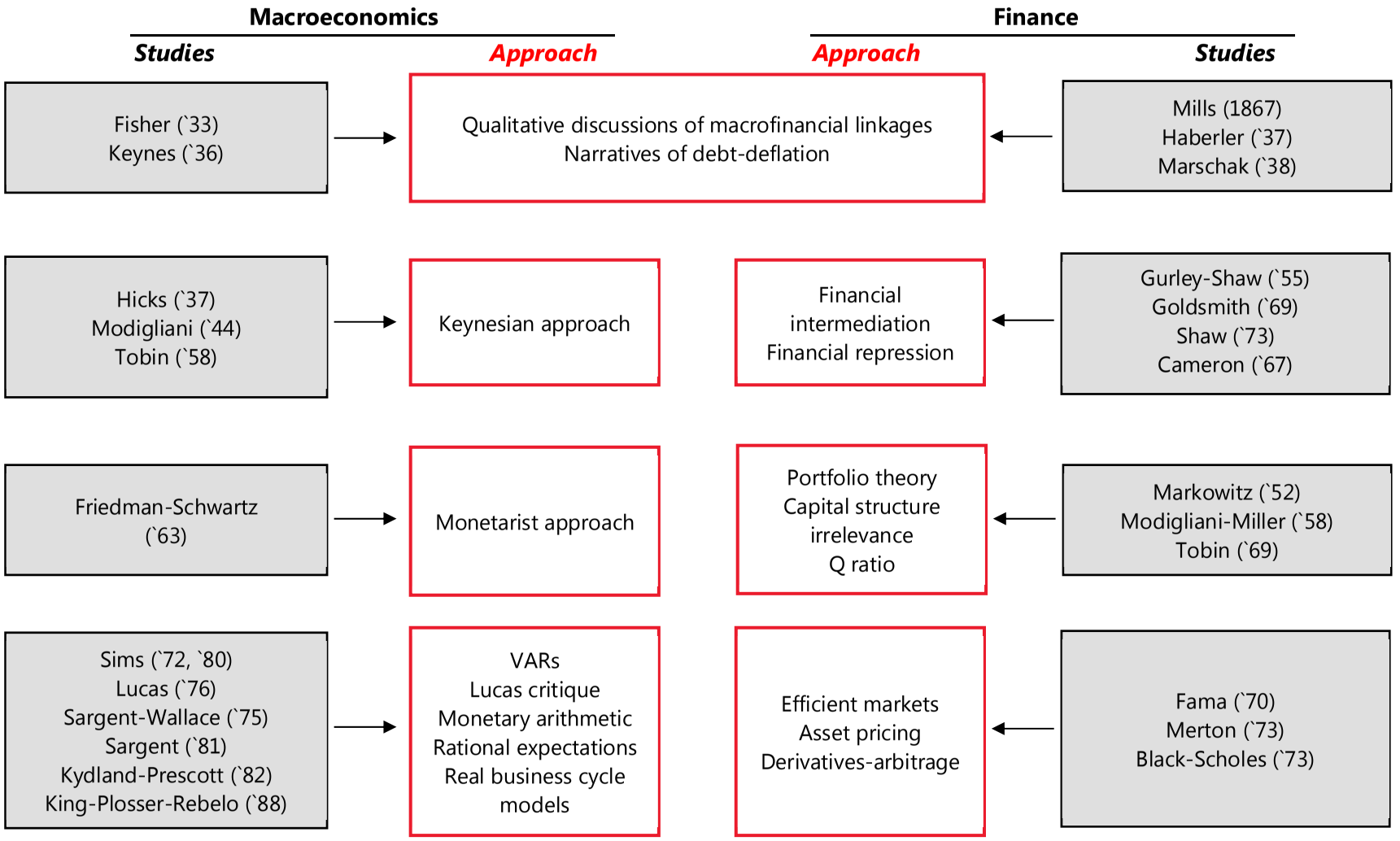
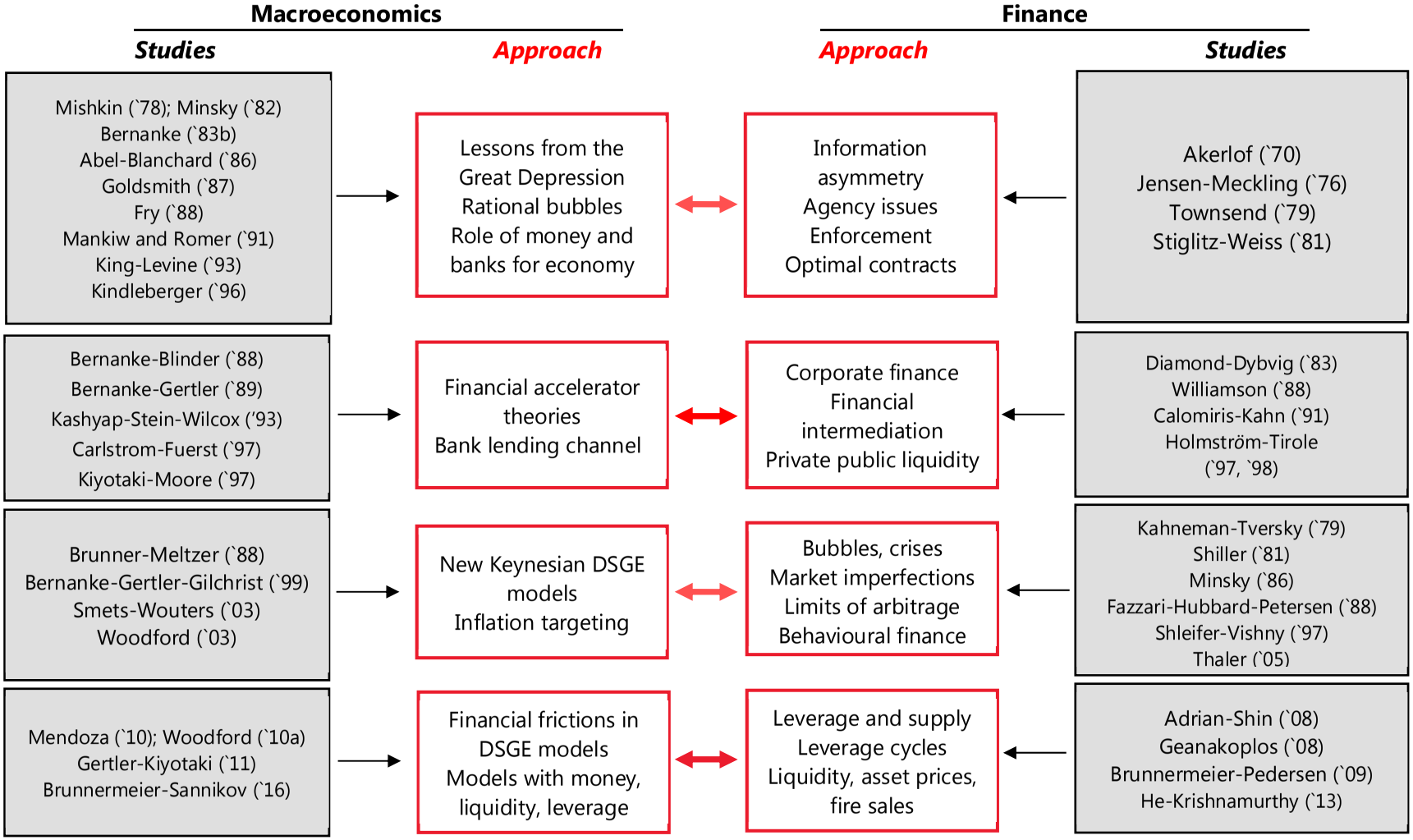


Figure 1.B1. Evolution of research on macrofinancial linkages (continued)




Notes: This diagram presents a rough representation of the evolution of research on macrofinancial linkages. Early interest in such linkages was triggered by the Great Depression. However, it remained largely qualitative. Although research became more analytical over time, it moved away from the analysis of financial market imperfections, especially over the period 1950–80. Since then, the literature has made significant progress in capturing the effects of microeconomic imperfections. More recently, it has combined theoretical insights from macroeconomics and finance in general equilibrium models. It has also produced many empirical studies at the micro- and macroeconomic levels. This diagram includes only a select set of studies because of space constraints. We summarize many other studies in the main text.

Over the past three decades, more rigorous analytical models have investigated the linkages between financial markets and the real economy. Some of these focus on amplification mechanisms, collectively known as "the financial accelerator", which operates through the demand side of financial transactions (Bernanke and Gertler (1989), Carlstrom and Fuerst (1997), Kiyotaki and Moore (1997) and Bernanke et al (1999)). These models show how accelerator effects arise when small shocks, real or financial, are propagated and amplified across the real economy as they lead to changes in access to finance. More recent theoretical and empirical research has illustrated the importance of amplification channels operating on the supply side, including through financial institutions and markets (Brunnermeier and Pedersen (2009), Adrian and Shin (2008) and Geanakoplos (2008)). New models that include both demand and supply types of macrofinancial linkage (Brunnermeier and Sannikov (2014), Gertler and Kiyotaki (2011), Williamson (2012) and Dávila and Korinek (2017)) have been developed.

and financial sector jointly but they resorted to mostly qualitative approaches. Later studies, however, emphasised the separation of the real sector from the financial sector and subscribed to the idea that the financial sector was no more than a "veil" to the real economy. Although progress has been slower than hoped for, the literature has been making a more concerted effort over the past three decades to analyse the interactions between financial markets and the real economy.

This study surveys the rapidly expanding literature on macrofinancial linkages. Two critical observations inform the structure and contents of our study. First, to have a good understanding of macrofinancial linkages, one needs to cover the ground on the links between asset prices and macroeconomic outcomes that are at the centre of broader macrofinancial linkages. The past quarter century has seen dramatic movements in asset prices and real economic activity. These developments highlight the importance of understanding the linkages between asset price movements and macroeconomic outcomes.

Second, since macrofinancial linkages often arise because of financial market imperfections, it is necessary to understand the implications of these imperfections for macroeconomic outcomes. A number of analytical models have been developed to analyse the critical roles played by financial factors for the real economy. These models have been used for a variety of purposes, including the analysis of the impact of monetary and fiscal policies on the real economy and financial markets.

In Chapter 2, we survey the literature on the linkages between asset prices and macroeconomic outcomes in models without financial market imperfections. In these models, changes in financial variables, such as asset prices, are associated with individual consumption and investment decisions. However, there are no aggregate feedback mechanisms from financial to real variables and little scope for macrofinancial linkages in these models.

Given the enormous volume of work on the links between asset prices and macroeconomic outcomes, we focus on three specific questions. First, what are the basic theoretical mechanisms linking asset prices and macroeconomic outcomes? Second, what is the empirical evidence supporting these linkages? And third, what are the main challenges to the theoretical and empirical findings? Our survey only scratches the surface of this large literature by providing a broad perspective on these questions in the context of the following asset price categories: equity prices, house prices, exchange rates and interest rates.

Chapter 2 starts with a general discussion of the determinants of asset prices with standard models of "complete markets". These models often apply to all types of asset. But to simplify the presentation, we first focus on equity and house prices within a closed economy context. We then analyse the international dimensions of asset

prices. Next, we discuss in more detail two other major asset prices: exchange rates and interest rates (and related bond prices).

Chapter 3 surveys the literature on the implications of financial market imperfections for macroeconomic outcomes. It focuses on two main channels through which financial market imperfections can lead to macrofinancial linkages. The first channel, largely operating through the demand side of finance, describes how changes in borrowers' balance sheets can amplify macroeconomic fluctuations. The central idea underlying this channel is best captured by the financial accelerator – an extensively studied propagation mechanism in a wide range of models. The second channel, associated with the supply side of finance, emphasises the importance of balance sheets of banks and other financial institutions in lending and liquidity provision for the real economy.

Chapter 3 first reviews the basic microeconomic mechanisms that could lead to financial market imperfections on the demand side. We then analyse general equilibrium models that feature amplification mechanisms operating through the demand side. This discussion is followed by a review of studies on the macroeconomic implications of financial imperfections in the context of open economies. Next, we present a summary of the amplification channels that operate largely on the supply side of finance and the empirical evidence relating to the importance of these channels. We then review recent empirical studies that analyse aggregate linkages between the real economy and the financial sector.

Our study contributes to the literature on macrofinancial linkages in several dimensions. First, it presents a broad review of the theoretical and empirical work on the topic. Second, it documents that basic models are able to capture many linkages as documented by a wide range of empirical studies. However, it also shows that a number of puzzles remain regarding the behaviour of asset prices and their interactions with macroeconomic outcomes. Third, it emphasises the global dimensions of these linkages in light of the rapid growth of international financial transactions and their critical role in the transmission of cross-border shocks. Fourth, it summarises the main empirical features of the linkages between the financial sector and the real economy. Finally, to help guide future research, our study attempts to identify the major gaps in knowledge on these issues.

Given the large number of studies on the macrofinancial linkages, a survey on the topic comes with a number of caveats. First, our objective is to provide intuitive explanations of how macrofinancial linkages arise and operate in different contexts. Hence, rather than delving into the details of certain models, we explain the general ideas describing the workings of models and then summarise the relevant empirical evidence for specific channels. In order to present a coherent review of this large body of work, each section provides a self-contained summary of the specific literature.

Second, macrofinancial linkages ultimately originate at the microeconomic level. Hence, whenever possible, we draw lessons from the theoretical and empirical work on the microeconomic factors that are relevant for the behaviour of macroeconomic and financial aggregates. Third, while many of the studies we review have policy relevance, we largely stay away from directly addressing policy issues, including those related to monetary, macroprudential, regulatory and crisis management policies. Finally, while we did our best to include all the major studies on the topic, it is probably unavoidable that a survey of such a rich literature would miss some contributions.

The topic of macrofinancial linkages promises to remain an exciting area of research, given the many open questions and significant policy interest. In Chapter 4, we discuss possible directions for future research, stressing the need for richer theoretical models, more robust empirical work and better quality data so as to advance knowledge and help guide policymakers going forward.

# 2. Asset prices and macroeconomic outcomes

## 2.1 Linkages between asset prices and macroeconomic outcomes

The past quarter century has seen dramatic movements in asset prices and real economic activity. Equity prices rose significantly during the second half of the 1990s and then fell abruptly in 2000–01 with the unwinding of the high-tech bubble. The large decline in equity markets coincided with recessions in many advanced economies. House prices increased substantially over 1996–2007 but declined sharply after that. The collapse in house prices was accompanied by the Great Financial Crisis (GFC) of 2007–09, which led to deep recessions in almost all advanced economies after an extended period of macroeconomic stability – the so-called Great Moderation.[4] Policymakers reduced interest rates to zero or even below as they attempted to mitigate the adverse effects of recession and establish a durable recovery. Exchange rates also swung widely, especially during periods of intense financial stress.

These developments highlight the importance of understanding the linkages between asset price movements and macroeconomic outcomes. Specifically, the GFC was a bitter reminder of how pronounced fluctuations in asset prices can have a dramatic impact on the balance sheets of households, corporations, financial intermediaries and sovereign nations. As asset prices fell sharply and the global financial system edged to the brink of collapse in late 2008, the global economy experienced its deepest contraction in more than half a century. This led to unprecedented challenges for fiscal, monetary and financial sector policies.

The links between asset prices and macroeconomic outcomes are obviously at the centre of broader macrofinancial linkages – the two-way interactions between the real economy and the financial sector. Shocks arising in the real economy can be propagated through asset prices via the operations of the financial sector, thereby amplifying business cycles. Imperfections in financial markets can intensify shocks to asset prices and consequently lead to more pronounced macroeconomic fluctuations. Conversely, developments in financial markets can be sources of shocks, which can, in turn, result in more pronounced asset price movements and macroeconomic fluctuations. Through cross-border connections, these developments can lead to international spillovers.

[4] A number of books, academic studies and "popular" literature pieces, discuss various macrofinancial linkages that have contributed to the devastating impact of the GFC on the real economy: Krugman (2009b), Sorkin (2009), Wessel (2009), Lewis (2010), Kose and Prasad (2010), Paulson (2010), Gorton (2012), Turner (2012), Bernanke (2013), Blinder (2013), Borio (2014), Claessens et al (2014a), Mian and Sufi (2014a), Wolf (2014), Geithner (2014), Farmer (2016), King (2016) and Taylor (2016). Lo (2012) reviews a set of 21 books on the GFC.

This chapter surveys the literature on the linkages between asset prices and macroeconomic outcomes. Given the enormous volume of work on this topic, we focus on three specific questions. First, what are the basic theoretical mechanisms linking asset prices and macroeconomic outcomes? Second, what is the empirical evidence supporting these linkages? And third, what are the main challenges to the theoretical and empirical findings? Our survey only scratches the surface of this large literature by providing a broad perspective on these questions in the context of the following asset price categories: equity prices, house prices, exchange rates and interest rates.[5]

Our survey in this chapter contributes to the literature on the links between asset prices and macroeconomic outcomes in several dimensions. First, it presents a broad review of the theoretical and empirical work on the main determinants of asset prices and the basic linkages between asset prices and economic activity. Second, it documents that basic models are able to capture many linkages as documented by a wide range of empirical studies. However, it also shows that a number of puzzles remain regarding the behaviour of asset prices and their interactions with macroeconomic outcomes. Third, it emphasises the global dimensions of asset price determination, the linkages between asset prices and economic activity and the critical role of such prices in the transmission of shocks across borders. Finally, to help guide future research, the survey attempts to identify the major gaps in knowledge on these issues.

Given their complex nature, a survey on the linkages between asset prices and macroeconomic outcomes comes with a number of caveats. First, both asset prices and macroeconomic outcomes are endogenous variables and, as a result, the nature of the relationships between them ultimately depends on the models employed for the analysis. Our objective here is to present the basic linkages in the context of standard models and review the most relevant empirical studies that test for the presence of these links. Second, while we study the linkages between asset prices and macroeconomic outcomes, we are keenly aware that many micro-level factors drive macro-level variables. Hence, whenever possible, we draw lessons from theoretical and empirical studies at the microeconomic level for macroeconomic aggregates.

Third, our focus is mostly on standard models, ie models that do not necessarily account for financial market imperfections. We consider these "frictionless" models as the benchmark frameworks to study the linkages between asset prices and macroeconomic outcomes. We present a discussion of models with financial imperfections in Chapter 3. Finally, although we did our best to include all major studies on the topic, it is unavoidable that a survey on such a vast literature would miss some contributions.

We start with a general discussion of the determinants of asset prices with standard models of "complete markets". These models often apply to all types of asset. But to simplify the presentation, we first focus on equity and house prices within a closed economy context. We then analyse the international dimensions of asset prices. Next, we discuss in more detail two other major asset prices: exchange rates

[5] Reference books analysing the dynamics of asset prices and their connections to macroeconomic outcomes include: Campbell et al (1996), Duffie (2001), Cochrane (2005, 2006, 2017), Singleton (2006), Pennacchi (2007), Brunnermeier et al (2013), Quadrini (2014), Morley (2016) and selected chapters of Constantinides et al (2013). See also Campbell (2014) who discusses the research on asset pricing conducted by the laureates of the 2013 Nobel Prize in Economics (Eugene Fama, Lars Peter Hansen and Robert Shiller). Woodford (2003) analyses interest rates and prices and the role of monetary policy in shaping them. Sarno and Taylor (2002), Klein and Shambough (2010), Chinn (2012), Rossi (2013) and Engel (2014) provide extensive surveys of different aspects of exchange rates.

and interest rates (and related bond prices). In order to make our survey more accessible, each section provides a self-contained review of the relevant segments of the literature. We also structure each section to address systematically the three questions posed above.

Section 2.2 starts with a brief analysis of the determination of asset prices in standard models. Models operating within a "complete markets" paradigm provide the basic analytical foundations for the determination of asset prices. Asset prices, like other prices, are endogenous and adjust to clear markets, including "anonymous" financial markets in these models. The standard models provide useful frameworks as they highlight the basic linkages between asset prices and agents' decisions, including through the well-known channels associated with wealth and substitution effects. Asset prices also provide economic agents with signals that allow them to make optimal saving and investment decisions. They also carry information about future profitability and income growth.

This section then turns to the empirical literature, analysing the linkages between asset prices, especially equity and house prices, and real variables. Empirical studies support many of the predictions of standard models with respect to linkages between asset prices and macroeconomic outcomes. First, movements in asset prices are associated with changes in investment and consumption that are broadly consistent with the predictions of many standard models. In particular, studies that use microeconomic data support various theoretical predictions regarding the impact of asset prices on household and firm behaviour. Second, asset prices appear to play a "signalling role" as they tend to co-move with (or lead) various measures of current and future activity.

Although the basic models provide helpful guidance, a number of puzzles remain, particularly with respect to inconsistencies between the predictions of models and the data. First, asset prices are much more volatile than fundamentals would imply. They can at times deviate substantially, or at least appear to, from predicted values based on fundamentals. Second, there are many questions about the quantitative importance of the linkages between asset prices and macroeconomic aggregates. The strength of these empirical linkages appears to depend on various factors. Investment and consumption, for example, respond differently to changes in asset prices than standard models would predict, with a significant role for non-price factors in influencing agents' behaviour. Third, there are limits to the predictive power of asset prices for economic activity. Empirical evidence also suggests that the channels leading to the predictive power of prices may be different from those suggested by the basic models.

Section 2.3 briefly reviews the international dimensions of linkages between asset prices and macroeconomic outcomes. Given the extent of cross-border integration of real and financial markets today, any discussion of the linkages between asset prices and activity has to take into account the international dimensions. Like their closed economy counterparts, however, many of the international asset pricing models are based on partial equilibrium analysis. Moreover, these models often do not consider whether international asset holdings are consistent with observed prices. While recent theoretical studies have taken significant steps to remedy these shortcomings and analyse the dynamics of asset prices in richer, general equilibrium environments, there is a broad realisation that gaps remain.

Empirical studies find that certain asset prices tend to move together and emphasize the importance of common (global) shocks (factors) in explaining fluctuations in asset prices. This is a natural outcome of the major role that

international financial integration has played in shaping asset price movements in recent decades. In addition, the empirical literature documents that domestic financial development and trade integration affect the degree of co-movement of asset prices across countries. Even prices of non-tradable assets, such as real estate, tend to move together across countries, suggesting that there are indeed global factors driving asset price movements.

However, there are many puzzling aspects associated with the international dimensions of asset prices. First, international financial integration appears to amplify both the volatility and co-movement of asset prices beyond what standard models would suggest. Second, the lack of international diversification of portfolio investment, the so-called home bias, has been hard to reconcile with the predictions of most asset pricing models. Moreover, the prices of internationally-traded assets continue to depend on local risk factors, suggesting some *de facto* segmentation of markets despite the removal of many barriers to cross-border trading (especially of equities).

Section 2.4 starts with a brief review of the determinants of exchange rates. The theoretical literature on exchange rate determination has gone through several phases, from basic arbitrage-related models to fully fledged general equilibrium models. These models point to long-run relations between exchange rates and a wide range of real and nominal variables. They also show that the exchange rate can play an important role in the transmission of monetary policy for small open economies. The more recent literature, often classified under the rubric of "new open economy macroeconomics", is making increasing use of advances from the closed-economy macroeconomic literature to help explain the properties of exchange rates in environments featuring nominal rigidities, imperfect competition and rational agents.

There has been a large theoretical literature analysing the linkages between fluctuations in exchange rates and macroeconomic fundamentals. Theoretical models are used to study how changes in exchange rates relate endogenously to various macroeconomic variables and how these relationships are affected by a variety of factors, including: the heterogeneity of sectors; economies of scale and imperfect competition; type of exchange rate regime; country-specific elements and time horizons. However, some of the theoretical linkages remain ambiguous, including the impact of exchange rates on investment and the effects of devaluations on output. Recent models employ richer environments and consider the roles of financial variables and valuation effects to get a better understanding of existing linkages between exchange rates and real and financial aggregates.

Empirical studies provide mixed evidence about the strength of linkages between exchange rates and macroeconomic outcomes. First, while most studies show that a depreciation (appreciation) tends to be associated with a contraction (expansion) of investment, the potency of this relationship varies across sectors, countries and time horizons. Second, while the exchange rate appears to play a supportive role in facilitating the reversal of current account imbalances, the quantitative importance of this role is ambiguous. Third, the exchange rate is a transmission channel through which monetary policy could affect the real economy but the strength of this channel appears to depend on many factors, including the sensitivity of interest rates to exchange rates, the degree of openness, the exchange rate regime, and the currency composition of debt and, related, any mismatches.

Moreover, a number of puzzles remain about the interactions between exchange rates and macroeconomic variables, and even more so about the linkages between exchange rates and financial variables. The key puzzle is the disconnect between

exchange rates and macroeconomic aggregates, as reflected in the limited success of exchange rate models relating future exchange rates to underlying short-run fundamentals. The roles played by financial variables in driving the behaviour of exchange rates have yet to be explained satisfactorily.

Section 2.5 reviews the links between interest rates and macroeconomic outcomes. Interest rates, real and nominal, play key roles in financial intermediation and can drive macroeconomic outcomes. The theoretical mechanisms that relate changes in (short-term) interest rates to fluctuations in output are well captured by standard models. The short-term nominal interest rate is, of course, closely related to the conduct of monetary policy. One of the main channels of monetary policy transmission, the direct interest rate channel, for example, focuses on the impact of interest rates on investment and consumption.

Empirical research confirms the special role played by interest rates in shaping activity. First, interest rates have a substantial effect on investment, consumption and overall activity. Second, there is evidence supporting the presence of a direct interest rate channel of monetary policy. Third, long-term interest rates relate to short-term rates through expectations and arbitrage in ways that are often consistent with the predictions of the standard models. Moreover, the spread between long- and short-term interest rates and other characteristics of the yield curve help predict the timing of recessions and the behaviour of some macroeconomic aggregates.

Much evidence supports the key channels but research also suggests there are other factors that affect the transmission of monetary policy. First, the quantitative importance of the direct interest rate channel has been debated. While empirical results are not necessarily inconsistent with the existence of a direct channel, they do suggest the need to consider firm, household and financial system heterogeneity, and variations over time, including in the state of domestic and international financial conditions. Second, there has been debate about the predictive value of the (slope of the) yield curve for future economic activity. More generally, the shape of the yield curve is determined by a variety of factors, including risk premia that can vary with economic and financial conditions. Lastly, the experience with unconventional monetary policies (UMP) since the GFC has introduced new aspects about the linkages between asset prices and activity that require further research.

Section 2.6 concludes with a summary of the key findings and documents some of the major gaps in the literature.

## 2.2 Understanding asset prices and macroeconomic outcomes

This section examines the basic determinants of asset prices and their linkages to macroeconomic variables in the context of standard models without frictions. These models, which often assume a world of complete markets in an Arrow-Debreu sense (as discussed below), provide the basic analytical foundations for the determination of asset prices.

The section comprises three parts. It starts with a brief summary of the basic price determination mechanisms contained in standard models and the implications of changes in asset prices for economic activity. It then reviews empirical studies, providing evidence relating to these mechanisms. It concludes with a summary of the major shortcomings of the models.

## A. Basic mechanisms

### *Determination of asset prices*

In competitive market models without frictions, the prices of assets, like the prices of goods, are determined by the forces of supply and demand. Assets studied typically include a broad array of tradable claims, such as bonds, equities, real estate, plant and equipment, patents etc. In these models, asset prices, as for other prices, reflect the equilibrium outcome of aggregate demand and supply forces, with no clear feedback from asset prices to aggregate demand or supply. This is clear in the most complete version, ie in an Arrow-Debreu world, where contingent claims span every possible state of the world, allowing agents to insure against any event, which in turn simplifies the choices they make.[6] The absence of feedback effects in these models makes them different from classes of models with a so-called financial accelerator or other feedback mechanisms arising from frictions that give rise to macrofinancial linkages (see Chapter 3). That said, by providing signals to economic agents, asset prices "help" households and corporations in making optimal decisions with respect to saving, investment and consumption.

In these models, asset prices reflect the present (discounted) value of future cash flows or services. They recognise that asset ownership constitutes a claim on the income derived from an asset (ie it is not the asset itself that is valued). The price of an asset is simply the present value of its future cash flows (dividends). The canonical representation of this idea is described by the "Gordon equation", which is often used in the context of the determination of equity prices (Gordon (1959 and 1962)). It implies that the price of an asset with a perpetual stream of dividends can be expressed as its current dividend divided by the appropriate discount rate for holding the asset minus the nominal growth rate of the dividends it pays. This calculation requires one to project the path of future cash flows. Depending on the type of asset under consideration, this entails the analysis of a wide range of factors influencing the stream of cash flows, including macroeconomic variables – such as output, household consumption, corporate investment and productivity – as well as uncertainty relating to these variables and correlations among them.

In addition, asset price determination requires the use of the "right" discount rate. The risk-adjusted discount rate used in present value calculations is the sum of the risk-free rate and the risk premium applicable to a specific asset. The risk-free rate can often be observed, eg the interest rate on Treasury bills or government bonds. The risk premium depends on the specific behaviour of an asset's cash flow and can be determined using an asset pricing model, assuming that markets are complete and without financial frictions. In partial equilibrium models – for example, when only the behaviour of financial variables is modelled – this is relatively easy as the risk-adjusted discount rate simply reflects movements in financial variables. For example, in the basic capital asset pricing model (CAPM), the required premium is determined by the degree to which an asset's risk is non-diversifiable with respect to all other

[6] This is also referred to as the Arrow-Debreu-McKenzie model. For a short conceptual review of asset pricing, see Geanakoplos (2008), and for an extensive treatment, see Cochrane (2005). For an overview of the empirical determinants and properties of various asset prices, see Hordahl and Packer (2007).

assets, captured by its *beta,* and the excess of the rate of return on all assets (the market rate of return) over the risk-free rate.[7]

In general equilibrium, preferences, technology and real factors (physical endowments) determine the discount rate and cash flows. In his seminal general equilibrium model, Lucas (1978) links the required rate of return on assets to investors' risk aversion and endowments ("cash flows"). Other general equilibrium asset pricing models extend this basic idea. The pricing model ("kernel") has gradually become more complex in these frameworks, but the underlying principle has remained the same: preferences, technology and the behaviour of real factors determine jointly the risk-adjusted discount factor. In turn, they affect investment and consumption decisions, with capital stocks and shocks to technology subsequently driving future cash flows and output. Shocks to technology and/or preferences can then generate correlated movements in investment, consumption, output and asset prices. The joint role of technology and preferences can be seen most easily in the context of a special class of general equilibrium models, the so-called consumption capital asset pricing models (CCAPMs).[8]

These general equilibrium models are highly stylised, however, and rely on a wide range of assumptions. The standard ones, including those used in the real business cycle (RBC) literature, most often assume complete markets, an absence of transaction costs and no financial imperfections. These assumptions are typically similar to those made in deriving the path-breaking Modigliani-Miller result of the irrelevance of financing structures for firm value (see Brealey et al (2016) for a textbook treatment).

In particular, as Modigliani and Miller (1958) showed, the market value of a firm is independent of the way it is financed under the following assumptions: (i) neutrality of taxation between debt and equity; (ii) no capital or financial market frictions (ie no transaction costs, agency issues, asset trade restrictions or bankruptcy costs); (iii) symmetric access to credit markets (ie firms and investors can borrow or lend at the same rate); and (iv) no information relating to prospective financial policies of the firm. Other common assumptions include no barriers across (international) markets, no heterogeneity among participants and perfect divisibility of real and financial assets.

The main implication of these assumptions is that the price of any asset, like the market value of a firm, is solely determined by the present value of the cash flows it

[7] The CAPM was developed (in several stages) by Treynor (1962), Sharpe (1964), Lintner (1965) and Mossin (1966). In a simple, one-factor CAPM, *beta* is equal to the regression coefficient of the observed rate of return of an asset on the market rate of return. In more general settings, *beta* equals the covariance of the cash flows of an asset with the cash flows of all assets traded in the economy relative to the variance of the cash flows of all assets. The determination of the rate of return, or of the cash flow process, is often left unspecified in such partial equilibrium models.

[8] In most models, the pricing formula equates the expected rate of return on an asset in excess of the risk-free rate (its risk premium) to (the negative of) the covariance between that asset's returns and the (stochastic) discount factor (the investor's intertemporal rate of substitution). Hence, the more negative the covariance between an asset's return and its discount factor, the higher its risk premium is (Campbell (2003), Cochrane (2006), and Campbell et al (2015)). In consumption-based asset pricing models, the discount factor is proportional to the covariance of the return on the asset's cash flow with consumption growth, thus creating a link between real (macroeconomic) aggregates and asset prices (Cochrane (2000)). Ludvigson (2013) presents a review of the recent literature on consumption-based asset pricing models.

generates.[9] While many of the assumptions underlying the Modigliani-Miller irrelevance result and the complete markets paradigm clearly do not apply in the "real" world, and have subsequently been questioned by the literature, such frameworks have been very useful in establishing some fundamental relationships. Adjustments correcting for specific deviations from these assumptions have been made. For example, the differential treatment of taxes on debt and equity can be accounted for by including the present value of tax shields (since interest payments are tax deductible) to the value of the firm (see Graham (2013) for a review on how taxes affect corporations' financial decisions). Corrections can also be made to capture the effects of inflation: for example, the real interest rate, rather than the nominal rate, may need to be used.[10]

For a long period of time, the Arrow-Debreu framework and the related Modigliani-Miller theorem greatly influenced the research agenda on macrofinancial linkages (see Chapter 3 for an overview of the evolution of this literature). Methodological advances in the 1970s contributed to this influence. Whereas money and credit featured prominently in earlier work, researchers focused increasingly on the real side of the economy and relied on the simplifying assumption that financial structures and intermediation did not matter for firm value or for the real economy in general. Although some empirical studies employing vector autoregressions (VARs), first proposed by Sims (1972), focused on the role of money as the key financial aggregate, until the early 1980s the literature considered mostly movements in real aggregates.

### *Asset prices and activity*

The standard models make clear predictions about how asset prices relate to individual agents' investment and consumption decisions. Implicit in most models is that asset prices, like any other prices, play an "allocative" role. This is clearly seen in corporations' investment and households' consumption decisions, ie the allocation of resources across different objectives, states of nature and time. This is probably best captured by Tobin's *q* theory, which posits that asset prices can be used to determine the market value of a firm's existing fixed capital stock. Tobin (1969) defines *q* as the market price of a firm, assuming that it is traded, relative to the replacement ("book") value of its assets. If *q* is high, new plants and equipment capital are cheap to add relative to the market value of the firm. The firm can then raise new equity and other external financing to expand its capital, or replace it, and thereby increase overall firm

[9] Another set of implications relates to the predictability of asset prices and the absence of arbitrage opportunities. The notion that asset returns are impossible to predict if asset prices reflect all relevant information ("follow a random walk") goes back a long time (Bachelier (1900)). Fama (1970), in his review of the existing literature, which included his own important empirical contributions (Fama (1963, 1965)), introduced the term "efficient market hypothesis" to capture this concept. He also provided a typology of possible empirical tests and related insights. See Fama (1991) for a review of the subsequent literature (up to the late 1980s).

[10] In addition, the time profile of the cash flows may matter as the maturity of the discount rate needs to match the profile of the cash flows. For example, the long-term interest rate, rather than the short-term rate, plays a major role for corporate investment, housing and the consumption of durable goods. The long-term interest rate is often a reflection of expected future short-term interest rates (the expectations hypothesis). Textbooks, such as Brealey et al (2016), discuss many of the "corrections" employed. Even with corrections, however, the market value of a firm and of other asset prices can differ from the ones implied by the standard theoretical models. There has consequently been an extensive research programme analysing the various deviations from the benchmarks.

value. Value can be added in this way until $q$ converges to its equilibrium level of one. Thus, the $q$ theory establishes a natural link between asset prices and corporate investment.[11]

Models also show how asset prices influence households' consumption and saving decisions through wealth and substitution channels. In most such models, consumption decisions are based on households' lifetime wealth, including current and future income and current financial and physical assets. Changes in asset prices can then influence current consumption as they change individuals' financial and real wealth.[12] In addition, by altering the rate of substitution between consumption allocations over time (the intertemporal marginal rate of substitution), asset prices can affect households' saving behaviour.[13]

Another channel operates through the information that asset prices incorporate about future profitability and income growth. Private fixed investment depends on expected output growth. Financial markets can aggregate efficiently information about the state of the economy and future prospects into asset prices (see Allen (1993)). For example, when prospects of future corporate earnings improve, equity prices are expected to increase. To the extent that asset prices reflect fundamentals or provide information about future output (or sales) growth of a corporation or its competitors, the corporation will tend to respond to asset price changes by adjusting its investment (in terms of the selection of specific projects or their timing). At the aggregate level, changes in, say, expected productivity due to technological advances can lead to movements in asset prices. Similarly, households' consumption depends on expectations about future income. Movements in asset prices can provide information to households regarding current or future fundamentals, for example, by signalling faster or slower future income growth. This can lead households to adjust their consumption and saving behaviour.

## B. Empirical evidence

There is extensive empirical evidence supporting a number of mechanisms linking asset prices to microeconomic and macroeconomic outcomes. This section focuses on two major aspects of this evidence. First, asset prices are associated with changes in investment and consumption behaviour in manners predicted by the standard models. Second, the informational value of asset prices can play a signalling role as

[11] There are conceptual complications associated with the links between asset prices and investment, even in the absence of financial frictions. An important one, pointed out by Hayashi (1982), is that it is the marginal $q$ which matters, not the average $q$. Since only the average $q$ is observable, not the marginal $q$, this requires further assumptions to allow for empirical tests. More importantly, though, the presence of financial frictions can affect the basic relationship between $q$ and investment.

[12] Wealth effects on consumption relate to Ando-Modigliani's (1963) life-cycle/permanent income hypothesis (see Deaton (1992) for a detailed analysis). Given households' limited ability to borrow against future labour income and smooth consumption over their lifetime (ie in the presence of liquidity constraints), a form of market incompleteness or of financial friction, changes in asset prices can influence current consumption more than what is predicted by these models.

[13] Implications of changes in asset prices for household balance sheets have been an active area of research (see a recent review by Guiso and Sodini (2013)).

such prices tend to co-move with activity and appear to help predict its future direction.[14]

### *Asset prices, investment and consumption*

Empirical evidence, both at the micro- and macroeconomic levels, suggests that asset prices appear to affect corporate investment decisions, as predicted by the basic models. Brainard and Tobin (1968) established an empirical relationship between Tobin's *q* and investment. Using firm-level data, Abel and Blanchard (1986) subsequently showed that firms' marginal *q* is positively related to their investment. At the aggregate level, various studies documented the links between asset prices and private investment. Based on evidence for 19 OECD countries, for example, Davis and Stone (2004) found a large elasticity, with a 1% change in equity prices being associated on average with a 1% change in long-run investment. However, others find minor or insignificant effects.[15]

A number of studies provide evidence that such links can arise because of other channels. Although most of these studies generally support the conclusion that equity prices are an important determinant of investment, notably in countries with more developed financial systems, some question this finding, in part due to the presence of channels arising from financial frictions. Such frictions can, for example, lead to a relationship between Tobin's *q* and investment independently of the investment adjustment and information channels outlined above. Chirinko (1997) and Gomes (2001) show that financial constraints, such as when the cost of external finance depends on leverage, are likely to be reflected in *q*, making that variable endogenous to firm choice. In a related paper, Erickson and Whited (2000) point out that measurement error in *q* can lead to a positive relationship between a firm's internal cash flow and its investment, even when there is no direct relation (which otherwise would suggest a deviation from the *q* model).

While results depend on methodology and data samples, empirical studies at the household level find significant wealth effects of asset prices on consumption. For the United States, estimates of the marginal propensity to consume (MPC) out of overall wealth (financial assets and illiquid assets, including housing) range between 4% and 7%. For financial wealth only, estimates for the United States suggest changes in consumption of the order of 0.03% to 0.07% for every 1% change in equity value.[16] Empirical estimates vary by country though. Bayoumi and Edison (2003) report that equity wealth effects are much weaker for countries other than the United States: for every 1% change in equity value, the change in consumption is 0.015% to 0.03% in Japan and 0.01% to 0.03% in various European countries. Others find long-run

[14] Anecdotal evidence also indicates that the basic price determination models discussed here are widely used for the valuation of firms, projects and assets (Benninga (2008)).

[15] Caballero (1999) and Altissimo et al (2005) provide additional discussions. See also Davis (2010a, 2010b) for a review of empirical papers on the relationship between asset prices and consumption and investment as well as some specific regression results for 23 OECD countries. Estimating investment functions for the G7 countries, Ashworth and Davis (2001) show that Tobin's *q* only has a long-run effect on investment in Japan and France.

[16] For overall wealth estimates, see Gale et al (1999), Kiley (2000), Davis and Palumbo (2001), Barrell and Davis (2007a) and Case et al (2013). Using a broader definition of equity wealth (including both corporate equity and other types of security), the effect has been estimated at about 3 1/2 cents per dollar change in wealth (Ludvigson and Steindel (1999)).

elasticities ranging from very small (or insignificant) to 0.35% on average for OECD countries (Catte et al (2004)).

The effects of asset prices also vary depending on financial market characteristics. In emerging market economies (EMEs), for example, wealth effects are small, possibly due to a limited and concentrated participation of households in capital markets. Slacalek (2009) reports an average wealth effect of 0.015% for a 1% change in equity value for 22 EMEs over 1985–2007. Funke (2004), in a study of 16 developing economies, reports that a 10% decline in annual real equity market return is associated with a reduction in real private consumption of about 0.2–0.4% on average.[17]

Linkages between asset prices and macroeconomic outcomes also tend to vary by type of asset. In theory, housing wealth could have a smaller effect on consumption than equity market wealth because it is less clearly connected with future increases in productive potential (Mishkin (2007)). Moreover, since housing services are a component of consumption, increases in house prices can negatively affect consumption. At the same time, real estate wealth tends to be a significant share of households' wealth and households can often borrow against this wealth and leverage the increase in house value for consumption purposes.

Both house and equity prices are much more volatile than output (Table 2.1A). House prices appear to be less volatile than equity prices, though, implying that changes in house prices are likely to be perceived more permanent than changes in equity prices (Cecchetti (2008)). Kishor (2007) reports that while 99% of the change in housing wealth is permanent, ie it remains after one quarter, only 46% of the change in equity wealth is. Housing also typically constitutes a larger share of total wealth,

House prices, equity prices and output: stylised facts

Percent — Table 2.1A

| | Mean | Volatility | Maximum | Minimum |
|---|---|---|---|---|
| **House prices** | | | | |
| Q1 1971-Q4 2016 | 2.17 | 7.64 | 59.80 | -21.77 |
| Q1 1971-Q4 1984 | 1.24*** | 8.92*** | 59.80 | -21.32 |
| Q1 1985-Q4 2016 | 2.57 | 6.96 | 36.74 | -21.77 |
| **Equity prices** | | | | |
| Q1 1971-Q4 2016 | 4.96 | 23.73 | 149.64 | -65.21 |
| Q1 1971-Q4 1984 | -0.07*** | 23.85 | 138.50 | -63.54 |
| Q1 1985-Q4 2016 | 7.16 | 23.34 | 149.64 | -65.21 |
| **Output** | | | | |
| Q1 1971-Q4 2016 | 2.30 | 2.61 | 28.08 | -9.26 |
| Q1 1971-Q4 1984 | 2.60*** | 2.62 | 10.76 | -4.10 |
| Q1 1985-Q4 2016 | 2.24 | 2.61 | 28.08 | -9.26 |

Note: Mean indicates the average year-over-year growth rate. Volatility is the standard deviation of the growth rate. Maximum (minimum) is the maximum (minimum) growth rate. The sample consists of 18 advanced economies. *** indicates that the results for the period Q1 1971 to Q4 1984 are statistically different from those for the period Q1 1985 to Q4 2016 at the 1% level.

[17] See Kim (2004) for Korea, Peltonen et al (2012) for 14 EMEs, and IMF (2008) for cross-country evidence.

possibly making changes in house prices more important for household consumption decisions.[18]

Business cycles, asset price busts and booms

Table 2.1B

| | | Output | | | | |
|---|---|---|---|---|---|---|
| **Recessions associated with financial disruptions** | | Number of events | Duration | Amplitude | Cumulative loss | Slope |
| A. | Recessions without house price busts | 95 | 3.38 | -1.96 | -3.08 | -0.60 |
| | Recessions with house price busts | 46 | 4.74*** | -2.76** | -7.29*** | -0.62 |
| | Recessions with severe house price busts | 26 | 5.04** | -2.76** | -5.86*** | -0.78 |
| B. | Recessions without equity price busts | 144 | 3.55 | -2.15 | -3.41 | -0.57 |
| | Recessions with equity price busts | 76 | 4.21** | -3.85*** | -6.85*** | -0.98*** |
| | Recessions with severe equity price busts | 38 | 4.47** | -5.17*** | -9.73*** | -1.27*** |

| | | Output | | | |
|---|---|---|---|---|---|
| **Recoveries associated with financial booms** | | Number of events | Duration | Amplitude | Slope |
| A. | Recoveries without house price booms | 126 | 4.76 | 2.89 | 0.75 |
| | Recoveries with house price booms | 14 | 2.29*** | 6.14*** | 1.35*** |
| | Recoveries with strong house price booms | 9 | 2.44*** | 6.65*** | 1.59** |
| B. | Recoveries without equity price booms | 161 | 4.89 | 3.96 | 1.11 |
| | Recoveries with equity price booms | 55 | 4.69 | 4.36 | 1.13 |
| | Recoveries with strong equity price booms | 30 | 5.18 | 4.46 | 1.21 |

Note: All statistics, except "Duration," correspond to sample medians and are in percent. For "Duration," sample means are reported. Duration for recessions is the number of quarters between peak and trough. Duration for recoveries is the number of quarters it takes to attain the previous peak level of output. The amplitude of recessions is defined as the decline in output from peak to trough. The amplitude for recoveries is the one year change in output after trough. Cumulative loss combines information about duration and amplitude to measure the overall cost of a recession and is expressed in percent. The slope of a recession is the amplitude from peak to trough divided by duration. The slope of a recovery is the amplitude from trough to the period when output reached its last peak, divided by duration. Booms correspond to the observations in the top 25% of upturns calculated by amplitude. Busts correspond to the observations in the worst 25% of downturns calculated by amplitude. Recessions, recoveries, equity prices and housing busts and booms are identified following Claessens et al (2012a). The sample consists of 21 advanced economies for the period Q1 1960 to Q4 2011. *** and ** denote that recessions (recoveries) with asset price busts (booms) are significantly different from those without asset price busts (booms) at the 1% and 5% levels, respectively.

Overall, the available evidence suggests that changes in house prices have a more pronounced impact on consumption than equity prices. For the United States, Carroll et al (2011) report that the propensity to consume from a $1 increase in housing wealth ranges between two (short-run) and nine (long-run) cents, twice as large as that estimated for equity wealth (see also Case et al (2013)). Kim (2004) shows that in Korea the elasticity of consumption with respect to housing wealth is larger than with respect to equity market wealth between 1988 and 2003. Gan (2010) reports

[18] Lettau and Ludvigson (2004) also find that transitory shocks dominate variations in wealth in the United States while permanent shocks dominate variations in aggregate consumption, helping explain why little of the variation in household net worth relates to the variation in consumer spending. Kaplan et al (2014) find that households holding (illiquid) housing wealth behave like hand-to-mouth consumers, implying that their consumption is quite sensitive to transitory shocks to income. Mian et al (2013) estimate the MPC out of housing wealth using US households data and find that more leveraged and poorer households suffer higher losses in consumption in response to changes in housing wealth. Some earlier studies also examine the interactions between house prices and the real economy across countries (Borio et al (1994), Kennedy and Anderson (1994) and Tsatsaronis and Zhu (2004)).

a significant impact in Hong Kong of housing wealth on consumption using a large panel data set of households. Case et al (2005), using annual data for 14 advanced economies, show that house prices are more important than stock prices in influencing consumption. These findings are consistent with the idea of a more permanent nature of house price changes and a larger share of housing in total wealth. Furthermore, changes in house prices also appear to have a differential impact on age groups, which is consistent with the relative importance of housing in overall financial wealth.[19] In addition, there is some evidence of asymmetric effects, with negative shocks to asset prices having a greater impact on consumption than positive shocks (Peltonen et al (2012)).

Recessions associated with asset price busts and recoveries accompanied by asset price booms tend to be more pronounced than those without such episodes. In particular, recessions associated with asset price busts are significantly longer than recessions without such disruptions (Claessens et al (2012a), Drehmann et al (2012) and Muir (2017); Table 2.1B). They also result in significantly larger drops in output and correspondingly greater cumulative output losses. Given that about one third of recessions are accompanied by a house price bust, these results point again to the relevance of asset prices movements for economic activity.

### *Co-movement between asset prices and macroeconomic outcomes*

Confirming the predictions of most general equilibrium-type models, asset prices tend to be correlated with current and future aggregate activity. Since they reflect current economic developments, both equity and house prices co-move with business cycles (Table 2.1C). The contemporaneous correlations between house prices and output, however, tend to be higher than those between equity prices and output while the definitions of asset price cycles affect their correlations with the real sector.

Correlations between asset prices and output

Correlation coefficient — Table 2.1C

| | Lags | | | | Leads | | |
|---|---|---|---|---|---|---|---|
| | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| **Equity prices** | | | | | | | |
| Q1 1971-Q4 2016 | 0.44 | 0.49 | 0.47 | 0.37 | 0.22 | 0.07 | -0.05 |
| Q1 1971-Q4 1984 | 0.47 | 0.49 | 0.44 | 0.26** | 0.05*** | -0.17*** | -0.32*** |
| Q1 1985-Q4 2016 | 0.44 | 0.50 | 0.50 | 0.41 | 0.27 | 0.12 | 0.01 |
| **House prices** | | | | | | | |
| Q1 1971-Q3 2016 | 0.34 | 0.41 | 0.46 | 0.47 | 0.44 | 0.39 | 0.35 |
| Q1 1971-Q4 1984 | 0.06*** | 0.17*** | 0.27* | 0.37 | 0.37 | 0.35 | 0.30 |
| Q1 1985-Q3 2016 | 0.39 | 0.45 | 0.48 | 0.47 | 0.44 | 0.39 | 0.35 |

Note: The average within-country correlation between the year-over-year growth rates of asset prices and output is presented. The sample consists of 18 advanced economies. Lags (leads) indicate that output is shifted one or more quarters forward (backward) relative to asset prices. ***, ** and * indicate that the average correlations for the period Q1 1971 to Q4 1984 are statistically different from those for the period Q1 1985 to Q4 2016 (or Q3 2016) at the 1%, 5% and 10% levels, respectively.

[19] Research documents that house prices have a stronger impact on the consumption of older, less indebted households (see Campbell and Cocco (2007), Calomiris et al (2013) and Attanasio et al (2011)).

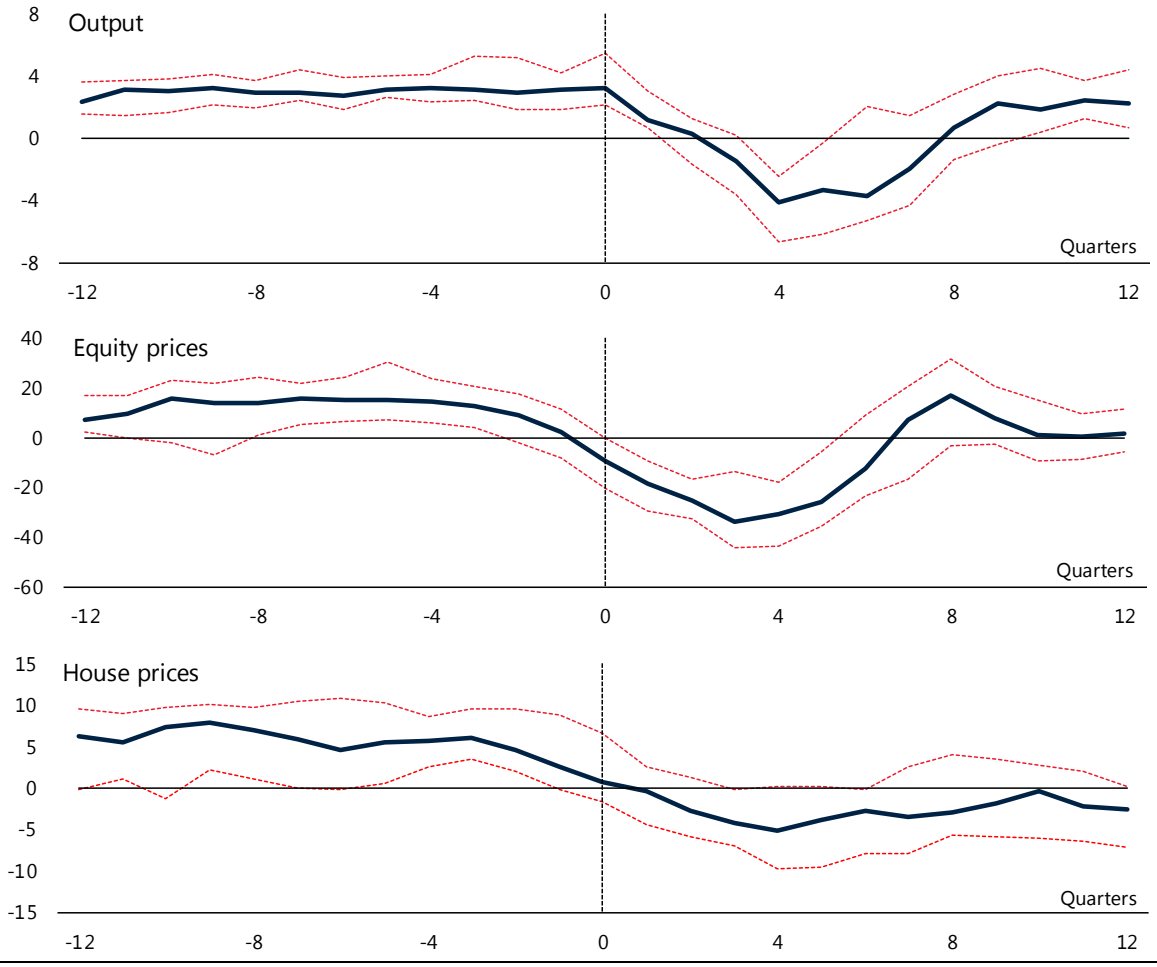
Being forward-looking variables, equity prices provide the market's aggregated views of future economic prospects. Empirical evidence for advanced economies confirms that changes in equity prices tend to lead output growth by a few quarters (Table 2.1C). The channel appears to run through investment. Indeed, for a wide variety of countries, including EMEs, equity prices seem to be better leading indicators of investment than GDP or consumption (Aylward and Glen (2000)). However, linkages between asset prices and activity also depend on country- and market-specific features (for reviews focusing on the predictive power of asset prices, see Stock and Watson (2003) and Cochrane (2008)).

House prices also display some predictive power for activity. There are several reasons for this (see Leamer (2007)). Housing market developments are sensitive to the same underlying factors affecting the overall economy (such as the level of interest rates and aggregate demand). As the economy expands or contracts, housing demand will change. This is highly relevant because the housing market is an important part of the overall economy. The housing market also exhibits long lags and is lumpy: it takes considerable time to start new housing projects, wealth effects associated with housing tend to operate with a lag and buying or selling of houses

Output and asset prices over the business cycle

Percent

Figure 2.1




Note: In each panel, the solid line denotes the median year-over-year growth rate of the indicated variable during recessions while dotted lines correspond to the upper and lower quartiles. Zero is the quarter during which each recession begins. The data sample consists of 18 countries and covers the period Q1 1971 to Q3 2011.

often involves large transactions costs. Together, these factors make various measures of housing sector activity, such as housing starts and prices, useful leading economic indicators. Although the predictive power of house prices for output growth is generally found to be somewhat weaker than that of equity prices, perhaps because housing is traded in relatively less liquid markets, changes in house prices have a greater power than equity prices in predicting future output gaps for some countries (IMF (2000)).

Equity and house prices are not only related to the overall business cycle but are also helpful in predicting cyclical turning points, albeit imperfectly. Recessions are often preceded by declines in equity prices or slowdowns in their growth (with the opposite for recoveries). For a large sample of countries for a period of almost 50 years, Claessens et al (2009) show that in the first year of a typical recession, equity prices decline on a year-to-year basis by roughly 35%. Anticipating the end of a recession, equity prices also often start registering positive growth after about three quarters into a recession (Figure 2.1). House price cycles generally lag business cycles, as reflected in the fact that house prices do not resume positive annual growth until at least 12 quarters after a recession has started whereas equity prices do after six to seven quarters.[20]

## C. Challenges to the standard models

The linkages between asset prices and activity differ from the predictions of standard models in a number of ways. First, asset prices are much more volatile than fundamentals would imply. They can at times deviate substantially, or at least appear to do so, from the predicted fundamentals-based values. Second, investment and consumption respond differently to asset prices than what standard models would predict, with a larger role for non-price factors in driving agents' behaviour and macroeconomic aggregates. Third, there are limits to the predictive ability of asset prices for real activity and the channels leading to the predictive power may be quite different from what the basic models would suggest. This sub-section discusses each of these issues in turn.

### *Asset pricing puzzles*

Asset prices are more volatile than what fundamentals suggest. An extensive literature, starting with Shiller (1979) for bond prices and Shiller (1981) for equity prices, has documented the "excess" volatility of asset prices. Shiller (1981) observed that if equity prices equal the expected sum of discounted dividends, then equity price volatility should face an upper limit determined by the volatility of what he called "ex-post rational" stock prices (defined as the sum of actual discounted dividends). However, he found that this was not born by the data. Studies using different approaches have also confirmed this finding (see Cochrane (2011b) for a review). In subsequent research, Campbell and Shiller (1987) showed that the excess volatility result remained even when the time series for prices and dividends were non-stationary (see LeRoy (2008)). Research has also shown that many other asset prices are much more volatile than the discounted value of the corresponding streams of dividend would suggest.[21]

[20] Bluedorn et al (2016) find that asset prices, especially equity prices, are helpful predictors of recessions in the G7 countries. Borio and Drehmann (2009) document that house prices, combined with credit, tend to predict financial crises.

[21] See Mankiw et al (1985, 1989), West (1988), Schwert (1989) and Barsky and De Long (1993).

Moreover, asset prices appear to move away at times from their predicted fundamentals-based values. This is not easy to confirm, however, because one does not know whether the mispricing represents a deviation from the "true" model or the use of a "mis-specified" model, including not knowing or using the "right" fundamentals. This can happen for individual assets (simply representing "arbitrage" opportunities) or for the market as a whole. Simple arbitrage opportunities are limited for most traded assets but markets may deviate at times from developments in fundamentals (Lo and MacKinlay (1999), Shiller (2000) and Akerlof and Shiller (2009, 2015)).

There is also ample evidence of stock price "bubbles".[22] As an illustration, one can compare the aggregate price-earnings ratio, the dividend yield and the implied equity premium in 1999, just before the stock market peak in advanced economies, with their historical averages over the period 1980–99 (IMF (2000)). Such a comparison shows that, in the late 1990s, the valuations implied by equity prices were considerably higher than their historical averages in terms of price-earnings ratio but lower relative to dividend yields and implied equity risk premia. At the same time, real GDP growth was not very different from its historical average.[23] These comparisons suggest some overvaluation at the time, with markets indeed experiencing a major correction after mid-2000.

The high volatility of asset prices relative to their fundamental values appears to stem partly from the volatile nature of discount rates. Asset price volatility can be decomposed into two parts: the volatility of expected future cash flows (eg dividends) and the volatility of the discount rate applied to those cash flows. Campbell and Shiller (1988a, 1988b) developed a methodology for decomposing the variation in the dividend-to-price ratio into variations in expected dividends and discount rates. Their research and subsequent work suggest that the variation in expected dividends accounts for no more than one-fourth of stock market volatility whereas variation in the discount rate accounts for the bulk of volatility (Cochrane (2011b) for a review).

This relates to the finding that most asset pricing models, including the basic consumption-based model, cannot fully explain the magnitude of the risk premium actually observed for equities – the spread between the rate of return required for holding the market portfolio and the risk-free rate (for a discussion of the credit risk premium, see Amato and Remolona (2013)). Using the CCAPM, Grossman and Shiller (1981) were the first to show that the premium is much higher and more volatile over time than most plausible risk aversion parameters would suggest. The phenomenon

[22] A bubble can be defined as: "*…the part of a grossly upward asset price movement that is unexplainable based on fundamentals*" (Garber (2000)). Patterns of exuberant increases in asset prices, often followed by crashes, figure prominently in many accounts of financial instability for all types of economy and going back centuries (Claessens and Kose (2014)). See Brunnermeier and Oehmke (2013), Scherbina and Schlusche (2014) and Williams (2013) for recent surveys on asset price bubbles. Some argue that fully irrational asset bubbles are not necessarily harmful and could even be beneficial (Kocherlakota (2009)).

[23] At the time, one explanation for the high level of stock prices was the strong labour productivity growth observed in the United States in the second half of the 1990s. This fuelled discussion of a "new economy" driven by information technology. However, later data revisions showed much lower labour productivity growth. The changes in (perceived or expected) productivity growth could well explain some of the run-up in prices and the following sharp corrections (Pastor and Veronesi (2006), Griffin et al (2011)). Lettau et al (2008) provide a summary of studies explaining persistently high stock market valuations, as observed in the late 1990s. They argue that a fall in macroeconomic risk or in economy-wide volatility can lead to such high stock prices.

was also noted by Shiller (1982) and Modigliani and Cohn (1979) but the literature truly emerged with the ground-breaking paper by Mehra and Prescott (1985).

Mehra and Prescott highlighted the difficulty that traditional models have in matching the observed excess return of stocks relative to a risk-free asset (with the degree of risk aversion viewed as realistic from a microeconomic perspective for a typical investor). The literature on the (excessive) equity risk premium in discount rates is large but inconclusive. The equity premium was subsequently refined by Epstein and Zin (1989) and Weil (1989), who developed models allowing preferences for risk and intertemporal substitution to be separated. Others explored the puzzle further, showing that one needs to distinguish between the intertemporal rate of substitution and the rate of risk aversion when trying to interpret the premium (see further Kocherlakota (1996), Mehra and Prescott (2003) and Rieger and Wang (2012)).

Higher asset price volatility can also arise if investors' risk aversion depends on macroeconomic volatility, as is the case, for example, in asset pricing models with habit formation (Campbell and Cochrane (1999)). Barro (2006) and Gabaix (2011) show that a standard model extended to allow for realistically calibrated rare-disaster probabilities can generate a high volatility of asset returns, high equity premia and low risk-free rates, which are all close to what is observed in practice.[24]

Apart from the overreaction of asset prices to swings in cash flows, the presence of various anomalies and other indications of "mispricing" also constitute a source of puzzles (see Schwert (2003) for a review). A number of possible answers to these puzzles have been proposed. For example, in some models, the rational expectations assumption that investors optimally use current information to forecast future dividend growth is relaxed. Instead, various market failures and forms of behavioural biases are introduced, such as investors' herding behaviour and sentiment (Barberis et al (1998)). Thaler (2005, 2015) presents a survey of the related behavioural finance literature (see also Shleifer (2000), Barberis and Thaler (2003), Barberis et al (2001) and Barberis (2013)).

Indications that investors tend to overestimate the persistence of variations in dividend growth – or, equivalently, to underprice risk – have motivated many studies (Barsky and De Long (1993)). Numerous reasons related to the functioning of markets – including limited market liquidity, "excessive" financial innovation, the perverse trading behaviour of large investors and the role of hedge funds – have also been mentioned as causes of the excessive volatility of asset prices (Bikhchandani and Sharma (2000)). Although this strand of research provides analytical models and some empirical evidence showing that asset prices are not simply determined by the present discounted value of future cash flows, it has not been able to identify definitive reasons driving the deviations from the basic models (Duffie (2010) reviews other examples of deviations).

### *Limits to the linkages between asset prices and activity*

A number of empirical studies report that firm investment reacts less to asset prices than what standard models predict. Research casts some doubt about the role of asset prices, in general, and Tobin's *q*, in particular, in explaining investment. Blanchard et al (1993), for example, find a limited role for market valuation in

[24] For additional information, see also Campbell et al (2013), Chen et al (2012), Ju and Miao (2012), Albuquerque et al (2016) and Krueger et al (2016))

explaining investment given fundamentals and current profits (see also Stein (2003) and Butzen et al (2003)). Other research finds that factors other than *q* or growth opportunities also drive investment (even though these may also be correlated with *q*).[25] Some studies suggest that, consistent with the presence of financial frictions, an important channel operates through the quantity rather than the cost (as reflected in *q*) of external financing.

The impact of asset price volatility on investment and other macroeconomic aggregates has been a fertile area of research. In theory, uncertainty associated with volatility has ambiguous effects on investment. On one hand, as Abel (1983) argues, uncertainty can increase the value of a marginal unit of capital and lead to more investment. On the other, as Dixit and Pindyck (1994) suggest, volatility may create incentives to delay investment, as more information about future payoffs becomes available over time, particularly given that investment may be irreversible (Bernanke (1983a)). Households' response to high uncertainty can be similar to that of firms; they reduce their consumption of durable goods as they wait for uncertainty to abate. On the supply side, firms' hiring plans are also negatively affected by higher uncertainty because of the cost of adjusting personnel (Bentolila and Bertola (1990)).

Some recent empirical studies report that the macroeconomic uncertainty associated with volatile asset prices tends to lead to a decline in output. Evidence based on VAR models points to a significant negative impact of uncertainty shocks on output, investment and employment (Bloom (2009, 2014), Hirata et al (2012), Nakamura et al (2017), Kose et al (2017b) and World Bank (2017a)). For example, a 1% increase in uncertainty is associated with a slightly larger than 1% decline in output in the first year (Figure 2.2). Using disaster data as instruments, Baker and Bloom (2013) offer evidence that causality runs from uncertainty to recessions and Bloom et al (2012) also report that (low) growth does not cause uncertainty. Predictions of theoretical models and findings from empirical studies collectively indicate that uncertainty, including that relating to asset prices, can play a dual role over the business cycle: it can be an impulse and a propagation mechanism (Gilchrist et al (2014) and Kose and Terrones (2012)).

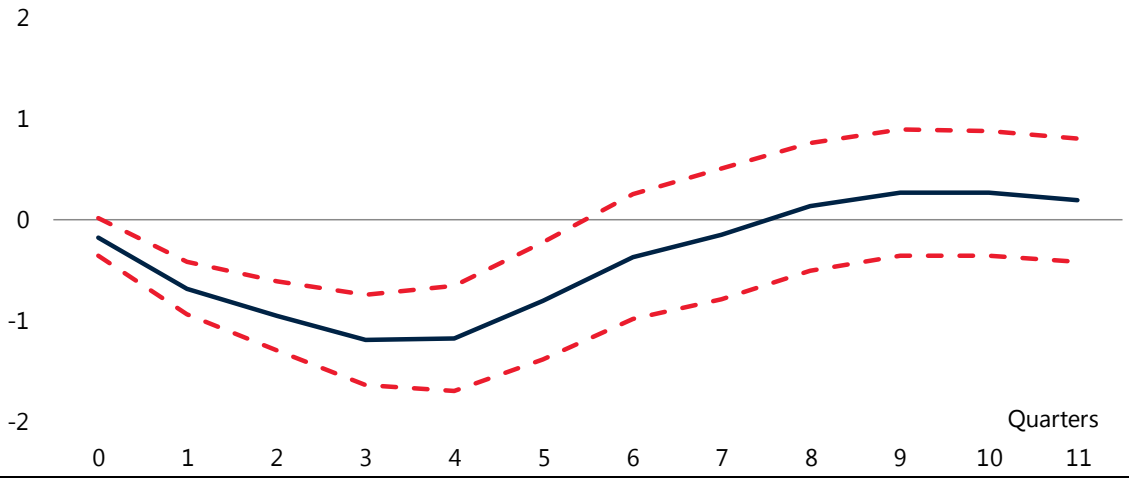
Studies of household behaviour also suggest many deviations from the predictions of the standard models of consumption smoothing over the life cycle. Although the empirical linkages between financial wealth and household consumption are less contested, numerous puzzles remain. For example, household consumption depends as much on disposable income as on lifetime wealth. This is in large part due to financial "imperfections": households have limited ability to borrow against future labour income, leading to liquidity constraints. Zeldes (1989) presents a test of the permanent income hypothesis against the alternative hypothesis that consumers optimise subject to borrowing constraints. He finds supportive evidence from household data that an inability to borrow against future labour income affects the consumption of a significant portion of the population (for reviews of this literature, see Caroll (2001), Meghir (2004) and Jappelli and Pistaferri (2010)).

[25] For evidence and reviews, see Fazzari et al (1988), Hubbard (1998) and Davis (2010b). Another channel is between productivity and *q* (Gomes (2001) and Abel and Eberly (2011)). Cuthbertson and Gasparro (1995) show that the average *q* alone is not a sufficient statistic but that output, capital gearing and the average *q* jointly provide an adequate model for capturing aggregate manufacturing investment behaviour in the United Kingdom (see also Bolton et al (2013)).

Impulse response of output to an uncertainty shock

Percent

Figure 2.2




Note: The graph shows the cumulative impulse response of global output to a global uncertainty shock. The solid line represents the median estimate and the dotted lines denote the 16% and 84% error bands. This impulse response is based on a FAVAR model that includes equity prices, uncertainty, interest rates, house prices and output. Shocks are identified using a recursive identification strategy. Uncertainty is constructed using the volatility of daily equity prices for G7 countries. The data sample consists of 18 countries and covers the period Q1 1971 to Q3 2011.

Many studies also report that household consumption reacts more strongly to changes in asset prices, especially house prices, than consumption-smoothing models predict. This finding suggests that asset prices affect borrowing capacity, in large part because real estate can be used as collateral, with the relationship again arising from financial frictions. The value of housing does not represent net wealth for the aggregate household sector because an increase in house value is also an increase in the implicit rental cost of housing (see Buiter (2010)). Similar to other asset prices, the effects of changes in house prices on overall economic activity must therefore either be due to distributional factors (eg households with different MPCs are affected diversely by changes in house prices) or arise because of imperfections (such as limits to collateralised borrowing that affect in turn current consumption) or due to various types of bounded rationality, behavioral and informational issues.[26]

The links between asset prices and investment also vary across countries. The relationship between changes in equity prices and investment tends to be stronger in the United States than in France and Germany while changes in property prices appear to have a closer relationship to investment in continental Europe and Japan (IMF (2002)). Barrell and Davis (2007b) show that equity price declines have an impact on US output that is three times larger than on euro area output. This is consistent with a stronger role for equity finance for firms in the United States than in other, more bank-based financial systems. It is also consistent with the presence of financial frictions that vary by country and institutional environment.[27]

[26] For reviews of these issues, see Davis and Van Nieuwerburgh (2015), Iacoviello (2004) and Piazzesi and Schneider (2016).

[27] Barrell and Davis (2005) analyse 13 European Union countries and the United States, and find a stronger association between equity prices and output in market-based than in bank-based financial systems. Using data for 16 OECD countries, Ludwig and Slok (2004) show that the long-run responsiveness of consumption to permanent changes in stock prices is higher for market-based than for bank-based systems.

The reaction of investment and consumption to changes in asset prices also appears to depend in part on legal regimes and traditions. Empirical analysis by Claessens et al (2014b) suggests that the responses of investment to changes in *q* are faster in countries with better corporate governance and information systems. They interpret this as evidence of fewer financial frictions in such countries. The effects of house price changes on household consumption can also depend on a country's financial system and institutional environment in ways that suggest the presence of certain financial frictions.

### *Limits to the predictive power of asset prices*

There are limits to the predictive value of asset prices. Such limits appear to vary by type of asset and financial system. The standard theory implies that asset prices should be good proxies for expected growth (at both microeconomic and macroeconomic levels) because they are forward-looking. Equity prices, however, with their low signal-to-noise ratio and their (excess) volatility, do not have a good record of forecasting general economic developments. While equity prices have some predictive ability for investment, they do not generally increase the out-of-sample forecasting ability of GDP when compared with other economic variables (see Aylward and Glen (2000)). This observation is succinctly described by the well-known saying that: *"The equity market has forecasted nine of the past five recessions."*[28] Indeed, the leading indicator property of asset prices appears to be limited to certain classes of asset and depends on the depth of markets. In their review, Stock and Watson (2003) conclude that: "*Some asset prices have been useful predictors of inflation and/or output growth in some countries in some periods.*" (page 822).[29]

The nature and direction of causality is also unclear. Some interpret the linkages between asset prices and future economic activity as evidence that financial markets correctly anticipate future earnings growth and other fundamentals while others argue that asset prices affect output because of some form of amplification mechanism, such as the "financial accelerator". In the first view, asset prices relate to current consumption and investment decisions because they are leading indicators of changes in activity. This suggests, however, no causal relationship and only an informational link between current prices and future output. In the other view, changes in asset prices have an impact on access to finance, partly because of frictions, and thereby influence current consumption and investment and thus help predict GDP growth (see Estrella and Mishkin (1998), Stock and Watson (2003) and Diebold et al (2006)).

Both effects are likely to be at play but their relative importance is hard to disentangle. The discussion above shows that linkages between asset price changes and output growth are complex and that the exact direction and source of causality

[28] One caveat is that most studies have only considered aggregate stock price indices. There is evidence (Di Mauro et al (2011)) that considering information about the return and volatility of individual equity prices, in addition to aggregate financial market information, can lead to significant improvements in the forecasting of business cycle developments in major economic areas (eurozone, Japan, the United Kingdom and the United States) at various horizons.

[29] One reason why equity prices, or asset prices more generally, could be weak predictors is that they are themselves influenced by shocks that do not have a clear impact on real activity and by shocks that do. If the only shock were a persistent total factor productivity shock, for example, then current equity prices and future economic activity could be tightly linked. However, there are many other types of shock and some affect real activity but not asset prices while some operate *vice versa*. This means that simply observing asset prices is not sufficient to predict real activity. This does not necessarily represent a failure of the underlying model. It could also stem from an incomplete specification of the environment when conducting reduced-form data analysis.

can be difficult to identify. Some studies document a long-run and two-way causal linkage between stock market performance and consumption, in which stock prices act, on the one hand, as leading indicators of consumption, and, on the other hand, are explained by consumption and real economic activity. More generally, though, the direction and source of causality between changes in asset prices and activity are not entirely clear.

## 2.3 International dimensions of asset prices

Any discussion of the linkages between asset prices and macroeconomic outcomes has to take into account the international dimensions of these linkages given the highly integrated nature of the real economy and financial markets. Like their closed economy counterparts, many of the international asset pricing models are based on partial equilibrium constructions that often imply relatively weak linkages between real and financial variables. Moreover, a number of puzzles remain with respect to the predictions that could be derived regarding the international dimensions of asset prices. This section first presents a short review of the theoretical approaches to asset price determination in open economy models. It then briefly examines the empirical evidence and concludes with a summary of the main challenges faced by international asset pricing models.

### A. Determination of asset prices in open economy models

Both domestic and international factors affect asset prices in open economy models. Early models (Solnik (1974), Stulz (1981) and Adler and Dumas (1983)) extended the domestic asset pricing models (mostly the CAPM) to an international context. These models suggest that the determination of (relative) asset prices is based on a trade-off between exchange rate risk and the diversification benefits of global investment, in addition to the domestic factors discussed earlier. Accordingly, the required rate of return is derived from global benchmarks, such as the correlations of domestic asset returns with those of world market portfolios.

As is the case with many closed economy models, international asset pricing models tend to be based on partial equilibrium frameworks (see Dumas (1994) for an early review). Typically, cash flow processes are assumed to be predetermined and little attention is devoted to whether changes in the domestic supply of securities and asset prices are consistent with actual cross-border portfolio holdings. Uppal (1993) and Engel (1994) are early exceptions: they develop general equilibrium models that take into account holdings of international assets and liabilities in the determination of asset prices. Engel and Matsumoto (2009) revive this class of models while Devereux and Sutherland (2009) extend them to dynamic settings with incomplete asset markets. However, these general equilibrium models continue to face difficulty in matching some of the basic statistical moments, such as variance and persistence of asset prices, including exchange rates (see Coeurdacier and Rey (2013) for a review).

A strand of the literature has focused on the implications of various barriers to cross-border investment and of home bias, ie the tendency of investors to invest close to their base. Although many models in this literature are simple extensions of the standard closed economy setup – and assume perfectly integrated financial markets – some have devoted greater attention to the effects of market segmentation, eg when some financial markets are only accessible to resident investors or when no outward investment is allowed. These and other types of (indirect) barrier, such as

ownership restrictions, have been shown to alter the determination of asset prices. This in turn leads to "deviations" from the predictions of standard models since an identical asset can be priced differently in two different markets.[30] Another branch of this research considers how changes over time and differences across markets, including the degree of financial openness, can affect the determination of asset prices and portfolio allocation and can lead to home bias (see Karolyi and Stulz (2003) and Bekaert et al (2016) for reviews and Sa (2013) for recent evidence on bilateral financial linkages).

## B. Empirical evidence

Consistent with theoretical predictions, global factors play an increasingly important role in determining asset prices. Cross-country correlations of asset prices are well documented, especially the high and growing correlations between equity prices (Figure 2.3). Over the past two decades, asset price movements (and output) have been explained increasingly by common factors (Figure 2.4). Correlations have increased not only among advanced economies and EMEs but also between these two groups of country (Ehrmann et al (2011), Rey (2015), Passari and Rey (2015) and Miranda-Agrippino and Rey (2015)). This was to be expected. Owing to technological advances and liberalisation, financial markets have become ever more closely integrated and gross international financial flows have increased sharply. Evidence shows that increases in co-movements between assets are due to both *de jure* capital account liberalisation (as stock return correlations and market betas increase after liberalisation) and actual increases in international capital flows.[31]

In addition to financial integration, financial development, the liquidity and depth of equity markets and real economic integration (including trade intensity) have been shown to affect the co-movement of asset prices across countries. Forbes and Chinn (2004) and Beine and Candelon (2011) show that bilateral financial and trade intensity drive stock market synchronisation. Dellas and Hess (2005) show how the liquidity and depth of equity markets can determine the synchronisation of equity returns. The adoption of a single currency (Walti (2011)), lower real exchange rate volatility and asymmetry in output growth (Tavares (2009)) also increase correlations. In addition, there is an extensive literature on the importance of financial linkages for international spillovers (see Diebold and Yilmaz (2009, 2015), Hirata et al (2012) and Helbling et al (2011)).

Prices of non-traded assets, such as houses, also tend to move together across countries.[32] While there are limited fundamental linkages between housing markets – housing being the quintessential non-traded good – house prices move together considerably across countries and have become more synchronised over time (Figure 2.3). Hirata et al (2012) report that the degree of concordance of housing

[30] For a detailed discussion of such deviations, see Black (1974), Stulz (1981), Errunza and Losq (1985) and Eun and Janakiramanan (1986).

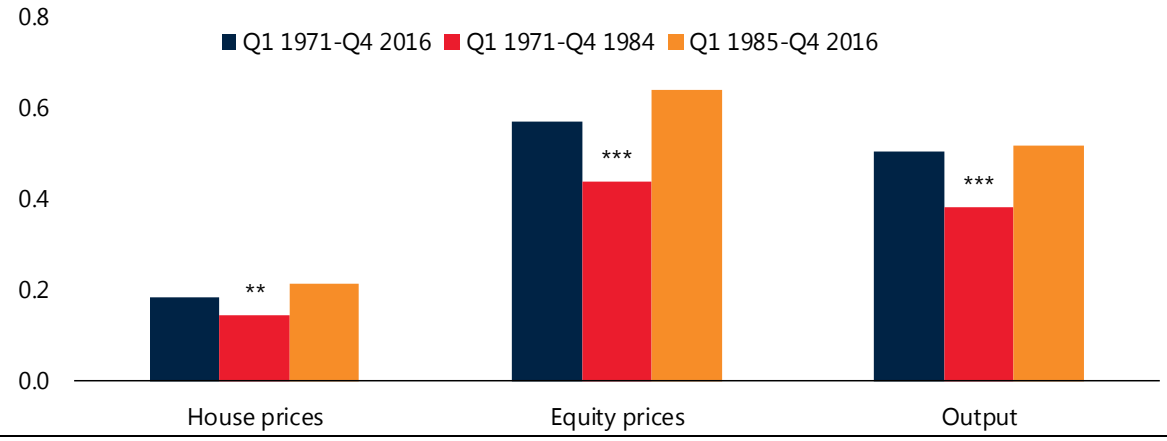
[31] See Bekaert and Harvey (2000), Goetzmann et al (2005) and Quinn and Voth (2010). Conversely, growing financial integration has reduced the cost of capital for firms in integrating countries. Chari and Henry (2004) find that liberalisation reduces systematic risk, thereby lowering the cost of capital for individual firms. The effects are quantitatively important since the covariance of the median "investible" (ie with no barriers to ownership) firm's stock return with the local market is 30 times larger than its covariance with the world market. At the same time, increased financial integration means that there might be smaller diversification gains for investors (Kose et al (2009) and Bekaert et al (2016)).

[32] See BIS (1993), Borio et al (1994), Sutton (2002), Borio and McGuire (2004), Claessens et al (2011), Cesa-Bianchi et al (2015), Harding and Pagan (2016) and Miles (2017).

cycles has increased from 51% during the period between Q1 1971 and Q4 1984 to more than 63% during the period between Q1 1985 and Q3 2011. The fraction of the variance of house prices explained by a global house price factor has increased from about 20% to 35% over the two periods (Figure 2.4). In addition, downturns in house prices tend to be synchronised across countries and overlap more frequently than recessions do, especially so during the most recent cycle (Figure 2.5).

## Cross-country correlations: asset prices and output

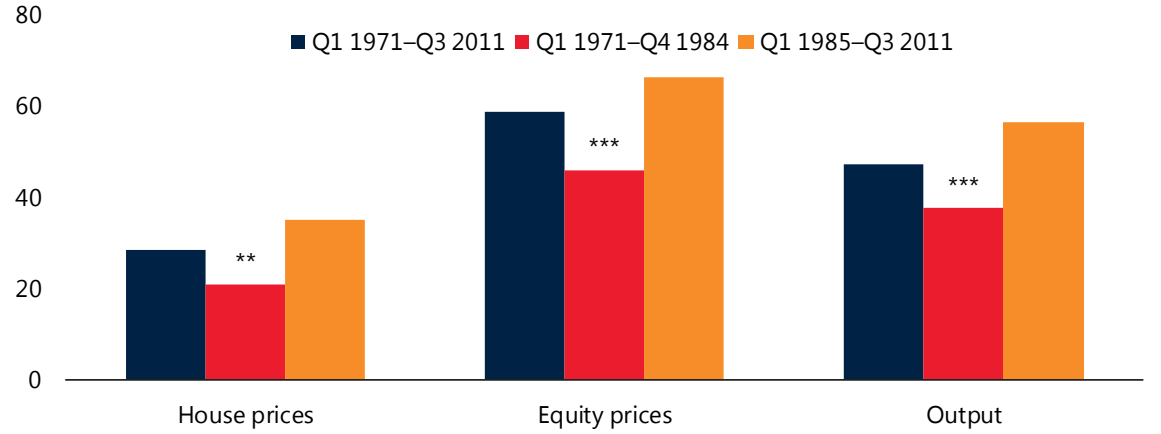
Correlation coefficient — Figure 2.3




Note: The average cross-country correlation for each variable in the respective periods is presented. The sample consists of 18 advanced economies. *** and ** indicate that average correlations for the period Q1 1971 to Q4 1984 are statistically different from those for the period Q1 1985 to Q4 2016 at the 1% and 5% levels, respectively.

## Variance due to the global factor: asset prices and output

Percent — Figure 2.4

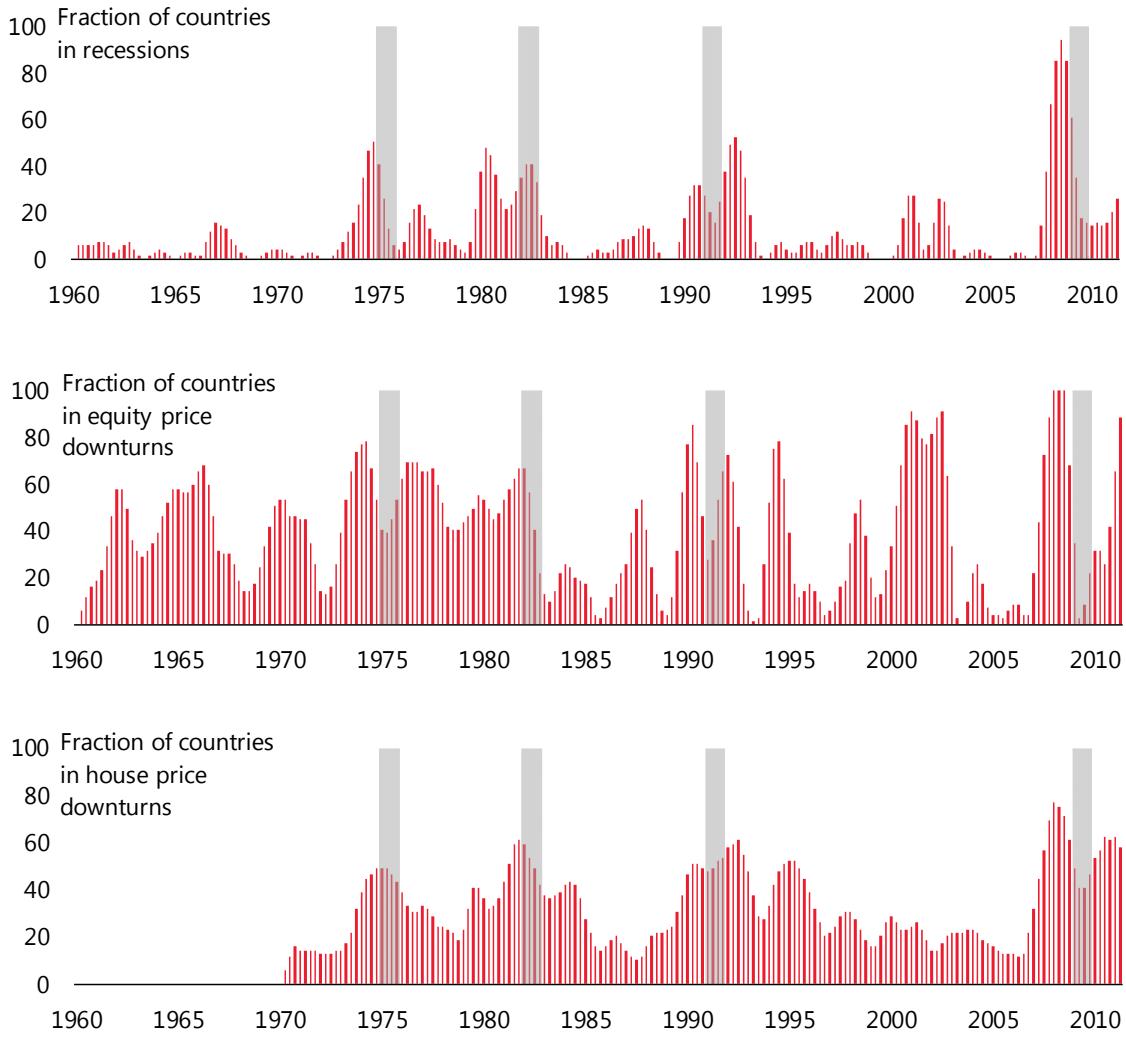



Note: The average fraction of the variance explained by the global factor is presented. The sample consists of 18 advanced economies. *** and ** indicate that variance explained by the global factors for the period Q1 1971 to Q4 1984 is significantly different from that for the period Q1 1985 to Q3 2011 at the 1% and 5% levels, respectively.

## Synchronisation of recessions and financial downturns

Percent

Figure 2.5



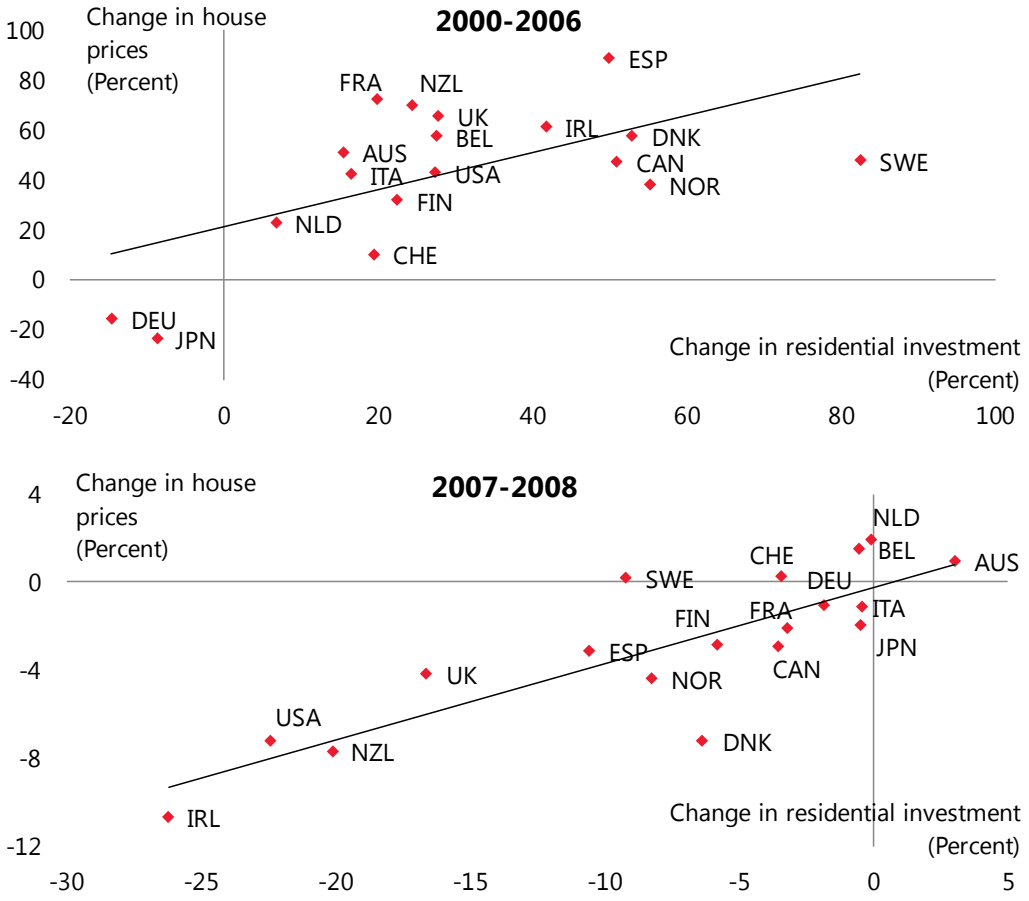

Note: Each bar represents the share of countries experiencing recessions or respective financial downturns. The figures include complete as well as ongoing episodes. The sample contains the quarterly data for advanced economies. Global recession years (1975, 1982, 1991 and 2009) are shaded in gray. House price data start in 1970.

As is the case for other asset prices, the co-movement of house prices is driven by real and financial global factors. Examples of global factors include the global business cycle, commodity prices and a measure of the "world" rate of interest (Hirata et al (2012)). The fact that house prices appear to be partly determined by current and past income growth (and real interest rates or some other proxy for mortgage costs) is not surprising. As the supply of land is fixed and that of residential dwellings and offices can only increase slowly, property prices tend to be largely demand-determined in the very short run. Over the business cycle, though, supply catches up with house prices, as prices and investment are driven by similar factors. And, indeed, prior to the GFC, countries that experienced housing price booms in 2000–06 also saw substantial growth in residential investment (Figure 2.6, upper panel). However, this trend reversed over the 2007–08 period (Figure 2.6, lower panel).

House prices and residential investment

Percent

Figure 2.6




Note: Each figure plots the percent changes in house prices and residential investment during the respective periods. The sample consists of 18 advanced economies.

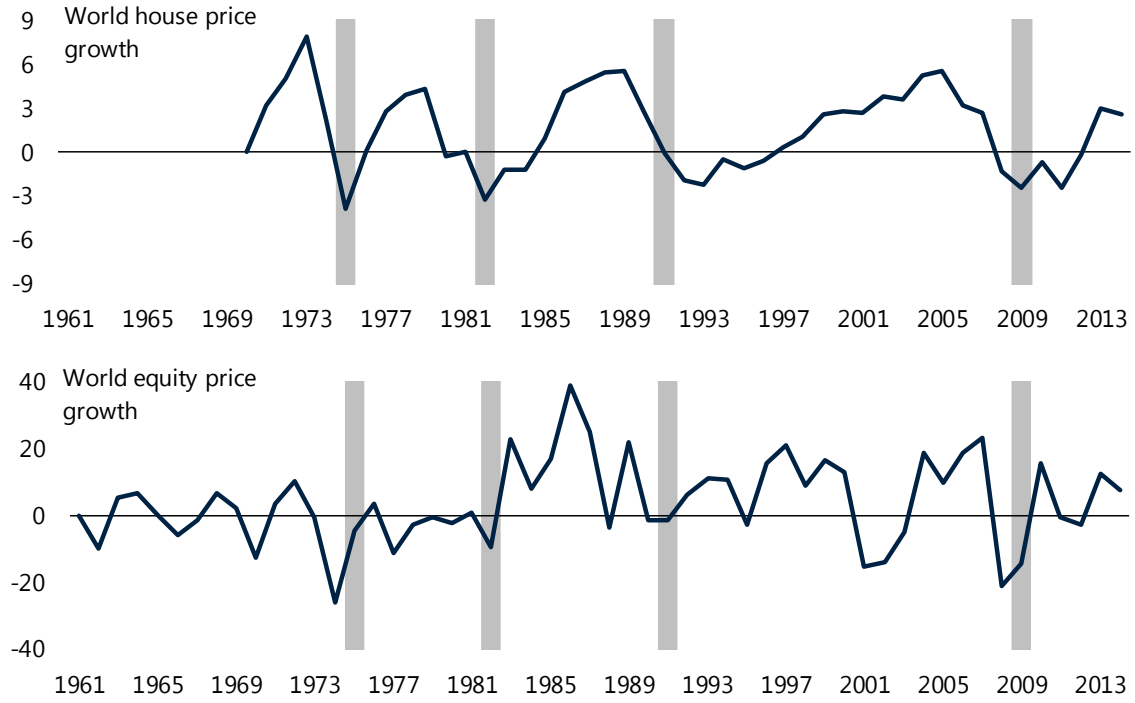
In addition, the common factor that captures cross-country house price movements is related across advanced economies to mortgage-to-GDP ratios (reflecting the depth of mortgage markets) and home ownership ratios (reflecting institutional structures and policies aimed at fostering home ownership). The impact of global factors on house prices consequently varies across individual countries, depending in part on the development of local mortgage markets, income growth and structural and policy factors, such as tax and subsidies (Terrones (2004)).

In related research, Vansteenkiste and Hiebert (2011) show that spillovers from country-specific house price shocks are relatively low in the euro area. Some studies document the coincidence of global recessions with sharp downturns in global house and equity prices (Kose and Terrones (2015); Figures 2.7A and 2.7B). Collectively, these findings underscore the importance of the international dimensions of real and financial linkages in driving asset prices. That said, some puzzles remain.

Evolution of world house and equity prices

Percent

Figure 2.7A




Note: Each panel shows the four-quarter average of market-weighted growth rates of the respective variables for advanced and emerging market economies. All variables are in real terms. House price data start in 1970. Growth in world equity prices starts in 1962; the market-weights are three-year rolling averages. Shaded bars indicate global recessions. The last observation is for 2014.

## C. International dimensions of asset pricing puzzles

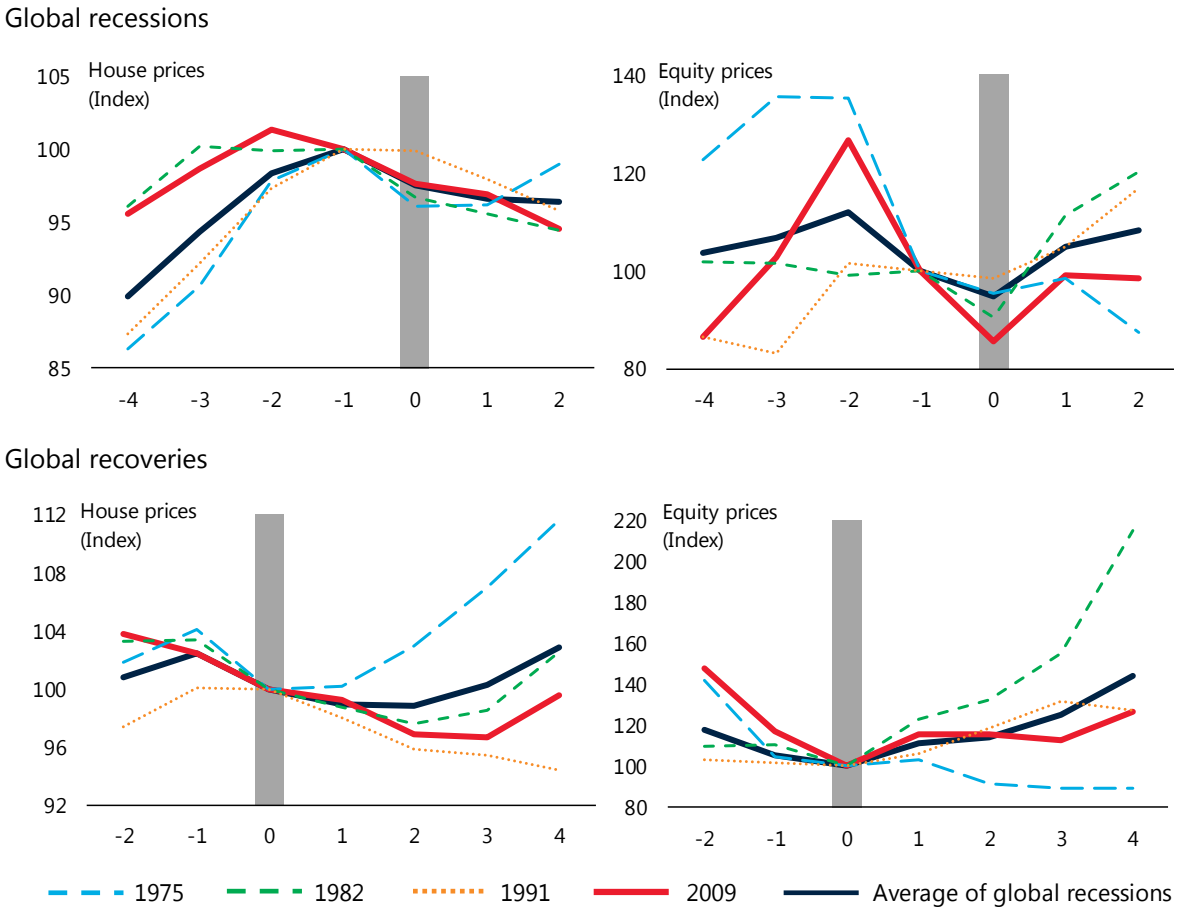
Similar to the domestic context, there are a number of puzzles relating to the international dimensions of asset prices. For example, cross-country correlations of equity prices tend to be higher than those implied by fundamentals. Similar to the weak link between equity prices and firms' fundamentals within a country, co-movements in asset prices appear to not (just) reflect the commonality of cash flow streams as would arise from synchronised business cycles. This delinking is partially attributed to co-movements in risk premia because investors in one market are likely to be exposed to other markets as well, triggering common price adjustments. Indeed, Engle and Susmel (1993) show that the high correlation of price volatility across countries is related to the degree of international financial integration.

Financial integration may also increase herding behaviour among investors, which can then lead to more volatile capital flows and cause asset prices to move significantly in one direction or the other, again amplifying correlations beyond what fundamentals-based models would suggest. Goodhart (1999) argues that a key factor for the high correlations of second moments is asymmetric and incomplete information. The high correlations observed across asset prices and the large volatility of capital flows suggest that various other channels of transmission are at play, including contagion. However, those channels require further study.[33]

[33] For research on these channels and related work, see Dornbusch et al (2000), Karolyi (2004), Pritsker (2011), Forbes (2012) and Cesa-Bianchi et al (forthcoming).

## Asset prices during global recessions and recoveries

Index — Figure 2.7B




Note: Time 0 denotes the year of a global recession (shaded in gray). All variables are at annual frequency. All variables are market-weighted by gross domestic product in US dollars, including all advanced and emerging market economies. Panels A and B (on global recessions) are index numbers equal to 100 one period before the global recession year. Panels C and D (on global recoveries) are index numbers equal to 100 in the global recession year.

The so-called home bias – ie the limited extent of international portfolio diversification – has been hard to reconcile with the predictions of most asset pricing models. Models that include barriers to cross-border investment, both direct, such as capital controls and ownership restrictions, and indirect, such as information asymmetries, are not very good at explaining the limited degree of actual cross-border asset holdings (they tend to underestimate home bias) and the behaviour of the rates of return (which are highly correlated). Furthermore while restrictions on international capital flows may have been a viable explanation for the home bias thirty years ago, they no longer do so today.

With barriers diminishing over time, the bias should have fallen. In fact, until the late 1990s the home bias among advanced countries changed little.[34] While there is

[34] See Lewis (1999, 2011), Karolyi and Stulz (2003) and Sercu and Vanpee (2007) for reviews of the literature on home bias. Research points to the importance of indirect barriers, such as those related to differences in corporate governance, ownership structures and information asymmetries, which may lead to home bias (see Stulz (2005)). These factors, however, would also suggest a reduction in

some evidence of a decline in the bias in more recent years (see Sorensen et al (2007)), international holdings still appear to be far below the levels determined by portfolio models, with correspondingly lower risk-adjusted rates of return (see also Sercu and Vanpée (2007) and Kho et al (2009) for evidence on the home bias in equity holdings).

Related to the home bias, prices of internationally-traded assets continue to depend on local risk factors. Firm-level equity prices, for example, depend significantly on domestic equity risks factors, such as value, size and market returns, even when conditioned on global equity counterparts (see Lewis (2011) for a review of global asset pricing models and the associated empirical evidence). Similarly, bond prices depend more than expected on local factors. These patterns suggest that there is still *de facto* segmentation, even though legal and other formal barriers among equity markets have largely been removed, at least for advanced countries. The predictable deviations from interest rate parity also suggest other failures of the standard international asset pricing model. Factors other than formal barriers, such as heterogeneous information and other asymmetries, may be behind these anomalies (Engel (2014)). Coeurdacier and Rey (2013) present a review of models focusing on home bias and its macroeconomic implications.

## 2.4 Exchange rates and macroeconomic outcomes

A rich research programme has analysed the determinants of exchange rate movements and their implications for macroeconomic outcomes. However, providing models that can satisfactorily explain the multiple linkages between macroeconomic and financial variables while accounting for the role of the exchange rate as the relative price of both domestic goods to foreign goods and domestic assets to foreign assets, has been a challenge. This section provides an overview of the literature on the linkages between exchange rates and macroeconomic outcomes. It begins by presenting a summary of the basic theoretical mechanisms regarding the determination of exchange rates and their impact on macroeconomic aggregates and financial variables. Next, it reviews empirical findings regarding the linkages between real exchange rates and activity. It concludes with a discussion of a number of puzzles regarding the dynamics of exchange rates and their relationships with macroeconomic and financial variables.[35]

### A. Basic mechanisms

#### *Determinants of exchange rates*

A large body of literature seeks to understand the determinants of exchange rates.[36] The basic building blocks used in this literature include two parity conditions: i) purchasing power parity (PPP), which posits a relationship between exchange rates,

home bias as countries have tended to converge in these dimensions. Berriel and Bhattarai (2013) emphasise the importance of government spending in explaining the home bias puzzle. For discussions of international diversification, see Baxter and Jermann (1997), Coeurdacier and Guibaud (2011) and Heathcote and Perri (2013, 2014).

[35] The discussion here touches upon the main puzzles only. We discuss the role of financial frictions in Chapter 3. For a discussion of abrupt movements in exchange rates associated with financial crises, see Claessens and Kose (2014).

[36] For more detailed discussions of the linkages between exchange rates and macroeconomic and financial variables, see Obstfeld and Rogoff (1996), Mark (2001) and Sarno and Taylor (2003). Engel (2014, 2016) present a discussion of the theoretical and empirical exchange rate literature, with a focus on interest rate parity and other financial arbitrage conditions.

on one hand, and local and foreign goods prices, on the other; and ii) interest rate parity (covered or uncovered), which stipulates the existence of arbitrage conditions between the exchange rate, on one side, and the interest rates on domestic and foreign assets, on the other.

To analyse exchange rate movements, early studies often employed extensions of closed economy models. For example, the Mundell-Fleming model, set forth (independently) by Mundell (1963) and Fleming (1962), is the open economy extension of the traditional IS-LM model. The model shows that an economy cannot simultaneously maintain a fixed exchange rate, free capital movement and an independent monetary policy (so called "the impossible trinity"; see Obstfeld et al (2005) for a review). Under a flexible exchange rate regime, shocks to money or goods markets can lead to capital flows through an equalisation of the local interest rate with the global rate, resulting in changes to the exchange rate and trade flows. Under a fixed exchange rate regime, the money supply adjusts to external or domestic shocks affecting the balance-of-payments. The model thus shows in a simple way the roles played by real and nominal variables in exchange rate determination.

The exchange rate can also play an important role in the transmission of monetary policy in small open economies. In early models, such as the monetary model of Frenkel and Johnson (1978), the nominal exchange rate simply reflects the relative demand for and supply of money in different countries. Changes in the quantity of domestic money then immediately affect the exchange rate. In these and other models, a lowering of the policy rate leads to a decline in the return on domestic assets relative to that on foreign assets. Consequently, the currency depreciates, leading to expenditure switching and a rise in net exports and aggregate demand.

The more recent literature, often under the rubric of "new open economy macroeconomics", incorporates advances in the domestic macroeconomic literature to help explain the main features of exchange rate movements. This literature has employed dynamic stochastic general equilibrium (DSGE) models to analyse the role played by nominal rigidities in environments featuring imperfect competition and rational optimising agents. Much of this literature is based on the canonical model developed by Obstfeld and Rogoff (1995a, 1995b). Like earlier models, such models try to predict the dynamics of exchange rates, including the possibility of overshooting. They are also used to analyse the dynamics of the current account, (net) debt, the exchange rate and the impact of exchange rate uncertainty on international transactions (see further Obstfeld and Rogoff (2000a)).[37]

### *Exchange rates and activity*

Many models examine the linkages between fluctuations in exchange rates and macroeconomic fundamentals. When focused on the real side, such models detail how changes in exchange rates endogenously relate to consumption, investment, exports and imports, both in terms of volumes and prices. Research has also looked at how these relationships are affected by a variety of factors, including the heterogeneity of economic sectors, economies of scale, imperfect competition, type of exchange rate regime, country-specific elements and time horizons (see Lane (2001) for a review).[38]

[37] See Corsetti (2008) for a review of DSGE models. See also Woodford (2010b) and Christiano et al (2011a) for an open economy model incorporating financial frictions.

[38] See, among others, chapters in Volume 3 of the *Handbook for International Economics* (Grossman and Rogoff (eds) (1995)) and Volume 4 (Gopinath et al (eds) (2014)).

In theory, some of the linkages between real exchange rates and macroeconomic outcomes are ambiguous. For example, a depreciation can lead to an increase in investment as the marginal profit from an additional unit of capital is likely to go up as future foreign sales rise. However, the higher price of imported capital and inputs can reduce profits and, in turn, lower investment. The overall impact of exchange rate changes on investment hinges then on which of these forces dominates (see Landon and Smith (2009)).

The theoretical literature on the effects of exchange rate devaluations on output is similarly inconclusive. On the one hand, devaluation can lead to an increase in the production of tradable goods and be associated with an expansion of output. On the other hand, it can have a contractionary impact on the non-tradable goods sector and translate into a decline in overall output. Related to these inconclusive finding are the financial effects of exchange rate changes, including those operating through adjustments in balance sheets, which are reviewed below. There is also an extensive theoretical literature looking at how linkages between exchange rates and output can depend on exchange rate regimes (see Uribe (1997) and Mendoza and Uribe (1996)).[39]

### *Exchange rates and financial variables*

Most of the early models sidestepped financial variables or resorted to simplifying assumptions, such as perfect financial markets. They only considered "real" environments, focusing on the role of the (real) exchange rate as the price that cleared goods markets in open economies. Although some models attempted to incorporate financial markets, this was typically under restrictive assumptions. The standard uncovered interest rate parity (UIP) condition, for example, requires at a minimum the joint presence of rational expectations and risk neutrality, which are strong assumptions already. Early models rarely considered the role of financial intermediation or market imperfections and assumed instead perfect financial markets (ie perfect substitutability between assets and no financial frictions or defaults).[40] While later models took into account the links existing between the exchange rate and other asset prices, this was largely through arbitrage conditions, notably with short-term interest rates linking the forward exchange rate to the current exchange rate and local and foreign interest rates.

More recently, researchers have studied how the role of the exchange rate in macroeconomic adjustment is affected by financial variables during "normal" times.[41] In particular, models have been developed to see how real linkages are impacted by capital flows and stocks and balance sheets valuation effects. These models (Tille (2008), Benigno (2009), Coeurdacier et al (2010) and Tille and van Wincoop (2014b)) allow for the exchange rate to influence the adjustment of current and capital accounts through two financial channels: (i) capital gains and losses on external assets

[39] Dornbusch (1981) provides a review of the early literature on the macroeconomic implications of devaluations and Marston (1995) presents a review of exchange rate policies in open economies.

[40] For example, some models (eg Stockman (1980) and Lucas (1982)) use cash in advance constraints, but this is a short cut to introduce money rather than a proper model of financial intermediation. Others (eg Branson and Henderson (1985)) use portfolio balance models to consider the trade-offs involved in the holding of various assets but do not include financial market imperfections, such as information asymmetries or principal-agent issues.

[41] The behaviour of exchange rates during financial crises and their role in macroeconomic adjustment and activity is discussed in Claessens and Kose (2014).

and liabilities due to exchange rate movements; and (ii) portfolio adjustments (trading in securities).

These models still employ rather restrictive assumptions and continue to face difficulties in explaining the behaviour of exchange rates. They often assume endowment economies, perfect foresight and exogenously-determined initial asset positions. Moreover, the types of asset considered are often limited and the possibility of investing in equity and bonds is ruled out. Notably, the current account has little role to play in intertemporal dynamics. In many models based on the framework of Obstfeld and Rogoff (1995a), the current account follows basically a random walk (as does the economy's net foreign asset position). These models are essentially "modern versions" of the monetary model (of Frenkel and Johnson (1978), for example) in that the exchange rate is determined by relative money supplies. Although more recent general equilibrium models provide richer environments, their basic predictions do not seem to square with the empirical evidence (Corsetti and Pesenti (2001) and Cavallo and Ghironi (2002)). In particular, the forward risk premium has been hard to incorporate, except in environments allowing unrealistically high rates of substitution and risk aversion (Obstfeld (2008)).

Recent classes of general equilibrium models with valuation effects and liquidity preference appear more promising. Such models have been harder to calibrate but they obtain simulated results that are more consistent with those of empirical studies. For example, the model by Gourinchas and Rey (2007) allows for international financial adjustments to affect the exchange rate. It highlights the role that valuation effects on the US net foreign asset position might have had in relaxing the country's external constraint.[42]

Others study how capital gains and losses on external portfolios can affect exchange rate and current account dynamics in general equilibrium settings (Devereux and Sutherland (2010) and Pavlova and Rigobon (2012)). Some of these models allow for international equity trading in a two-country DSGE model with production under monopolistic competition, and separate asset prices and quantities to account for capital gains and losses and portfolio adjustments (Ghironi et al (2015)). These models appear to deliver more realistic findings. Limited participation models have also had some success in explaining the behaviour of exchange rates. For example, Alvarez et al (2009) build a two-country model in which the fraction of agents that participate in financial markets varies over time due to transaction costs across assets. The exchange rate in their model is much more volatile than consumption – something difficult to achieve in models with complete markets but more consistent with real-world observations.

Some recent models examine the impact of learning on the linkages between exchange rates and fundamentals. The literature reviewed above clearly suggests that there is no consensus on a specific model that fully captures the relationships between exchange rates and macroeconomic and financial variables (Ca' Zorzi et al (2017) and Eichenbaum et al (2017)). A reasonable assumption consequently is that agents do not know the true model or at least do not know the true parameters linking exchange rates to economic and financial fundamentals. Therefore, they need time to learn about the structure of the economy. Bacchetta and van Wincoop (2004, 2006, 2013) and Bacchetta et al (2010) show how, if structural parameters are

[42] See Gourinchas and Rey (2014) and Coeurdacier and Rey (2013) for extensive reviews of such models. Gabaix and Maggiori (2016) present a model in which exchange rates are driven by capital flows in imperfect financial markets. For research on the effects of "ambiguity aversion" or "taste for robustness" in the determination of exchange rates, see Ilut (2012) and Djeutem (2014).

unknown (or imperfectly known) and time-varying, market participants can change the weight they give to certain fundamentals. Hence, their models provide a framework that allows for a disconnect between observed macroeconomic fundamentals and exchange rates in the short- to medium-run but still exhibit a close relationship in the long-run (Hassan et al (2016)).

## B. Empirical evidence

### *Tests of models of exchange rate determination*

Although there is broad acceptance of the basic building blocks of exchange rate models, there remains a large gap between the predictions of such models and empirical regularities. Each successive generation of models has provided new insights into the determination of exchange rates and empirical testing has much improved. But the more complete models that have emerged have met with limited empirical success (Frankel and Rose (1995)). As Meese and Rogoff (1983a, 1983b), initially, and Cheung et al (2005), later, have shown, models do not necessarily work consistently well across time and different countries.

The purchasing power parity (PPP) hypothesis provides a useful framework for thinking about the relevance of exchange rate models. PPP was initially found to have little explanatory value, especially when considering very short periods (Taylor and Taylor (2004)).[43] However, when considering longer time periods, the evidence relating to PPP is more favourable (Flood and Taylor (1996)). Furthermore, although there may be little response of the exchange rate to deviations from PPP when the exchange rate is close to parity, even in the short- to medium-run, there can be a rapid response when the rate is far away from it (see Sarno and Taylor (2002)). More generally, it has been found that there can be non-linear dynamics in exchange rate adjustment, with "bands of inaction" around the PPP rate and faster adjustment as the rate moves further away from the level consistent with PPP (see further Taylor et al (2001) and Taylor and Taylor (2004)).

There is also some empirical support for the monetary approach to exchange rate determination. Early studies provided evidence for the flexible-price monetary model (Frenkel (1976) and Balassa (1978)) but later studies were less supportive. Notably, Meese and Rogoff (1983b) showed that monetary models fit poorly out of sample.[44] In a related paper, Eichenbaum and Evans (1995) showed how, in response to a monetary shock, expected exchange rates displayed a hump-shaped pattern rather than the sharp depreciation implied by the overshooting model of Dornbusch (1976). Mark and Sul (2001), using exchange rate data for 17 industrialised countries to implement a panel version of the test developed by Mark (1995), found that monetary fundamentals outperform a random walk (as well as PPP fundamentals) at short and long horizons. Rapach and Wohar (2002), using long historical series for 14 advanced economies, documented some support for a simple form of the long-run

[43] Ghironi and Melitz (2005) also find this effect with a micro-founded model allowing for heterogeneous firms and productivity shocks.

[44] Meese and Rogoff (1983b) and most of the subsequent literature use the root mean square error (RMSE) as the main criterion for judging models. Since the RMSE values under- and over-predictions equally, it is not necessarily a good yardstick for examining the profitability of trading strategies because trading depends on the quality of the directional forecast ("buy or sell"). See further Elliott and Ito (1999) and Abhyankar et al (2005).

monetary model. Cerra and Saxena (2010) also provided evidence supporting the monetary approach.[45]

Some studies confirm the Balassa-Samuelson hypothesis of a link between productivity and exchange rates, especially over the long run (Balassa (1964) and Samuelson (1964)). However, the channels that generate this effect appear to be more complex than the traditional view suggests (Chong et al (2012) and Bordo et al (2017)). In particular, while higher labour productivity tends to lead to real exchange rate appreciation, which is consistent with the traditional view that richer countries have stronger exchange rates, the productivity effect is transmitted through relative prices between tradable goods rather than through the relative prices of tradable and non-tradable goods (Lee and Tang (2007) and Ricci et al (2013)). Other evidence regarding the effect of productivity on the real exchange rate is more ambiguous. Chinn and Johnston (1999) and Fitzgerald (2003), for example, find little evidence of a long-term relationship between real exchange rates and productivity differentials (see further Froot and Rogoff (1995), Tica and Druzic (2006) and Bordo et al (2017)).

The literature also considers the roles played by many other "fundamentals" in explaining the (real) exchange rate. For example, several papers have studied the effects of fiscal spending and deficits on the real exchange rate (Bouakez and Eyquem (2015) and Alves da Silva et al (2015)). Following work by Monacelli and Perotti (2011), Ravn et al (2012) find that increases in government spending can lead to a depreciation of the real exchange rate in some advanced economies. However, this finding contradicts the predictions of many traditional models (see Kim and Roubini (2008) for a review and estimates for the United States).

### *Exchange rates, prices and activity*

There is a vast empirical literature on the linkages between exchange rates, prices and macroeconomic outcomes (including the current account and external adjustment), with the major caveat that many of these relationships are endogenous and simultaneous. Moreover, a number of empirical puzzles involving those linkages remain, as discussed further in the next sub-section.

**Exchange rates and prices.** Empirical evidence supports some of the basic channels through which exchange rates affect export and import prices (Burstein and Gopinath (2014)). Understanding the quantitative importance of linkages between exchange rates and prices is an important step since these linkages are influential in shaping how fluctuations in exchange rates may subsequently affect macroeconomic aggregates. While deviations from the law of one price remain one of the most fundamental puzzles, exchange rates have been found to have a quantitatively significant impact on both import and export prices, especially in the long run. For example, in advanced countries about 64% of the change in exchange rates is estimated to be transmitted to import prices after one year (IMF (2007) and Choudhri and Hakura (2015)).

However, the extent of pass-through (ie the impact of exchange rate movements on prices) varies over time and across countries (Forbes et al (2017)). Reflecting differences in market size and sectoral composition of imports (the lack of which in earlier estimations was part of the reason for the limited estimated impact on

[45] The hump-shaped behaviour documented by Eichenbaum and Evans (1995) has been shown by Steinsson (2008) to be consistent in the context of a two-country sticky-price business cycle model. See Engel et al (2008) for a view suggesting that exchange rate models do not perform as poorly as commonly thought.

aggregate prices), pass-through coefficients have been found to vary greatly across sectors: they are higher for commodities and lower for highly differentiated manufacturing products (Amiti et al (2014) and Chen and Juvenal (2016)). They also vary across countries. An important determinant of pass-though is the currency of invoice, which is often the US dollar. The United States has a low pass-through of 0.4, for example, while smaller, more open economies have coefficients estimated to be closer to one (Gopinath (2015) and Casas et al (2017).[46]

Changes in exchange rates: stylised facts

Percent Table 2.2A

| | Mean | Volatility | Maximum | Minimum |
|---|---|---|---|---|
| **Real effective exchange rate** | | | | |
| Q1 1971-Q3 2016 | 0.22 | 6.11 | 47.80 | -22.66 |
| Q1 1971-Q4 1984 | 0.62* | 6.50*** | 47.80 | -15.39 |
| Q1 1985-Q3 2016 | 0.10 | 5.99 | 39.02 | -22.66 |
| **Nominal effective exchange rate** | | | | |
| Q1 1971-Q3 2016 | 0.30 | 6.42 | 43.50 | -23.70 |
| Q1 1971-Q4 1984 | -0.32*** | 6.91*** | 31.92 | -20.53 |
| Q1 1985-Q3 2016 | 0.58 | 6.18 | 43.50 | -23.70 |
| **Output** | | | | |
| Q1 1971-Q4 2016 | 2.30 | 2.61 | 28.08 | -9.26 |
| Q1 1971-Q4 1984 | 2.60*** | 2.62 | 10.76 | -4.10 |
| Q1 1985-Q4 2016 | 2.24 | 2.61 | 28.08 | -9.26 |

Note: The mean indicates the average year-over-year growth rate. Volatility is the standard deviation of the growth rate. Maximum (minimum) is the maximum (minimum) growth rate. The sample consists of 18 advanced economies. *** and * indicate that the results for the period Q1 1971 to Q4 1984 are statistically different from those for the period Q1 1985 to Q4 2016 (or Q3 2016) period at the 1% and 10% levels, respectively.

**Exchange rates and macroeconomic aggregates.** Exchange rates, real and nominal, are much more volatile than output (see Burstein et al (2007)). For example, the real effective exchange rate for advanced economies in the post-Bretton Woods era is on average more than two times more volatile than output (Table 2.2A). At the same time, the contemporaneous correlations (as well as the lead and lag relations) between real and nominal exchange rates and output are very low for advanced economies (Table 2.2B).

A large research programme analyses the direct linkages between movements in exchange rates and macroeconomic aggregates (Cordella and Gupta (2015)). Most studies show that currency depreciations (appreciations) are associated with a contraction (expansion) of investment (see Landon and Smith (2009), Goldberg (1993) and Campa and Goldberg (1999)). The strength of this relationship, however, varies across sectors, countries and time horizon. Some other studies consider the impact of real exchange rate volatility on investment and international trade (see Darby et al

[46] This difference relates to the stronger domestic competition for imported goods in the United States and the international use of the US dollar in the invoicing of exports and imports (Goldberg and Tille (2008). Another factor here is the role of vertical specialisation. Chinn (2010) shows that, combined with changing tariff rates and transportation costs, it can account for the high-income elasticities typically found for trade. A number of studies analyse the extent of pass-through, see Campa and Goldberg (2005), Hellerstein et al (2006), Thomas and Marquez (2009), Frankel et al (2010) and IMF (2006). Campa and Goldberg (2005) also document that import prices in local currencies reflect 60% of exchange rate fluctuations in the short run, with this fraction increasing to 80% in the long run.

(1999), McKenzie (1999), Chowdhury (1993), Caballero and Corbo (1989) and Grier and Smallwood (2013)). Others, such as Harchaoui et al (2005), find ambiguous results of exchange rate volatility on investment, which is consistent with theoretical models. Habib et al (2017) find that a real appreciation (depreciation) is associated with significantly lower (higher) GDP growth but only for developing and currency-pegging countries.

Correlations between exchange rates and output

Correlation coefficient — Table 2.2B

| | Lags | | | | Leads | | |
|---|---|---|---|---|---|---|---|
| | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| **Real effective exchange rate** | | | | | | | |
| Q1 1971-Q3 2016 | -0.11 | -0.10 | -0.08 | -0.04 | 0.01 | 0.05 | 0.08 |
| Q1 1971-Q4 1984 | -0.18 | -0.21 | -0.15 | -0.09 | -0.05 | -0.03 | -0.04 |
| Q1 1985-Q3 2016 | -0.10 | -0.08 | -0.06 | -0.03 | 0.02 | 0.06 | 0.09 |
| **Nominal effective exchange rate** | | | | | | | |
| Q1 1971-Q3 2016 | -0.07 | -0.06 | -0.04 | -0.01 | 0.02 | 0.04 | 0.06 |
| Q1 1971-Q4 1984 | -0.06 | -0.05 | -0.01 | 0.03 | 0.06 | 0.06 | 0.02 |
| Q1 1985-Q3 2016 | -0.07 | -0.05 | -0.03 | 0.00 | 0.03 | 0.06 | 0.07 |

Note: The average within-country correlation between the year-over-year growth rates of exchange rates and output is presented. The sample consists of 18 advanced economies. Lags (leads) indicate that output is shifted one or more quarters forward (backward) relative to exchange rates.

Although standard models of international risk sharing with complete asset markets predict a positive association between relative consumption growth and real exchange rate depreciation, empirical studies investigating this relationship do not report conclusive results (Backus and Smith (1993) and Obstfeld (2007)). One strand of the literature considers the effects of exchange rate devaluations. In many cases, real depreciations are contractionary, which is not consistent with the predictions of basic models for which a positive output effect results from an increase in net exports (see Burstein et al (2005) and Kearns and Patel (2016)). Other studies, though, suggest that any contractionary impact of devaluations tends to disappear in the longer run (IMF (1999, 2005)).

**Exchange rates and the current account.** Although the empirical linkages between exchange rates, trade volumes and current accounts are weak in the short run, they reappear in the longer run (IMF (2015)). Because of limited pass-through, low short-run elasticities and the presence of imported intermediate goods, the expenditure-switching effect of exchange rate changes on trade volumes is muted in the short run (Engel (2010)). Fratzscher et al (2010) show that shocks to the real exchange rate explain less than 7% of the movements in the US trade balance.

However, the impact of exchange rate changes on the current account materialises over time. Many studies (eg McKinnon (1990)) test the empirical relevance of the well-known J-curve effect, which describes how the current account worsens immediately after a depreciation and improves only with a time lag. While studies often report mixed findings on short-run effects (see Bahmani-Oskooee and Ratha (2004) for a review), the terms of trade and the flows of exports and imports seem to relate to the real exchange rate in expected ways in the longer run, although with a different quantitative impact across countries (Hooper and Marquez (1995)).

Exchange rates can play a supportive role in reversing current account imbalances, albeit with a lag. Many studies argue, for example, that the large US

current account deficit of the 2000s could not be reduced without a significant depreciation of the real exchange rate (Blanchard et al (2005), Obstfeld and Rogoff (2000b, 2007) and Blanchard and Milesi-Ferretti (2012)). The role of the exchange rate in facilitating external adjustment is reported for a wide range of countries (Calvo (2005), IMF (2007), Gervais et al (2016) and Martin (2016)).[47]

### *Exchange rates and financial variables*

As noted earlier, the exchange rate has been identified as one of the transmission channels through which monetary policy affects the real economy. The potency of this channel depends on three main factors. First, of course, the exchange rate regime matters in this relationship.[48] Second, the sensitivity of the exchange rate to the interest rate appears to vary across models. Early models found the sensitivity to be small, even though theoretical models that imposed UIP suggested a large role for this channel (Boivin et al (2011)). More recent models, however, explicitly acknowledge the tenuous and complex empirical links between monetary policy and the exchange rate (see Walsh (2010) and Engel (2017) for reviews; and see also Bruno and Shin (2015)).

Third, as one would expect, this channel is more pronounced for small open economies. Devereux et al (2006) illustrate that the effectiveness of this channel depends on the degree of exchange rate pass-through. Indeed, for small open EMEs, especially those targeting inflation, the exchange rate appears in practice to play an important role in monetary policy frameworks, much more so than is the case for advanced economies (Mishkin (2008)). This appears to reflect, among others, concerns about second-round effects, notably of exchange rate depreciations on inflation expectations.

Research supports the expected links between exchange rates and interest rates but with some caveats. Until the GFC, covered interest rate parity (CIP) was the norm in normal times as few arbitrage opportunities emerged. Akram et al (2008), for example, showed that deviations dissipated in a matter of minutes. However, the GFC was a notable exception. Heightened counterparty risk (and other risks) led to significant deviations from CIP (see Baba et al (2008), Baba and Packer (2009), Coffey

[47] The quantitative importance of exchange rates in reducing (global) imbalances has been a hotly debated issue (Blanchard and Milesi-Ferretti (2012) and Claessens et al (2010)). Exchange rates are strongly related to capital flows and external financing during financial crises (Claessens and Kose (2014)). Fluctuations in exchange rates can also have a strong impact on the allocation of resources in small open economies, especially during crises (Calvo (2005)).

[48] Countries vary greatly in the exchange rate regime they pursue. Moreover, regimes can also change over time with their choice mattering for macroeconomic developments, including for growth and inflation. Aizenman et al (2011) find that, controlling for other factors, greater monetary independence – as captured by greater exchange rate flexibility – is associated with lower output volatility while exchange rate stability implies more output volatility. Ghosh et al (2010) show that pegged exchange rate regimes tend to provide a useful nominal anchor and deliver lower inflation without compromising growth. Floating rate regimes, however, are associated with a lower susceptibility to financial crises and faster and smoother external adjustment than other regimes. Chinn and Wei (2013) question whether a flexible regime facilitates current account adjustment. Similarly, Engel (2010) concludes that exchange rate adjustment may have only a modest effect on current account imbalances in the short run. Klein and Shambaugh (2010) also analyse exchange rate regimes and Rose (2011) surveys the literature on the incidence, causes and consequences of a country's choice of exchange rate regime (see also Gagnon (2011)).

et al (2009) and Griffoli and Ranaldo (2010)). Since then, deviations have declined but not disappeared.[49]

Evidence also suggests that, while there can be substantial deviations from UIP in the short-to-medium term (leading to "carry-trade", as discussed below), local interest rates are affected by global rates in the longer run, especially for countries with fixed or pegged exchange rates (see Engel (1986) for an earlier survey).[50] Chinn and Meredith (2004) show that the UIP hypothesis obtains empirical support when interest rates on longer-maturity bonds of G7 countries are used, which is consistent with models where "fundamentals" drive exchange rates over longer periods. Chinn (2006), using data for major advanced economies and EMEs, shows that the evidence against UIP in the current floating rate era is not as strong as is commonly thought (see also Ismailov and Rossi (2017)).[51] Based on a new measure of sovereign credit risk, "the local currency credit spread", defined as the spread of local currency bonds over a synthetic local currency risk-free rate based on cross-currency swaps, Du and Schreger (2016) find that local currency credit spreads are positive and sizeable. However, they are lower than credit spreads on foreign currency-denominated debt as well as less correlated across countries and less sensitive to global risk factors.

Fluctuations in equity and other asset prices have also been found to relate to exchange rates. Individual firms are affected by exposures to exchange rates in expected ways, with inter alia firm size, multinational status, foreign sales, international assets and competitiveness found to matter (see Dominguez and Tesar (2006)). Moreover, the direction of exposure depends on the evolution of the exchange rate vis-à-vis other countries as firms dynamically adjust their operational behaviour in response to exchange rate risk. With the usual caveats about endogeneity and causality, aggregate and individual stock prices in advanced economies as well as in many EMEs have also been found to be affected by exchange rates in ways that were expected (Phylaktis and Ravazzolo (2005), Jorion (1990, 1991) and Cenedese et al (2016)).

## C. Exchange rate puzzles

There are a number of puzzles associated with the behaviour of exchange rates. Indeed, some of the six puzzles of international macroeconomics identified by Obstfeld and Rogoff (2000c) are intimately related to exchange rates: McCallum's home bias in trade puzzle; the Feldstein-Horioka saving-investment puzzle; the French-Poterba equity home bias puzzle; the Backus-Kehoe-Kydland consumption

[49] See, among others, Borio et al (2016), Sushko et al (2016), Avdjiev et al (2017), Du et al (2017), Rime et al (2017) and papers presented at the conference "CIP – RIP?" and Levich (2017) for a review of the general literature on CIP deviations.

[50] Flood and Rose (2002) found that UIP worked better on average in the 1990s than in previous eras as the slope coefficient from a regression of exchange rate changes on interest rate differentials was positive. Moreover, UIP worked systematically better for fixed and flexible exchange rate countries, less so for countries experiencing financial crises. And there was no statistically significantly difference between rich and poor countries.

[51] In general, the relationship between interest rates and exchange rates can be complex. For example, Hnatkovska et al (2013) argue that higher interest rates have three distinct effects: raise the fiscal burden, reduce output (due to a higher cost of capital) and raise the demand for domestic currency assets. The first two effects act to depreciate the currency while the last one tend to appreciate it. The net effect depends on the relative strength of these opposing forces.

correlation puzzle; the PPP puzzle; and what they call the exchange rate disconnect puzzle.[52]

The key puzzle is the disconnect between exchange rate movements and macroeconomic aggregates. This is reflected in the limited success of models relating exchange rates to underlying short-run fundamentals. As highlighted by Obstfeld and Rogoff (2000c), this disconnect can be considered as an umbrella of puzzles that all refer to *"the remarkably weak short-term feedback links between the exchange rate and the rest of the economy."*

Some of these "disconnect puzzles" are closely related. By explicitly introducing costs in international trade (including transport costs, tariffs, non-tariff barriers and other trade costs), Obstfeld and Rogoff (2000c) argue that they can explain several puzzles, including the PPP puzzle and the exchange rate disconnect puzzle. Some of the puzzles also relate to the widespread use of linear models in empirical exchange rate economics, which leaves no room for transaction costs.[53] Engel (2011) points out how another set of puzzles comes into play: any successful model of the exchange rate must simultaneously explain why high interest rate currencies tend to earn excess returns (the forward premium puzzle) and why high real interest rate currencies tend to be stronger than what their fundamental values would imply (the discounted rationally expected future real interest differentials). The joint observation of these puzzles means, in turn, that if there is an exchange risk premium, it should tend to shrink as real interest rates rise.

### *Exchange rates and fundamentals*

Many exchange rate puzzles mimic those reported in the literature on other asset prices in that the ability of models to explain and predict exchange rates using fundamentals remains limited. First, exchange rates can be modelled as the present value of expected fundamentals (Frenkel (1981)). Relative to fundamentals, however, exchange rates appear to exhibit much higher volatility. This is similar to the excess volatility of stock prices relative to underlying dividend streams (Shiller (1981)), raising the puzzle of "excess volatility" (see Baxter and Stockman (1989) and Flood and Rose (1995)).[54] Second, macroeconomic and financial news appear to affect exchange rates "too much", which is also similar to how bond and other asset prices overreact to news.[55]

Importantly, the forward exchange rate is not an unbiased predictor of the future exchange rate. Much work has rejected the speculative efficiency hypothesis (which posits that the forward rate is the expected spot rate without a risk premium). Rejection can be due to a departure from rationality and/or to risk premia (Froot and

[52] The latter includes both the Meese-Rogoff exchange rate forecasting puzzle and the Baxter-Stockman neutrality of exchange rate regime puzzle. See Engel and Zhu (2017) and Eaton et al (2016) for recent reviews and empirical work on the major puzzles.

[53] The incorporation of transaction costs creates an intrinsically non-linear relationship. This means that in the presence of such costs, the estimation of linear models is inappropriate. A true empirical test of the validity of the hypothesis must be based on non-linear models.

[54] See Killeen et al (2006), Hau (1998) and Jeanne and Rose (2002) for discussions on the sources of excess volatility in exchange rates.

[55] For recent studies on excess sensitivity to news, see Jaimovich and Rebelo (2008), Bacchetta and van Wincoop (2006) and Ehrmann and Fratzscher (2005). For early evidence, see Goodhart (1999) and Goodhart and Figliuoli (1991). For an examination of the impact of news in explaining the relationship between exchange rates and consumption using general equilibrium models, see Lambrias (2016), Opazo (2006) and Nam and Wang (2010).

Frankel (1989)). Empirically, the recent literature is converging towards the view that the forward bias and the resulting profitability of carry trades are driven by a foreign exchange risk premium that is non-zero on average and varies over time according to global factors (Menkhoff et al (2012), Lustig et al (2011) and Burnside et al (2011b) review the literature on carry trade). This is akin to the presence of an equity premium that appears to be excessively high for most asset pricing models (see Fama (1984), Mehra and Prescott (1985) and the review by Mehra and Prescott (2003)).

One of the enduring puzzles involves the difficulty of forecasting exchange rates out of sample. Meese and Rogoff (1983b) were the first to show that asset market-based models do not outperform a simple random walk in predicting exchange rates. Although there is some evidence that models perform better than a random walk at longer horizons (Mark (1995)), in part due to the changing weight of fundamentals, the success of such models remains limited for predictive purposes (Sarno and Valente (2009)).[56] Cheung et al (2017) assess the success of exchange rate predictions using a wide variety of models (interest rate parity, productivity-based, a composite specification, PPP and the sticky-price monetary model) and find that a model that works well in one period may not necessarily work well in another, or for all countries or all horizons.[57] This suggests that, while each model has merits, none is able to capture completely the determinants of exchange rates.[58]

Some studies show, though, that exchange rates and fundamentals are connected in a way that is broadly consistent with asset pricing models. As Frankel and Meese (1987) noted early on, empirical tests of the "excess volatility" of exchange rates are hard to implement. In a world with sticky prices (Dornbusch (1976)), for example, the exchange rate can be volatile because of overshooting but this does not necessarily imply excess volatility relative to what the fundamental determinants of exchange rates would predict. Engel and West (2005) show that if fundamentals are integrated of "factor one" and the factor for discounting future fundamentals is near one, then the exchange rate exhibits a behaviour that approximates a random walk. Sarno and Sojli (2009) empirically confirm the assumption of near unity of the discount factor. The results by Engel and West (2005) thus help explain the exchange rate disconnect puzzle since they imply that fundamental variables (such as relative

[56] Three exchange rate models often used in practice are: i) the macroeconomic balance approach, which builds on Obstfeld and Rogoff (1996) and focuses on flows (ie current account equilibrium) over the medium term; ii) the equilibrium real exchange rate (ERER) approach, which looks for consistency of the real effective exchange rate (REER) with trend fundamentals (including the stock of net foreign assets (NFAs)) over the medium term (see Rogoff (1996) for a survey); iii) and the external sustainability approach, which checks for stock-flow consistency and budget constraint (see Lee et al (2008) for the application of these types of model and their forecasting power).

[57] Sarno and Valente (2009) report that: (i) the weak out-of-sample predictive ability of exchange rate models is caused by a poor performance of model selection criteria rather than a lack of information content of the fundamentals; and that (ii) the difficulty of selecting the best predictive model is largely due to frequent shifts in the set of fundamentals driving exchange rates, including swings in market expectations (see also Della Corte et al (2016a) and Menkhoff et al (2017)).

[58] Rossi (2013) provides a comprehensive review of the literature on the predictability of exchange rates and concludes that: *"Overall, our analysis of the literature and the data suggests that the answer to the question: "Are exchange rates predictable?" is, "It depends" on the choice of predictor, forecast horizon, sample period, model, and forecast evaluation method. Predictability is most apparent when one or more of the following hold: the predictors are Taylor rule or net foreign assets, the model is linear, and a small number of parameters are estimated. The toughest benchmark is the random walk without drift."*

money supplies, output, inflation and interest rates) offer little help in explaining changes in exchange rates.

Conversely, exchange rate movements can help predict changes in fundamentals. Standard present-value models suggest that exchange rates are driven by expected fundamentals. Sarno and Schmeling (2014) test the implication that exchange rates contain information about future fundamentals. Employing a variety of tests in a sample of 35 currency pairs ranging from 1900 to 2009, they find that exchange rates have strong and significant predictive power for nominal fundamentals (inflation, money balances and nominal GDP). They also find that the predictability of real fundamentals and risk premia is much weaker and largely confined to the post-Bretton Woods era.[59]

### *Exchange rates and financial factors*

Some studies have had partial success in incorporating financial variables into exchange rate models. Since financial conditions play a significant role in affecting expectations, they have been found to be helpful in predicting exchange rates, even though the underlying mechanisms are not entirely clear. For instance, recent research reports that out-of-sample exchange rate forecasting can be improved by incorporating monetary policy reaction functions (Taylor rules) into standard models.[60]

Combining monetary fundamentals and policy reaction functions with yield curve factors reflecting expectations and risk premia further helps to explain exchange rate movements and excess currency returns one month to two years ahead, outperforming the random walk (Chen and Tsang (2013)). Conversely, as Engel and West (2005) show, exchange rates are useful in forecasting future monetary policy, consistent with the idea that they reflect market expectations of policy. These findings suggest that excess currency returns reflect both real (business cycle) and financial factors.

The literature has also established linkages between movements in exchange rates and order flows in foreign exchange markets. In the very short run, order flow – the volume of buy and sell requests and the related willingness of dealers to trade at certain prices – affects exchange rate behaviour over periods varying from minutes to a couple of months (see Lyons (1995, 2001) and Sarno and Taylor (2002) for reviews). This link seems to reflect in part the micro market structure of trading as well as the information gleaned by traders from the positions of other market participants. It also appears to be related to the information contained by order flows about the underlying macroeconomic factors and parameters of exchange rate processes.

[59] A related study is Chen et al (2010) who show that the exchange rates of commodity-exporting countries can help predict commodity prices but conversely that commodity prices do not help predict exchange rates (Ferraro et al (2015)). They attribute this asymmetry to the forward-looking nature of exchange rates. Hassan (2013) shows that a large fraction of currency returns is explained by differences in the size of economies.

[60] For example, Molodtsova et al (2008) and Molodtsova and Papell (2009) find that incorporating Taylor rule variables improves short-term predictability more than conventional interest rate, purchasing power parity or monetary models. See also Benigno (2004), Engel and West (2006), Mark (2009), Corsetti et al (2011) and Engel et al (2010) for models and empirical evidence relating to monetary policy rules that can, among others, generate some of the observed persistence in real exchange rates.

In particular, traders respond to economic news in deciding what currencies to buy and sell, and that order flow is a powerful predictor of future exchange rates (Breedon et al (2016) and Menkhoff et al (2016)). Rime et al (2010) argue that taken together the two results imply that economic variables are indeed linked to exchange rates but that the link is likely to be partly indirect in the sense that it is established via the trading decisions of dealers rather than via the macroeconomic channel posited by standard rational expectations models. On a related note, Evans (2010) presents evidence that order flow information reaching dealers provides signals concerning the slowly evolving state of the macroeconomy (see also Evans (2011) for a review of this and the associated literature).

Another possible channel is that the order flow provides information about the (true or perceived) parameters of the exchange rate process – information, which, in turn, affects exchange rate behaviour. Consistent with this hypothesis, Chinn and Moore (2011) show that combining a standard monetary model with order flow information can improve out-of-sample exchange rate forecasting. Furthermore, Fratzscher et al (2015) find that a large fraction of the variation and directional change in exchange rates can be explained by a combination of order flow and survey data on the relative importance attributed by traders to various fundamental factors. This supports the "scapegoat" theory of exchange rates (Bacchetta and van Wincoop (2004), Bacchetta et al (2010) and Tille and van Wincoop (2014a)).

Exchange rate behaviour could also be linked to the level of financial development and to global saving-investment dynamics. Caballero et al (2008a) argue that the lack of well-developed financial systems leads developing economies to run persistent current account surpluses with countries that can generate "sound" or liquid financial assets (such as the United States). In addition, they show that shifts in growth rates, in the presence of home bias in consumption and portfolio holdings, can lead to changes in exchange rates. In their model, the exchange rate moves in response to financial shocks rather than to the current account balance. Using this model, they explain how the GFC exacerbated the shortage of liquid assets and induced a rush to dollar assets (see also Della Corte et al (2016b)).

There is also evidence suggesting that the safe haven function of some currencies allows them to enjoy a privileged cost of capital and liquidity. The United States, for example, appears to pay less on its external liabilities than it earns on comparable external assets, correcting for exchange rate movements (Gourinchas et al (2010)). The relatively sharp appreciation of the US dollar following the GFC appears to be related to this role.[61] Curcuru et al (2013), however, find that the hypothesis of an exorbitant privilege – insofar as portfolio claims are concerned – suffers from a number of weaknesses, including measurement problems and statistical insignificance, and can largely be explained by differences in the relative composition of asset holdings between US residents and non-residents (see Rogoff and Tashiro (2015) for a discussion of the safe haven privilege in the context of Japan).

Another phenomenon that needs more work is how a shortage of dollar liquidity in Europe and other markets seems to have created upward pressure on the dollar during the GFC (Engel and West (2010)). Why the safe haven and liquidity roles of a currency arise and why they do not apply equally to various major currencies (eg the euro) is still unclear. One possible reason is that lender of last resort facilities have

[61] Gourinchas and Rey (2014) review the literature on the so-called "exorbitant privilege" enjoyed by the United States (see also Gorton (2017) for a review of the general literature on safe assets and Cohen et al (2017) for a review of the literature on global liquidity). McCauley and McGuire (2009) for their part focus on bank behaviour in the context of the US dollar's appreciation after the GFC.

traditionally been limited to local commercial banks and have not been available to foreign banks in other markets. Since lending in dollars is large outside the United States, including in EMEs with extensive liability dollarisation, in times of stress there is a large demand for US dollars (Obstfeld (2004), Engel and West (2010) and Rajan and Tokatlidis (2005)).

Many studies find evidence of the importance of balance sheet variables and related valuation effects (Gourinchas and Rey (2014) review the literature). Balance sheet and valuation effects appear to be important in driving exchange rates and, in turn, real variables (as first formally documented by Gourinchas and Rey (2007), followed by Lane and Milesi-Ferretti (2009)). Gourinchas and Rey (2007) find that the effects of exchange rate changes on financial variables have contributed to about 30% of US external adjustment since the 1950s. This is not to deny that exchange rates affect real variables, net exports in the case of their work, thereby aiding adjustment; rather, this financial adjustment channel results in a high degree of predictability of the exchange rate over a two- to four-year horizon.[62]

The results of the model developed by Gourinchas and Rey have been examined in various studies. Using aggregate data, Alquist and Chinn (2008) compare the relative predictive power of the sticky-price monetary model, UIP and the Gourinchas and Rey model and find some support for the latter model but only at short horizons for bilateral exchange rates. Moreover, they find that no model outperforms a random walk. The Gourinchas and Rey model also predicts that cyclical external imbalances in the United States are linked to future movements in the dollar. Della Corte et al (2012) test this prediction and find a negative correlation between nominal exchange rate returns and lagged measures of bilateral external imbalances. Specifically, using exchange rates, data on valuation effects and the ratio of net exports to net foreign assets, they show that a model using cyclical external imbalances provides substantial economic value to a risk-averse investor when compared to a random walk.

The carry trade puzzle illustrates that the literature is still struggling to integrate a number of financial factors. One can clearly exploit interest differentials in the short run, as exchange rates do not satisfy UIP. The carry trade, however, appears to be a more persistent phenomenon – even though risk-adjusted UIP should preclude this over the longer term.[63] Carry trade is likely to be behind some of the increase in cross-border holdings of assets although this is hard to confirm given data limitations (see Galati et al (2007)). Since the profitability of carry trade is the flip side of the forward premium bias coin, any explanation must be consistent with risk premium patterns (Engel (2011) and Cenedese et al (2014)).[64]

[62] Despite its empirical importance, the source of this financial adjustment channel effect remains unclear. Gourinchas and Rey (2007) argue that the effect is consistent with a home bias in asset holdings.

[63] For evidence, see Jordà and Taylor (2012) and Brunnermeier et al (2009b). Clarida et al (2009) show that the forward rate bias disappears during periods of high volatility. Burnside et al (2011a) show that rare disasters (or "peso" problems) can be significant in explaining returns on carry trades. Hassan and Mano (2014) show that carry trade has little to do with the forward premium puzzle: carry trade exploits persistent differences in interest rate differentials across currencies while the premium puzzle seems to be driven by the interest rate movements of all currencies against the dollar.

[64] One "fundamentals-based" explanation could be the presence of disaster risk. Farhi et al (2009) show that, for a large set of advanced economies over the 1996–2008 period, disaster risk premia accounted for about 25% of excess returns on carry trades (see also Farhi and Gabaix (2016)).

One such possible risk premium is a reward for assuming global foreign exchange volatility risk. Indeed, Menkhoff et al (2012) show that a global premium can explain more than 90% of cross-sectional excess returns on five carry trade currencies with high interest rates. While liquidity risk also matters, volatility risk appears to be more important.[65] They document that there is a clear connection between global foreign exchange volatility "innovations" and portfolio returns on carry trades. They also report that when volatility innovations are high, carry trades perform poorly, implying that low interest rate currencies perform better than high interest rate currencies.

## 2.5 Interest rates and macroeconomic outcomes

This section surveys the interactions between interest rates and economic activity. It begins with a summary of the basic mechanisms that relate changes in interest rates to fluctuations in output in standard models. Next, it reviews the empirical evidence supporting these mechanisms. It concludes with a brief discussion of arguments challenging the mechanisms.

### A. Basic mechanisms

The main channel of monetary policy transmission is the so-called interest rate channel. Conceptually, by adjusting the policy rate, such as the fed funds rate in the United States, the central bank affects the nominal short-term rate at which banks and financial intermediaries borrow.[66] A change in nominal interest rates alters the real interest rate given some degree of price stickiness, ie the price level does not adjust fully in the short run.

When the short-term interest rate changes because of monetary policy decisions, long-term interest rates can also be affected. Long-term interest rates are directly linked to short-term rates by expectations and arbitrage relationships, at least in the standard models. However, the degree to which a central bank can affect long-term rates depends, among others, on the monetary policy regime, the credibility of the central bank, the structure of financial markets and various external factors (Walsh (2010), Duffee (2013) and Vavra (2014)).[67]

The real interest rate affects the user cost of capital and thereby economic activity. Standard neoclassical models of investment, such as Tobin's $q$ model (reviewed above), imply that the user cost of capital is one of the factors that determine the demand for investment and durable goods, including housing and consumer durables. In response to changes in the real cost of capital, corporations adjust their decisions with respect to production and investment. A decline in interest

[65] Adrian et al (2015) provide evidence that the funding liquidity aggregates of US financial intermediaries forecast dollar exchange rate returns – at weekly, monthly and quarterly horizons – both in-sample and out-of-sample and against a large set of currencies. They attribute the association to time-varying risk premia.

[66] See Mishkin (1995), Smets (1995), Borio (1997) and Boivin et al (2011) for reviews of monetary policy transmission channels. Our presentation is a highly stylised summary of how the direct interest rate channel of monetary policy operates. In reality, in the case of the United States, the fed funds rate, which is the interest rate prevailing in the overnight interbank market, is not controlled by the Federal Reserve, ie it is not a set rate. Instead, the Federal Reserve sets a target for that rate and tries to ensure that the actual rate remains close to the target by buying and selling securities in the open market. Similar mechanisms operate in other countries. For a detailed review, see Woodford (2003).

[67] This discussion, as most text-books do, ignores the possibility of default on domestic public debt, which is not uncommon (see Reinhart and Rogoff (2011) and Claessens and Kose (2014)).

rates, for example, leads to a rise in investment as the user cost of capital falls relative to the return on investment. Interest rates also affect household spending on durable goods and saving and investment decisions. In turn, through these mechanisms, real activity responds to changes in interest rates.

Such mechanisms are found in a wide variety of models, including the textbook IS-LM model and the new Keynesian (NK) models. The latter group of models starts from the standard real business cycle (RBC) framework but adds monopolistic competition in the goods market and rigidities in nominal price-setting. Christiano et al (2005) and Smets and Wouters (2007) provide NK models that include features, such as a sluggish response of prices and a large and delayed response of real variables. Similar mechanisms are also at play in recent DSGE models (see Blanchard (2009), Walsh (2010) and Christiano et al (2011b) for reviews). In many of these models, however, financial intermediation is largely irrelevant because there are no financial frictions. This means, in turn, that important channels by which interest rate changes could affect the real economy are left out. While this deficiency has been widely acknowledged following the GFC (see Hall (2010), Woodford (2010a), Ohanian (2010), Caballero (2010) and Blanchard (2017b)), progress with modelling has been slow (see further Chapter 3).

Recent developments, notably the UMPs under which interest rates were brought at or near the zero lower bound (ZLB) in many advanced economies have raised many questions because the standard transmission channels are no longer effective. At the ZLB, a central bank loses its conventional policy instrument, the short-term rate (Woodford (2012b), IMF (2013), Borio and Zabai (2016), Farmer and Zabczyk (2016), Gourinchas and Rey (2016) and Rogoff (2017)). It can then try to target real long-term yields and inflation expectations directly through forward guidance and purchases of government bonds and other assets.

Forward guidance can convince markets that rates will remain low for longer than what is consistent with the usual policy rule.[68] If successful, this can impart downward pressure on expected nominal and real rates (ie flatten the yield curve) and stimulate current spending. Since forward guidance poses a time consistency problem, in order to be effective it needs to be employed by a central bank with a solid reputation. Given the extraordinary nature of these policies, however, more research is required to gain a better understanding of their effects on the real economy.[69]

## B. Empirical evidence

Short- and long-term interest rates, both nominal and real, display considerable variation in advanced economies (Table 2.3A). While, as expected, nominal long-term rates have been less volatile than short-term rates, real long-term rates have been as volatile as short-term rates, at least in advanced economies. That said, the volatility of interest rates has declined since the mid-1980s. Consistent with the expectation hypothesis, evidence indicates that monetary policy shocks affect, albeit not

[68] See Eggertsson and Woodford (2003), Gertler and Karadi (2011), Del Negro et al (2017) and McKay et al (2016).

[69] Pre-announced thresholds for the timing and pace of the interest rate "lift-off" from the ZLB and purchases of long-term assets are thought to help enhancing the credibility of this policy. Other solutions have been proposed involving policy rules, such as price-level or nominal GDP-level targeting that allow for temporarily higher inflation. Woodford (2012a) reviews this literature with a focus on the implications for the conduct of US monetary policy (see also Gust et al (2017)).

necessarily at all times, the whole yield curve (eg Estrella and Hardouvelis (1991) and Evans and Marshall (2007) for the United States and Estrella and Mishkin (1997) for a panel of European economies).[70]

Interest rates and output: stylised facts

Percent Table 2.3A

| | Mean | Volatility | Maximum | Minimum |
|---|---|---|---|---|
| **Nominal short-term interest rate** | | | | |
| Q1 1971-Q4 2016 | -0.18 | 2.13 | 13.86 | -17.50 |
| Q1 1971-Q4 1984 | 0.21*** | 2.84*** | 12.28 | -11.53 |
| Q1 1985-Q4 2016 | -0.35 | 1.70 | 13.86 | -17.50 |
| **Nominal long-term interest rate** | | | | |
| Q1 1971-Q4 2016 | -0.10 | 1.33 | 11.59 | -13.19 |
| Q1 1971-Q4 1984 | 0.27*** | 1.51*** | 6.15 | -6.88 |
| Q1 1985-Q4 2016 | -0.26 | 1.21 | 11.59 | -13.19 |
| **Real short-term interest rate** | | | | |
| Q1 1971-Q4 2016 | -0.07 | 2.32 | 14.82 | -16.19 |
| Q1 1971-Q4 1984 | 0.15*** | 3.25*** | 12.37 | -10.04 |
| Q1 1985-Q4 2016 | -0.16 | 1.76 | 14.82 | -16.19 |
| **Real long-term interest rate** | | | | |
| Q1 1971-Q4 2016 | 0.00 | 2.17 | 12.83 | -10.65 |
| Q1 1971-Q4 1984 | 0.21*** | 2.95*** | 11.76 | -10.65 |
| Q1 1985-Q4 2016 | -0.09 | 1.72 | 12.83 | -9.53 |
| **Output** | | | | |
| Q1 1971-Q4 2016 | 2.30 | 2.61 | 28.08 | -9.26 |
| Q1 1971-Q4 1984 | 2.60*** | 2.62 | 10.76 | -4.10 |
| Q1 1985-Q4 2016 | 2.24 | 2.61 | 28.08 | -9.26 |

Note: Mean indicates the average year-over-year change (growth rate) in interest rates (output). Volatility is the standard deviation of the change in interest rates (growth rate of output). Maximum (minimum) is the maximum (minimum) change in each interest rate (growth rate of output). The sample consists of 18 advanced economies. *** indicates that the results for the period Q1 1971 to Q4 1984 are statistically different from those for the period Q1 1985 to Q4 2016 at the 1% level.

Many studies provide evidence that is consistent with the theoretical mechanisms described above. Early work found large effects of short-term interest rate movements on output through changes in consumption and investment (see Taylor (1995) for a summary). Romer and Romer (1994) document that changes in the fed funds rate are negatively correlated with US output fluctuations. Christiano et al (1999) provide evidence suggesting that, following an unexpected change in the interest rate, prices respond sluggishly, leading to movements in the real rate and hence activity. Uhlig (2005), on the other hand, shows with a less restrictive identification strategy that, although prices still move sluggishly, one cannot reject neutrality (ie real variables do not display a significant response).

Other evidence also supports the relevance of the interest rate channel. For example, results for the euro area suggest that the interest rate channel completely (or substantially) characterises the direct transmission of monetary policy in most

[70] Deviations from the simple arbitrage-free model and other conundrums exist. For example, the period of low long-term US interest rates between 2004 and 2006 could not easily be explained by existing term structure models (with residuals amounting to some 40–50 basis points) and was attributed at the time by some to a "global savings glut" and globalisation more generally (see Rudebusch (2010)). Since the GFC, there have been many studies on the drivers of the natural interest rate (eg Laubach and Williams (2016) and Holston et al (2016)).

countries (BIS (1995) and Angeloni et al (2003)). The traditional channel of monetary transmission is also embedded in most "policy" models. Indeed, a number of large-scale macroeconometric models used by central banks and other policy institutions exhibit a negative interest rate elasticity of investment.[71] Coenen et al (2012) present a review of seven structural models commonly used by policymaking institutions.

The interest rate channel operates with lags and can have asymmetric effects on output. Nominal short-term rates tend to have a higher correlation with output than other interest rates (Table 2.3B). Consistent with policy operating with a lag, nominal rates lead the business cycle, that is, rates rise (decline) slightly before output growth goes down (up) (see Cooley and Hansen (1995), Stock and Watson (1999) and Aruoba (2011)). Albeit reflecting various mechanisms (not only the direct interest rate channel), a typical finding for the United States is that a 1 percentage point decrease in the federal funds rate is associated with an increase in quarterly output growth over the following two years of about 0.5 percentage points. There are asymmetries, however: a 1 percentage point increase in the federal funds rate, for example, is associated with a reduction in quarterly output growth over the following two years of about 1.2 percentage points, more than double the effect of a similar decrease (see Angeloni et al (2003) and Boivin et al (2011)).

## Correlations between interest rates and output

Correlation coefficient — Table 2.3B

| | Lags | | | | Leads | | |
|---|---|---|---|---|---|---|---|
| | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| **Nominal short-term interest rate** | | | | | | | |
| Q1 1971-Q4 2016 | -0.10 | 0.04 | 0.21 | 0.35 | 0.42 | 0.42 | 0.36 |
| Q1 1971-Q4 1984 | -0.23** | -0.11*** | 0.08** | 0.22 | 0.26 | 0.28 | 0.21 |
| Q1 1985-Q4 2016 | 0.00 | 0.13 | 0.28 | 0.40 | 0.46 | 0.44 | 0.37 |
| **Nominal long-term interest rate** | | | | | | | |
| Q1 1971-Q4 2016 | -0.17 | -0.06 | 0.06 | 0.17 | 0.21 | 0.20 | 0.15 |
| Q1 1971-Q4 1984 | -0.44*** | -0.30*** | -0.13*** | 0.09 | 0.25 | 0.29 | 0.24 |
| Q1 1985-Q4 2016 | -0.08 | 0.02 | 0.12 | 0.20 | 0.21 | 0.18 | 0.12 |
| **Real short-term interest rate** | | | | | | | |
| Q1 1971-Q4 2016 | 0.05 | 0.08 | 0.11 | 0.12 | 0.09 | 0.06 | 0.01 |
| Q1 1971-Q4 1984 | 0.03 | 0.08 | 0.19 | 0.24 | 0.16 | 0.07 | -0.07 |
| Q1 1985-Q4 2016 | 0.05 | 0.05 | 0.07 | 0.08 | 0.08 | 0.07 | 0.06 |
| **Real long-term interest rate** | | | | | | | |
| Q1 1971-Q4 2016 | 0.04 | 0.00 | -0.05 | -0.12 | -0.18 | -0.23 | -0.24 |
| Q1 1971-Q4 1984 | 0.02 | 0.03 | 0.05* | 0.05** | -0.02* | -0.13 | -0.25 |
| Q1 1985-Q4 2016 | 0.00 | -0.06 | -0.11 | -0.17 | -0.21 | -0.22 | -0.20 |

Note: Mean indicates the average year-over-year change (growth rate) in interest rates (output). Volatility is the standard deviation of the change in interest rates (growth rate of output). Maximum (minimum) is the maximum (minimum) change in each interest rate (growth rate of output). The sample consists of 18 advanced economies. *** indicates that the results for the period Q1 1971 to Q4 1984 are statistically different from those for the period Q1 1985 to Q4 2016 at the 1% level.

Empirical studies also report high cross-country correlations of nominal interest rates and significant correlations of real interest rates. These correlations have risen over the past 25 years (Figures 2.8 and 2.9), due in part to greater financial market

[71] For reviews of the various DSGE models employed by central banks, see Smets and Wouters (2003) for the euro area; Edge et al (2008) and Chung et al (2010) for the United States; and Dorich et al (2013) for Canada).

integration but also to the adoption of more similar monetary policies (see King (2012) who reviews the experience with inflation targeting). Henriksen et al (2013), in a model that replicates the high degree of co-movement of interest rates, argue that, in response to cross-border spillovers of technology shocks, central banks' reactions can lead to highly correlated interest rate movements (see further Rey (2016) regarding the international co-movements of interest rates and the global transmission of US monetary policy shocks).

The spread between long- and short-term interest rates appears to help predict the timing of recessions.[72] Estrella and Mishkin (1998) document that term structure models based on the three-month and ten-year US Treasury rates provide a reasonable combination of accuracy and robustness in predicting US recessions. A number of studies have since documented that the slope of the yield curve or the term spread – the difference between the long- and the short-term rate – has significant power in predicting economic slowdowns (Estrella and Trubin (2006), Rudebusch and Williams (2009) and Croushore and Marsten (2016)).[73] Indeed, Figures 2.10A and 2.10B show how the difference between the 10-year Treasury bond yield and the three-month Treasury-bill rate can be useful in predicting recessions in the United States. The slope also helps predict changes in certain components of real economic activity, including consumption and investment (see Estrella and Hardouvelis (1991) and Ang et al (2006)).[74]

Evidence on the effects of UMP measures is somewhat limited. A rigorous assessment of the effects of asset purchases and forward guidance on aggregate demand is difficult, in part because it requires establishing a counterfactual scenario and elucidating an unstable transmission channel.[75] With this caveat in mind, the literature generally finds that central bank statements affect not only current interest rates but also their future path. Campbell et al (2012), for example, performing event studies over narrow time windows, find that 90% of the variation in the expected federal funds rate four quarters-ahead can be attributed to factors related to surprises in the timing of changes to the policy target. It also appears that there are temporary effects of UMPs on output and inflation. Evidence also suggests that asset purchases can significantly reduce long-term yields, especially during times of financial market

[72] If the market expects economic activity in the longer term to be stronger than what it is today, then the short-term real interest rate should be higher in the future relative to today because the central bank would be expected to increase its target rate to avoid an increase in inflation. An expected increase in the short-term rate would, in turn, increase the long rate today through a no-arbitrage relation. This would lead to a higher slope of the yield curve today. By contrast, a negative slope of the yield curve would signal expectations of a recession (see also Smets and Tsatsaronis (1997)).

[73] Analysing different spreads, Bernanke (1990) shows that the spread between US commercial paper and Treasury bill rates is the best predictor. Also for the United States, Boulier and Stekler (2000) show that the spread between the 10-year Treasury bond yield and the 90-day Treasury bill rate is positively associated with real growth rates. For the euro area, Moneta (2005) finds the spread between the ten-year government bond yield and the three-month interbank rate to be the best in predicting recessions. The slope of the yield curve has a greater predictive power than an index of leading indicators, real short-term interest rates, lagged growth in economic activity and lagged rates of inflation (see Wheelock and Wohar (2009) and Duffee (2013) for recent reviews). Gilchrist and Zakrajsek (2012) document the predictive ability of credit spreads for economic activity in the United States.

[74] Mehl (2009) reviews the literature on the predictive ability of the yield curve in EMEs and shows that, depending on the extent of market liquidity, it has informational value for future inflation and growth.

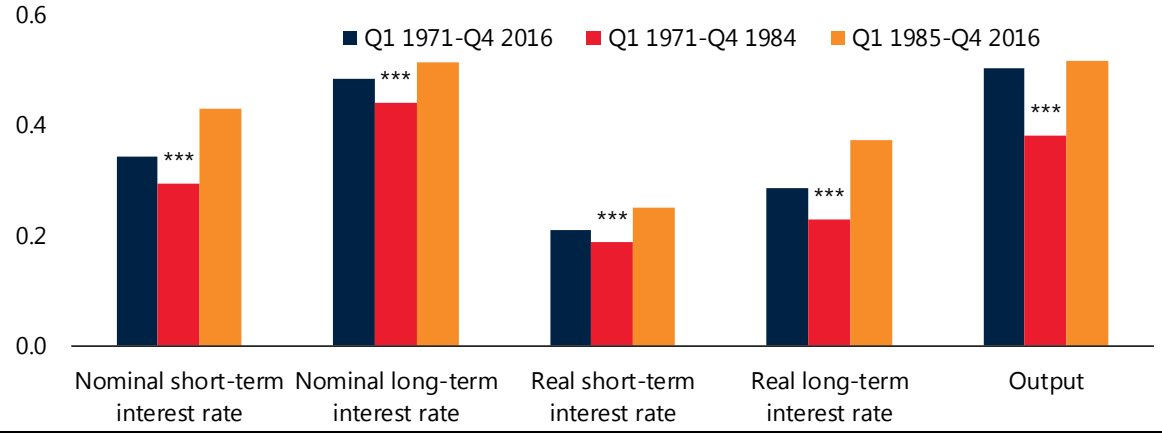
[75] See IMF (2013), Krishnamurthy and Vissing-Jorgensen (2013), Baumeister and Benati (2013), Gust et al (2017), Arteta et al (2015, 2016), and World Bank (2015a) for reviews.

turmoil (see also Krishnamurthy and Vissing-Jorgensen (2012) and Hancock and Passmore (2011)).

## Cross-country correlations: interest rates and output

Correlation coefficient

Figure 2.8

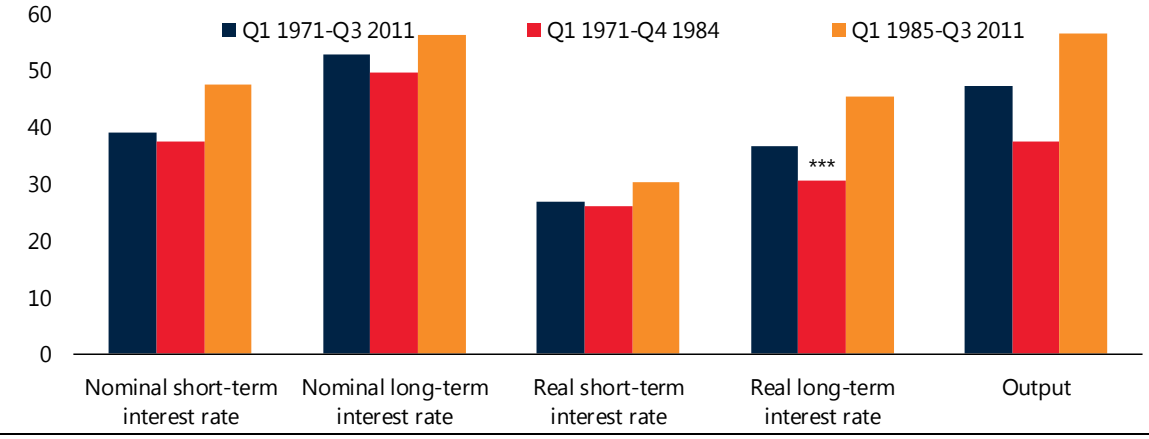



Note: The average of cross-country correlations for each variable in the respective periods is presented. The sample consists of 18 advanced economies. *** indicates that average correlations for the period Q1 1971 to Q4 1984 are statistically different from those for the period Q1 1985 to Q4 2016 at the 1% level.

## Variance due to the global factor: interest rates and output

Percent

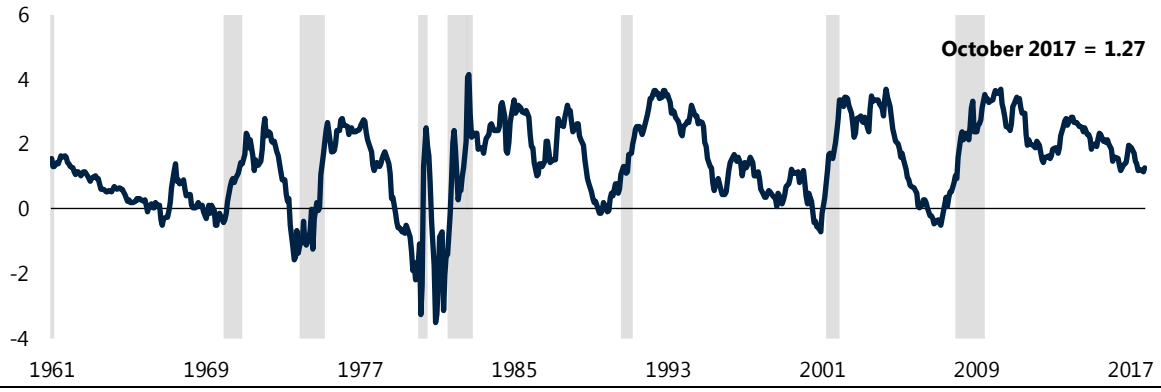
Figure 2.9




Note: The average percent of the variance explained by the global factor is presented. The sample consists of 18 advanced economies. *** indicates that variance explained by the global factors for the period Q1 1971 to Q4 1984 is significantly different from that for the period Q1 1985 to Q3 2011 at the 1% level.

Treasury spread: 10-year Treasury bond yield minus 3-month Treasury bill rate

Monthly average, in percent — Figure 2.10A




Note: This figure shows the US Treasury spread, which is calculated as the difference between 10-year Treasury bond yield and the three-month Treasury bill rate. The gray areas show recessions in the United States.

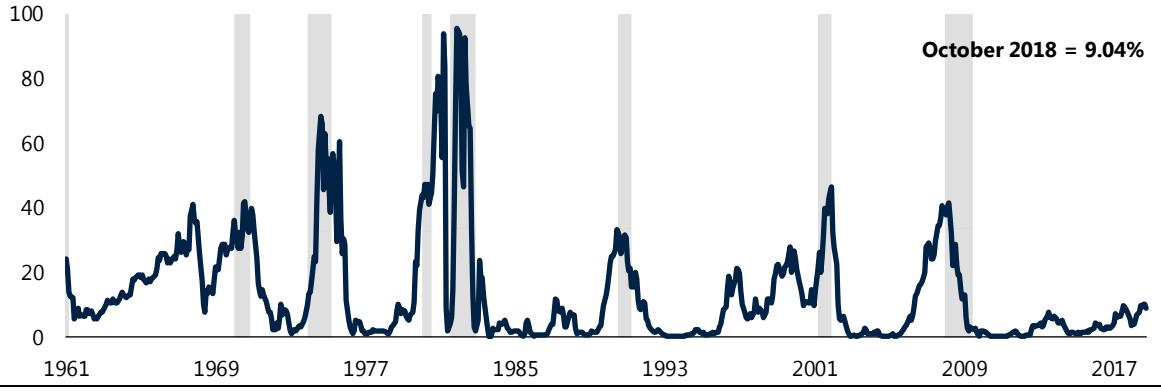
Source: Federal Reserve Bank of New York.

## C. Challenges to the standard models

While much research supports the basic transmission channels, evidence suggesting that other factors play a role is accumulating. First, the quantitative importance of the direct interest rate channel has been questioned. While results are not necessarily inconsistent with other evidence that the direct channel exists, they do suggest the need to consider firm, household and financial system heterogeneity and variations over time in the transmission of policy. Second, there is intense debate about the causal factors underlying the predictive value of interest rates and the slope of the yield curve for economic activity. These findings suggest collectively that other elements, possibly associated with financial frictions, could be quite significant for transmission.

Probability of US recession predicted by treasury spread

12-month ahead, monthly average, in percent — Figure 2.10B




Note: This figure shows the probability of a US recession predicted by the Treasury spread. This prediction is based on a model estimated using data from January 1959 to December 2009. Recession probabilities are predicted using data through October 2017. The gray areas show recessions in the United States.

Source: Federal Reserve Bank of New York.

### *Strength of the interest rate channel*

A number of studies reveal that the direct impact of interest rate changes on economic activity tends to be weak. Hall (1988) and Yogo (2004) find the effects of interest rates on aggregate consumption not to be significantly different from zero (Elmendorf (1996) and Islamaj and Kose (2016)). Other studies using micro data also fail to find strong evidence of a direct interest rate impact on investment (Chirinko (1993)). This result appears to be related to heterogeneity among firms. Since corporations engage in both saving and borrowing decisions, the effects of interest rate changes depend on the structure of balance sheets, including the maturity of assets and liabilities (Riddick and Whited (2009)). This could explain in part why the empirical macroeconomic literature finds a weaker effect for the direct interest rate channel.

Other studies find that the impact of interest rates varies according to individual household characteristics. Some studies find a weak effect for (financially) constrained households and a stronger impact for non-constrained ones. Vissing-Jørgensen (2002), for example, reports the elasticity of intertemporal substitution to be close to zero for agents that do not hold stocks and bonds but about 0.3–0.4 for stockholders and around 0.8–1.0 for bondholders. Changes in interest rates would therefore rarely matter for agents that do not participate in asset markets (Wong (2016)).

The potency of the direct interest rate channel also depends on the state of the economy and the financial sector. In a weak economy, or one with an undercapitalised financial system, interest rate changes tend to have a smaller impact on activity. In particular, in recessions and periods of financial stress, pass-through from the policy rate to the cost of borrowing gets smaller as more firms and households are excluded from credit markets. Moreover, even when they do not face borrowing constraints, corporations and households could well be more constrained during recessions for many other reasons and could change their investment and consumption decisions for other reasons than interest rate changes (see Borio and Hofmann (2017) for the non-linearity of interest rate effects).

The direct interest rate channel can depend especially on the capitalisation of banks. When banks try to restore profitability in the face of recession-impaired balance sheets, a change in the policy rate may only be passed through partially to lending rates. This would act to limit the lending response to a lower policy rate in the short run (see Woodford (2003), Eggertsson and Woodford (2004) and Bernanke et al (2004)). Conversely, low interest rates can lead to more risk-taking when bank balance sheets are stronger. De Nicolò et al (2010) show theoretically that when the policy rate is low, high-charter value (well capitalised) banks may increase risk-taking and low-charter value (poorly capitalised) banks may do the opposite (see further Dell'Ariccia and Marquez (2013) for a discussion of the theoretical literature on the links between interest rates, bank capitalisation and risk-taking).

Suggestive of market imperfections and financial frictions, many studies document that the indirect effects of interest rates on activity can be quite large. Those studies, notably Bernanke and Gertler (1995), argue that additional factors related to financial imperfections can amplify and propagate the quantitative effect of the conventional direct interest rate transmission channel. Using aggregate time series data for the United States, Bernanke and Gertler (1995) show that because of frictions in financial intermediation, the transmission of monetary policy largely operates through the financial system and depends on the balance sheets of firms and households.

The quantitative importance of different mechanisms also depends on country-specific financial and institutional environments. In bank-based financial systems, where retail deposits typically play an important role in funding and a large share of investment is financed by banks, the direct interest channel can be expected to be more influential in transmitting the effects of interest rates (see Allen and Gale (2000)). Indeed, while the overall quantitative impact of changes in interest rates in the euro area is comparable to that reported for the United States, there is a larger direct effect on investment (relative to consumption) in the euro area. Angeloni et al (2003), for example, find that the interest rate channel characterises monetary policy transmission in some euro area countries.[76] By contrast, in the United States, complementary channels through which interest rates affect consumption and investment are more important (see Boivin et al 2011)).

### *Limits to the predictive power of the yield curve*

Some interpret the predictive power of the slope of the yield curve for economic activity as evidence of other channels. While many argue that the slope reflects expectations about the monetary policy stance, and its relationship to economic activity, others question the analytical foundations of this channel (Stock and Watson (2003)). Some give more credence to the view that the slope of the yield curve affects intertemporal consumption choices that lead to sales or purchases of assets in anticipation of changes in income (Campbell (1986)).

Others point out that the direction of influence can be from activity to the yield curve. In a dynamic model with rational expectations, Estrella (2005) shows that the term spread contains information about expectations of future activity and is affected by current monetary policy, which is, in turn, influenced by current activity. Using a state-space model that comprises yield curve and macroeconomic factors, Diebold et al (2006) document that the two sets of factor interact in both directions: macroeconomic variables affect the yield curve (perhaps through the central bank's reaction function) and the yield curve influences macroeconomic variables.

Furthermore, in the finance literature, movements in the term structure are thought to reflect changes in (inflation) risk premia rather than (just) real activity. Advanced term structure models, which employ data on interest rates at different maturities, explain the predictive power by allowing for time-varying risk premia. For example, changes in the term structure largely reflect changes in risk premia in the canonical affine no-arbitrage term structure models augmented with macroeconomic variables. This is related in part to shifts in the perception of inflation risk, with risk premia guiding, albeit imperfectly, macroeconomic and financial developments (Gürkaynak and Wright (2012)).[77]

[76] For the eurozone, see Kok Sørensen and Werner (2006) and van Leuvensteijn et al (2011). See also Mojon (2000) for an analysis of differences in financial structures across euro area countries and their implications for the interest rate channel.

[77] For empirical evidence, see Diebold et al (2005, 2006) and Rudebusch and Wu (2008). Affine models are a special class of arbitrage-free term structure models, in which bond yields are affine (constant plus-linear) functions of some (vector of) state variables (see further Rudebusch (2010)). Campbell et al (2014, 2017), Christiansen and Ranaldo (2007), David and Veronesi (2013), Guidolin and Timmermann (2007) and Viceira (2011) further examine the drivers of bond returns. For additional reviews of the literature on the linkages between the nominal and real term structures of interest rates and macroeconomic outcomes, see Dai and Singleton (2003), Gürkaynak and Wright (2012), Duffee (2013) and Adrian (2017a).

Some studies report that risk premia are affected by macroeconomic factors. Using a dynamic term structure model, Joslin et al (2014) find that macroeconomic variables have significant predictive power over and above the level, slope and curvature of the yield curve. Specifically, they report that macroeconomic risks that cannot be hedged by financial variables (so called "unspanned risks") explain a substantial portion of the variation of the forward term premium, with unspanned real economic growth being the key driving factor.[78] Baele et al (2010) show that macroeconomic factors are important in explaining bond return volatility. This research suggests that macroeconomic factors affect not only the level of short-term interest rates but also the term structure and other moments of the yield curve.

There are also limits to the predictive ability of the yield curve, which depend on the time horizon, country-specific circumstances and external factors. In particular, predictive ability is largely relevant for up to one year in advance, especially in forecasting the timing of recessions. The predictive value also varies across time periods (Bordo and Haubrich (2004)), with its power possibly having declined over time (Stock and Watson (2003)). In related research, Mody and Taylor (2003) find evidence of predictive power in the 1970s and 1980s in the United States, possibly due to high and volatile inflation but not in the 1990s and 1960s. Chinn and Kucko (2015) report that predictive power has deteriorated in the United States and in some European countries in recent years. Bonser-Neal and Morley (1997) find that the yield spread explains 30% to 50% of future real economic activity in Canada, Germany and the US, and less than 10% in Switzerland and Japan.

Predictive power also seems to depend on global financial market conditions. The close relationship between the risk premium in swap markets and real activity, for example, breaks down around the year 2000 and during the 2006–07 period (Joslin et al (2014)). Since these were periods of elevated financial stress, it suggests that predictive ability results from developments in the financial system rather than from the direct effects of changes in interest rates on activity (see also Adrian (2017a) for a review).

## 2.6 Taking stock

The GFC of 2007–09 revived an old debate in the economics profession about the importance of macrofinancial linkages. Some argue that the crisis was a painful reminder of our limited knowledge of such linkages. Others claim that the profession has already made substantial progress in understanding them but that there is too much emphasis on certain approaches and modelling choices.[79]

[78] In addition to the models that add macroeconomic variables to the canonical arbitrage-free term structure model, Rudebusch (2010) identifies two additional strands: those that examine the financial implications of bond pricing in DSGE models and those that use the Arbitrage-Free Nelson-Siegel (AFNS) model. The first strand augments the standard RBC model with habit or recursive preferences (Epstein and Zin (1989) and Hansen and Sargent (2008)) but has difficulty in replicating the size and volatility of bond premia. Furthermore, the financial sector in these models remains very rudimentary in terms of frictions and intermediation. The second class, AFNS-models, lacks theoretical foundations but can be easily estimated and often exhibits a superior forecasting record. These models are extensively used by policy institutions.

[79] We presented some quotes reflecting the tenor of the debate at the beginning of the survey. Krugman (2009a) criticises the macroeconomics literature because of its failure to recognise the strong relationship between the financial sector and the real economy while Cochrane (2011a)

At the centre of the macrofinancial nexus lies the relationship between asset prices and macroeconomic outcomes. A long-held view among some academics, market participants and policymakers is that asset prices are set in an efficient manner by market forces, which helps guide the allocation of resources among competing projects. However, the apparent disconnect between asset prices, fundamentals, market volatility and other phenomena, on the one hand, and the predictions of standard models, on the other, has led many to question the "efficient markets" framework, especially after the GFC. A broad review of *"what we know"* and *"what we do not know"* about the linkages between asset prices and macroeconomic outcomes is thus called for.

This chapter provides a survey of the literature on the linkages between asset prices and macroeconomic outcomes, which is the natural starting point for an analysis of macrofinancial relationships. Since the literature covers a wide array of topics, there are many caveats associated with a survey like ours. In light of these caveats, our survey focuses on a small set of specific questions. First, what are the basic theoretical linkages between asset prices and macroeconomic outcomes? Second, what is the empirical evidence supporting these linkages? Third, what are the main challenges to the theoretical and empirical findings? We analyse these questions in the context of the following asset price categories: equity prices, house prices, exchange rates and interest rates. In this section, we summarise our answers to these three questions.

**Basic theoretical mechanisms.** A broad lesson of the survey is that standard models provide elegant benchmarks that allow the main mechanisms between asset prices and macroeconomic variables to be analysed. Asset prices play a significant role in determining the allocation of real and financial resources. They influence consumption, saving and investment decisions through wealth and substitution effects. Through the information they carry about future profitability and income growth, they also affect activity at both micro- and macroeconomic levels. Moreover, the linkages between asset prices and macroeconomic outcomes play critical roles in the cross-border spillovers of real and financial shocks.

The linkages between exchange rates and macroeconomic outcomes are also multidimensional. Many models look at how exchange rates are endogenously related to macroeconomic variables and how these relationships are affected by a variety of factors, including the heterogeneity of economic sectors, economies of scale, imperfect competition, the type of exchange rate regime, country-specific elements and time horizons. Recent theoretical models employ richer environments, including a consideration of the role of financial variables and valuation effects in developing a better understanding of the linkages between exchange rates and real and financial aggregates. However, some of the links between exchange rates and

provides a critical response to Krugman's views. Kocherlakota (2010), Caballero (2010), Romer (2016) and Reis (2017) assess the state of research on macroeconomics, but arrive at different conclusions. Blanchard (2017a) looks at the state of macroeconomics, focusing on the need to include distortions other than nominal price rigidities, including financial frictions. For perspective, Blanchard (2000, 2009) and Mankiw (2006) provide general reviews of the state of macroeconomics before the GFC. Many others, including Bernanke (2010), Blanchard et al (2010, 2013), Woodford (2010a), Taylor (2011), Turner (2012), Borio (2014), Claessens et al (2014a), Kose and Terrones (2015) and Blanchard and Summers (2017) and several papers in the Fall 2010 issue of the *Journal of Economic Perspectives* look at how the GFC may have influenced research. These and other reviews cover a broader set of issues than macrofinancial linkages and the intersection between macroeconomics and finance (see for example Gopinath (2017) who provides a review of the recent macroeconomic policy-related work in international economics). In addition, contributions have taken a broader perspective on how economic policies have been reassessed (Blanchard et al (2012, 2016) and Akerlof et al (2014)).

macroeconomic outcomes remain ambiguous, including with respect to the effects of devaluations on investment and output.

The short-term interest rate is a special asset price since it is the main tool of monetary policy. One of the key channels of monetary transmission, the direct interest rate channel, focuses on the impact of interest rates on economic activity. In standard models, changes in real interest rates lead to movements in the cost of capital and these, in turn, affect business and household investment and consumption decisions.

**Empirical evidence.** Empirical studies provide evidence supporting some of the basic mechanisms linking asset prices and activity. For example, there is evidence indicating that asset prices affect corporate investment. Research also suggests that linkages arise through a wide range of channels, with their impact depending on the characteristics of financial markets and the types of asset under consideration. Moreover, consistent with the predictions of most models, asset prices tend to be correlated with current and future aggregate activity. And global factors play an increasingly important role in driving variations in asset prices.

The empirical literature documents economically meaningful long-run relationships between exchange rates and economic activity. The strength of these relationships, however, varies across sectors, countries and time horizons. While empirical studies have been inconclusive about the link between exchange rate depreciation and consumption growth, there appears to be stronger long-run links between changes in exchange rates, volume of trade and current account. A number of studies emphasize that exchange rates can play supportive roles in facilitating reversals of current account imbalances. The exchange rate can also affect aggregate activity (as a transmission mechanism of monetary policy), especially in small open economies. In addition, there is a large empirical literature analysing the interaction between exchange rates, financial variables and macroeconomic outcomes.

The role of interest rates in shaping macroeconomic outcomes has also been extensively documented. A number of empirical studies show that interest rates affect investment, consumption and overall activity. The interest rate channel of monetary policy operates with lags and can have asymmetric effects on output. Moreover, certain characteristics of the yield curve can help in explaining the behaviour of various macroeconomic aggregates and can help in predicting the timing of recessions.

**Challenges to theoretical and empirical findings.** The links between asset prices and activity differ from the predictions of standard models in a number of ways. First, asset prices are much more volatile than fundamentals would imply and can at times deviate, or at least appear to do so, from their predicted fundamental values. The term structure of interest rates is not fully consistent with the simple expectation hypothesis. Although exchange rates can be modelled as the present value of expected fundamentals, they appear to be overly volatile, as is the case between equity prices and their underlying dividend streams (the puzzle of "excess volatility"). Moreover, macroeconomic and financial news seem to have an exaggerated effect on asset prices: equities, bonds and currencies overreact to news about cash flows and other fundamentals.

Second, investment and consumption respond differently to asset prices from what standard models would suggest, with a larger role for "non-price factors" in driving agents' behaviour and macroeconomic aggregates. Firm investment reacts less strongly to asset prices than predicted by models while household consumption reacts more vigorously to changes in asset prices, especially house prices, than

consumption-smoothing models would suggest. In addition, the links between asset prices and macroeconomic outcomes appear to vary across countries depending on financial, institutional and legal structures. Research also questions the strength of the direct impact of interest rate changes on activity and highlights its dependence on the state of the economy and the financial sector, and institutional arrangements. Recent studies emphasize the importance of uncertainty (measured among others by the volatility of asset prices) in explaining macroeconomic outcomes.

Third, there are limits to the predictive ability of asset prices for real activity. The basic theory implies that asset prices should be good proxies for expected growth as they are forward-looking variables. Equity prices, however, with their low signal-to-noise ratio and their (excess) volatility, have a mixed record in forecasting activity. There are also limits to the predictive ability of the yield curve, which depends on the time horizon, country-specific circumstances and external factors. Although this remains a topic of intense research, recent studies suggest that movements in exchange rates help only to a limited degree in predicting changes in fundamentals.

Fourth, similar to the domestic context, there are many puzzles involving the international dimensions of asset prices. As is the case for the weak link between equity prices and firms' fundamentals within a country, co-movements in asset prices appear to not (just) reflect commonality in cash flow streams. The observed high correlations across asset prices suggest other channels of transmission, including contagion, as suggested by the high volatility of capital flows. The limited international diversification of investment, the so-called home bias, has been hard to reconcile with the predictions of most asset pricing models.

Fifth, recent research emphasises the important role played by financial imperfections in explaining the linkages between asset prices and macroeconomic outcomes. Such imperfections appear to curtail households' ability to borrow against future labour income, leading to liquidity constraints. Similarly, asset prices affect firm behaviour, including their willingness and ability to issue new equity, in ways suggestive of financial frictions. Imperfections also appear to amplify and propagate movements in asset prices (including through changes in agents' balance sheets). Moreover, financial factors and imperfections seem to influence the linkages between exchange rates and macroeconomic outcomes.

# 3. Macroeconomic implications of financial imperfections

## 3.1 Why do financial imperfections matter?

As we noted in Chapter 1, the Great Financial Crisis (GFC) of 2007–09 confirmed the vital importance of advancing our understanding of macrofinancial linkages. The GFC was a bitter reminder of how sharp fluctuations in asset prices, credit and capital flows can have a dramatic impact on the financial position of households, corporations and sovereign nations.[80] These fluctuations were amplified by macrofinancial linkages,

[80] A large literature documents the various macrofinancial linkages that have contributed to the devastating impact of the GFC. Some of the important books on the topic include Krugman (2009b), Sorkin (2009), Wessel (2009), Lewis (2010), Kose and Prasad (2010), Paulson (2010), Gorton (2012), Turner (2012), Bernanke (2013), Blinder (2013), Claessens et al (2014a), Geithner (2014), Mian and Sufi (2014a), Wolf (2014), Farmer (2016), King (2016) and Taylor (2016). Lo (2012) reviews a set of 21 books on the GFC.

bringing the global financial system to the brink of collapse and leading to the deepest contraction in world output in more than half a century. Moreover, these linkages have resulted in unprecedented challenges for fiscal, monetary and financial sector policies.

Macrofinancial linkages centre on the two-way interactions between the real economy and the financial sector. Shocks arising in the real economy can be propagated through financial markets, thereby amplifying business cycles. Conversely, financial markets can be the source of shocks, which, in turn, can lead to more pronounced macroeconomic fluctuations. The global dimensions of these linkages can result in cross-border spillovers through both real and financial channels.

The crisis has led to a lively debate over the state of research on the role of financial market imperfections in explaining macroeconomic fluctuations. Some argue that the crisis showed that the profession did not pay sufficient attention to these linkages. Others, by contrast, claim that they have been recognised for a long time and that substantial progress has been made in understanding them. But most acknowledge that financial market imperfections can often intensify fluctuations in the financial and real sectors. Yet, the absence of a unifying framework to study the two-way interactions between the financial sector and the real economy has limited the practical applications of existing knowledge and impeded the formulation of policies.[81]

This debate can be seen as a natural extension of the long-standing discussion about the importance of financial market developments for the real economy (as we described in detail in Box 1.1 in Chapter 1).[82] The diverging paths followed by the

[81] We presented some quotes reflecting the flavour of this debate at the beginning of the survey. Krugman (2009a) criticises the macroeconomics literature for its failure to recognise the strong relationship between the financial sector and the real economy, while Cochrane (2011a, 2017) responds critically to Krugman's views. Caballero (2010), Kocherlakota (2010), Taylor (2011), Romer (2016) and Reis (2017) provide varying assessments of research on macroeconomics. Blanchard (2017a) stresses the need for a broader class of macroeconomic models.

[82] Early surveys of the literature on macrofinancial linkages include Gertler (1988), Bernanke (1993), Lowe and Rohling (1993) and Bernanke et al (1996). Mankiw (2006) and Blanchard (2000, 2009) offer more general reviews of the state of macroeconomics before the crisis. Recent (but more selective) updates on macrofinancial linkages include Gilchrist and Zakrajšek (2008), Matsuyama (2008), Solimano (2010), BCBS (2011, 2012), Caprio (2011), Gertler and Kiyotaki (2011), Quadrini (2011), Borio (2014) and Morley (2016), as well as papers in Friedman and Woodford (2011). Work related to macrofinancial linkages includes: Cochrane (2006) on financial markets and the real economy; Brunnermeier (2001) and Cochrane (2005) on asset pricing; and Tirole (2006) on the role and impact of financial imperfections on corporate finance and other economic variables. Crowe et al (2010) and Nowotny et al (2014) present collections of papers on macrofinancial linkages. Brunnermeier et al (2013) provide an analytical review of the literature on macro models with financial frictions. On the supply side, Adrian and Shin (2010b) survey the literature on the changing role of financial institutions and the growing importance of the shadow banking system. Gorton and Metrick (2013) and Pozsar et al (2013) review the role of securitisation and shadow banking; Brunnermeier and Oehmke (2013) and Scherbina and Schlusche (2014) review the literature on asset price bubbles; and Forbes (2012) reviews the literature on asset price contagion. Blanchard (2017a) looks at the state of macroeconomics, focusing on the need to include distortions other than nominal price rigidities, including financial frictions. Kocherlakota (2016) shows how the predictions of real business cycle models significantly change in the presence of small nominal rigidities and argues that these types of models are not useful tools for analysis of business cycles. For a recent discussion of the need to incorporate financial frictions, labour market frictions and household heterogeneity in benchmark macroeconomic models, see Ghironi (2017). Obstfeld and Taylor (2017) consider the importance of finance in the context of the international monetary system. The literature on law and finance also

fields of macroeconomics and finance are at the root of recent debates. The literature has exhibited an oscillating pattern between integration and separation of financial and real economy issues. Early studies often considered developments in the real economy and financial sector jointly but they resorted to mostly qualitative approaches. Later studies, however, emphasised the separation of the real sector from the financial sector and subscribed to the idea that the financial sector was no more than a "veil" to the real economy. The corporate finance and asset pricing literatures largely adopted the "efficient markets" paradigm. An influential branch of the macroeconomic literature (following the real business cycle (RBC) approach) mostly focused on models that do not account for financial imperfections and their potential role in shaping macrofinancial linkages.[83]

Although progress on the topic has been slower than hoped for, the literature has been making a more concerted effort over the past three decades to analyse the interactions between financial markets and the real economy. A number of studies have emphasised the critical roles played by financial factors for the real economy. Starting with Bernanke and Gertler (1989) – followed by Carlstrom and Fuerst (1997), Kiyotaki and Moore (1997) and others – rigorous analytical models have been developed. These models have been used for a variety of purposes, including the analysis of the impact of monetary and fiscal policies on the real economy and financial markets.

This chapter surveys the rapidly expanding literature on the implications of financial market imperfections for macroeconomic outcomes. It attempts to contribute to the research programme in at least four dimensions. First, it presents a broad perspective on theoretical and empirical studies on the implications of financial market imperfections for macroeconomic outcomes. Second, it emphasises the global dimensions of these linkages in light of the rapid growth of international financial transactions and their critical role in the transmission of cross-border shocks. Third, it summarises the main empirical features of the linkages between the financial sector and the real economy. Finally, it attempts to identify gaps in the literature in order to provide guidance for future studies.

The survey focuses on two main channels through which financial market imperfections can lead to macrofinancial linkages. The first channel, largely operating through the demand side of finance, describes how changes in borrowers' balance sheets can amplify macroeconomic fluctuations. The central idea underlying this channel is best captured by the *financial accelerator* – an extensively studied propagation mechanism in a wide range of models. The second channel, associated with the supply side of finance, emphasises the importance of balance sheets of banks and other financial institutions in lending and liquidity provision for the real economy.

Given the large number of studies on the macroeconomic implications of financial imperfections, a survey on the topic comes with a number of caveats. First, for presentational purposes, we use the rough distinction between the demand and supply sides of finance, reviewing each separately and analysing how they can lead to macrofinancial linkages. The demand and supply sides are of course interrelated

relates to the broad theme of macrofinancial linkages (see La Porta et al (2013) for a recent review) but more from a longer-run developmental perspective.

[83] Chapter 2 reviews research on the interactions between asset prices and macroeconomic outcomes in models without financial market imperfections. In these studies, changes in financial variables, such as asset prices, are associated with individual consumption and investment decisions but there are no aggregate feedback mechanisms from financial to real variables and little scope for macrofinancial linkages.

as transactions are endogenous outcomes, especially when they are considered in a general equilibrium framework. Nevertheless, this rough demarcation allows us to classify many studies in a simple manner. Second, our objective is to provide intuitive explanations of how financial frictions can lead to macrofinancial linkages. Hence, rather than delving into the details of certain models, we explain the general ideas describing the workings of models and then summarise the relevant empirical evidence for specific channels. In order to present a coherent review of this large body of work, each section provides a self-contained summary of the specific literature.

Third, macrofinancial linkages ultimately originate at the microeconomic level. Hence, whenever possible, we draw lessons from the theoretical and empirical work on the microeconomic factors that are relevant for the behaviour of macroeconomic and financial aggregates. Fourth, while many of the papers we review have policy relevance, we largely stay away from directly addressing policy issues, including those related to monetary, macroprudential, regulatory and crisis management policies. Finally, while we did our best to include all the major studies on the topic, it is probably unavoidable that a survey of such a rich literature would miss some contributions.

Section 3.2 presents a brief review of the basic microeconomic mechanisms that could lead to financial market imperfections on the demand side. It starts with a conceptual discussion of how imperfections (financial frictions) stemming from information asymmetries and enforcement difficulties affect the amount and costs of external financing available to firms and households.[84] Financial frictions can lead to deviations from the predictions of the standard complete market models in terms of how (real and financial) resources are allocated.[85] Models incorporating financial frictions typically predict that access to external finance becomes easier and the premium charged for such financial transactions decreases with the strength of borrowers' balance sheets and net worth. This can lead to the amplification of (monetary, financial and real) shocks as changes in net worth affect access to finance – and the use of that finance – and subsequently influence consumption and investment.

The section also reviews the empirical evidence on the importance of financial market imperfections on the demand side. Studies have employed microeconomic (firm, household, and sector-level) data to examine the role of imperfections in explaining the behaviour of households, firms and sectors over the business cycle. Some also analyse the importance of imperfections in driving macroeconomic outcomes during specific episodes. Most studies find that these imperfections tend to affect small firms and households the most, especially during times of financial stress. Although many studies provide supporting evidence concerning the roles played by imperfections, there is also a debate about their aggregate quantitative importance.

Section 3.3 reviews general equilibrium models that feature amplification mechanisms operating through the demand side. These models show how financial accelerator-type effects can arise when small shocks are propagated and amplified across the real economy through their impact on access to finance. In these models,

[84] Some of the pioneering papers on financial frictions include Akerlof (1970), Jensen and Meckling (1976), Townsend (1979), Stiglitz and Weiss (1981), Bulow and Rogoff (1989) and Hart and Moore (1994).

[85] Throughout this book, the terms "financial market imperfections" and "financial frictions" are used interchangeably. Financial frictions – in conjunction with a country's legal, regulatory and tax system – influence the design and evolution of financial contracts, markets and intermediaries.

the interactions between access to external financing and firms' or households' net worth or cash flows (or relevant asset prices) serve as transmission mechanisms between the financial sector and the real economy. Small, temporary shocks can amplify and spill over to other segments of the economy and generate large, persistent fluctuations in consumption, investment and output.

The past two decades have witnessed significant growth in research featuring financial accelerator mechanisms. This research programme, which often uses dynamic stochastic general equilibrium (DSGE) models, emphasises the important role played by shocks to external financing and asset prices in amplifying business cycles. For example, it models that changes in asset prices and net worth significantly influence household borrowing and spending through their impact on households' access to finance and the cost of such finance. More recent work highlights how financial frictions can affect the allocation of resources across a number of dimensions (firm heterogeneity, project choice, technological change, housing market structure and the functioning of labour markets). Section 3.3 also reviews how the financial accelerator mechanism has been incorporated into the analysis of the transmission of monetary policy to the real economy.

Section 3.4 looks at studies on the macroeconomic implications of financial imperfections in the context of open economies. As is the cases for a household or firm, imperfections can have an impact on net worth and affect a country's ability to borrow. Research has considered the importance of various imperfections using different types of open economy models. It has found that, with contracts being more difficult to enforce and information asymmetries being more prominent across borders, imperfections can be important for macroeconomic outcomes in open economies. For example, the financial accelerator mechanism has been shown to be quantitatively important in explaining the real effects of financial stress in open economy models. Another strand of the literature examines the interactions between imperfections and exchange rates, and considers the transmission of shocks in open economies through changes in the external value of the collateral required for financing. Recent empirical work supports the importance of global shocks to credit markets in leading to large cross-border spillovers in real activity.

Sections 3.5 and 3.6 present a summary of the amplification channels that operate largely on the supply side of finance and the empirical evidence relating to the importance of these channels (for discussions of the main functions of the financial system, see Levine (1997, 2005) and Zingales (2015)). Some of the same financial sector imperfections that give rise to the financial accelerator mechanism also affect the operations of financial intermediaries and markets, ie the *supply side* of finance. Just as is the case for firms, financial institutions' operations are affected by their net worth. Furthermore, financial intermediaries and markets themselves are subject to various imperfections and related market failures. Importantly, interactions among financial market participants can lead to aggregate developments on the supply side of finance. Together, these observations imply that the supply side can be a source of shocks, amplification and propagation, leading, in turn, to macrofinancial linkages.[86]

[86] Important contributions on the supply side include Diamond and Dybvig (1983), Gale and Hellwig (1985), Calomiris and Kahn (1991), Holmström and Tirole (1997), Allen and Gale (1998) and Diamond and Rajan (2001). More recent work includes Adrian and Shin (2008), Geanakoplos (2008) and Brunnermeier and Pedersen (2009), Danielsson et al (2011), Gertler and Karadi (2011), Gertler and

Developments on the supply side can have a substantial influence on macroeconomic outcomes through various mechanisms that can be classified under three major groups, although there are significant overlaps between these groups. The first two groups focus on banks' special role in intermediation. The first includes the *bank lending* channel, a mechanism traditionally identified in the literature as being particularly relevant for the transmission of monetary policy. Notably, changes in the balance sheets of banks, especially their liquidity, can affect the overall supply of financing. The second and related group is associated with (changes in) *bank capital*. As capitalisation varies over the cycle, banks expand or cut back lending, leading to aggregate procyclical effects. Both mechanisms matter especially to those households and firms for which bank credit cannot easily be substituted for.

The third and most recent group of studies focuses on the financial system's overall leverage and liquidity. The GFC showed that *leverage* could build up to excessive levels during upturns and drop sharply in downturns. This has important implications for the supply of external financing, asset prices and, consequently, for the real economy. In addition, providing *liquidity* is an important function of the financial system. The aggregate supply of financing and liquidity to the private sector depends, however, on a complex set of interactions between financial institutions, notably (but not only) through the interbank and other financial markets. Fluctuations on the supply side can have a significant impact on macroeconomic outcomes, with cycles of growing leverage, ample liquidity and rising asset prices being followed by cycles of deleveraging and liquidity hoarding (especially during periods of financial stress). More generally, a wide range of factors, including balance sheet positions of households, non-financial enterprises and financial institutions, interactions between those agents and financial markets, and access to information and ability to process it, can affect asset prices and the supply of external financing.

Empirical work shows that supply side shocks can affect the evolution of external financing, asset prices and market liquidity, with the potential for feedback loops between real and financial markets. A number of recent studies focus specifically on the linkages arising from the first two supply side channels for the transmission mechanisms of monetary policy. They document that the supply side can influence macroeconomic outcomes through an amplification of credit supply and external financing during boom periods and deleveraging and liquidity hoarding during periods of financial stress. A more recent strand documents the role of such supply factors internationally.

Section 3.7 reviews recent empirical studies that analyse aggregate linkages between the real economy and the financial sector. Using long series of cross-country data, those studies report a number of salient facts about the features of business and financial cycles and about the interactions between the two. They document that financial cycles appear to play an important role in shaping recessions and recoveries. In particular, recessions associated with financial disruptions are often longer and deeper than other recessions while, conversely, recoveries associated with rapid growth in credit and house prices tend to be relatively stronger. These results collectively point to the importance of the two-way linkages between financial markets and the real economy.

Section 3.8 concludes with a summary of the main messages.

Kiyotaki (2011), Goodhart et al (2012), He and Krishnamurthy (2012), Brunnermeier and Sannikov (2014, 2016), Begenau (2016), Gertler et al (2016), Begenau and Landvoigt (2017) and Piazzesi and Schneider (2017). Many recent models combine demand and supply side considerations (including banks, shadow banks and payment and collateral services).

## 3.2 Financial imperfections: the demand side

This section reviews the basic mechanisms through which financial market imperfections on the demand side can lead to macrofinancial linkages. It starts with a conceptual discussion of how the state of borrowers' balance sheets affects their access to external financing at the microeconomic level, ie at the levels of households and corporations. This is followed by a summary of microeconomic and sectoral evidence supporting the importance of imperfections on the demand side. Although most demand side studies support the role of imperfections, their quantitative importance is still under debate.

### A. Basic mechanisms

Financial market imperfections often stem from information asymmetries and enforcement problems. Due to information asymmetries, lenders and investors know less about the expected rate of return on prospective projects than firm managers or owners do. Moreover, lenders and investors do not know everything about borrowers; for example, whether they are well qualified, exerts sufficient effort or selects economically efficient projects (ie with positive net present value). Since the economic prospects of projects, the financial position of borrowers and the actual effort expended by borrowers cannot be observed perfectly *ex-ante,* adverse selection and moral hazard problems arise. Lenders and investors may also face difficulty in enforcing contracts *ex-post*. In part due to information asymmetries (eg to verify the exact state of affairs of borrowers such as the actual effort they exerted) but also as the legal and institutional frameworks may not allow for efficient *ex-post* settlements (eg as collateral is hard to repossess) lenders may have to incur large costs and therefore refrain from lending in the first place.

These information asymmetries lead to transaction costs and incomplete financial markets in the sense that not every worthwhile project is financed.[87] In order to choose worthwhile projects, avoid adverse selection and prevent shirking, lenders and investors will have to incur transaction costs. In order to overcome monitoring problems, savers and principal investors have to rely on agents (such as banks) for monitoring to be done on their behalf or employ certain *ex-post* mechanisms (for example, costly state verification (Townsend (1979)). For this to happen, they need to incur additional costs. These costs and other imperfections create, in turn, a wedge between: i) what the expected value of a firm or project would be and how much external financing it could obtain with no agency costs (ie under perfect information

[87] As Quadrini (2011) notes in his review, the presence of financial frictions implies the absence of complete trade in certain risks, that is, models with financial frictions feature missing markets, thus limiting a full sharing of risk. Models (implicitly or explicitly) also assume heterogeneous agents since there would otherwise be no reason to trade claims inter-temporally or intra-temporally. The fact that markets are missing may be exogenously assumed or can arise from financial frictions, that is, forms of market incompleteness due to information asymmetries and limited enforcement. There has been an extensive theoretical literature on how such imperfections can lead to missing markets or incomplete contracts, including in financial markets. Seminal corporate finance papers include Akerlof (1970), Jaffee and Russell (1976), Jensen and Meckling (1976), Rothschild and Stiglitz (1976), Stiglitz and Weiss (1981) and Myers and Majluf (1984). Tirole (2006) provides a textbook treatment of the role of imperfections in corporate finance and discusses some of their macroeconomic implications. Meyers (2015) reviews capital structure theories and how they have been tested. Samphantharak and Townsend (2009) discuss how finance affects household behaviour. Dewatripont and Tirole (1994) and Freixas and Rochet (1997) present early analytical overviews of imperfections as they affect financial institutions (see also Greenbaum et al (2016)).

or run by the principal); and ii) what the value of the firm would be under a particular external financing arrangement.[88] This wedge means a higher cost of external financing or can even lead lenders to ration the external financing they provide *ex-ante* (Stiglitz and Weiss (1981)).

Models incorporating these imperfections typically predict that access to external finance is related to the strength of borrowers' balance sheets. Because of this link, most models do not only predict that access to finance differs from what is predicted by models without imperfections, but also that to the extent that financing is available, its amount depends on borrowers' net worth – the value of assets less outstanding debt obligations – and the collateral value of easily saleable assets, especially liquid assets (eg cash). Net worth and collateral provides three types of assurance to investors. First, with skin in the game, borrowers have better incentives to select profitable projects and work hard to deliver successful results. Second, borrowers have assets to help repay the loan, ie the simple value of recoverable collateral. Third, collateral can help investors screen out quality borrowers from low quality ones or help trustworthy borrowers signal their quality (Bester (1987) and Besanko and Thakor (1987)).

Lenders may demand a premium over the risk-free rate to provide credit to borrowers. This "external finance premium," ie the difference between the cost of external funds and the opportunity cost of internal funds, covers the costs incurred by financial intermediaries in evaluating borrowers' prospects and monitoring their actions. It can also be seen as compensating investors for the inefficiencies and risks induced by moral hazard and adverse selection. If borrowers have limited net worth, their access to external financing can be fully constrained, even if they have profitable investment projects. This is because lenders have little confidence in their incentives to perform (and the lenders cannot screen out good projects) and their ability to repay. This premium and constraint on external financing also imply that deadweight losses can arise because not all profitable projects can obtain financing.

Changes in borrowers' net worth then affect their access to finance. Shocks, such as fluctuations in asset prices or changes in economic prospects, influence the balance sheets of borrowers. Given financial imperfections, resulting changes in net worth affect the volume of external financing supplied and its cost. Specifically, as net worth rises, the volume of external financing increases while its cost declines to a level that is comparable to the implicit cost of internal funds. Conversely, as net worth declines, the volume of external financing falls while its cost increases.

The relationship between borrowers' net worth and their access to external financing (and its cost) implies that the impact of shocks (monetary, real and financial) can be amplified. This is an expected outcome as borrowers adjust their investment or consumption plans in the face of changes in the volume and cost of external financing. However, the effects of financial imperfections can be asymmetric over the business cycle. In fact, when net worth is high (more likely to be the case during booms), the problems of adverse selection or moral hazard are less relevant (as lenders' collateral requirements are less binding). Conversely, with adverse shocks, net worth-related constraints can suddenly become much more significant. The asymmetric nature of shocks has been exploited by the empirical literature to show the relevance of macrofinancial linkages.

[88] These imperfections also affect the formation of firms since a firm (as an organiser of activities) can be a mechanism to internalise some of those constraints (Coase (1937)). Aghion and Holden (2011) present a review of research on incomplete contracts and the theory of the firm.

The key mechanisms described above are also relevant to understanding the implications of changes in household balance sheets. As is the case for corporations, the borrowing potential of households also hinges on the strength of their balance sheets. This means that movements in asset (such as house or equity) prices can lead to changes in household borrowing and spending that are larger than what is suggested by conventional life-time wealth and consumption effects (see Chapter 3 for additional discussion on this). Since housing represents a large part of household net worth, movements in house prices can affect homeowners' access to financing and the external financing premium they face (Mian et al (2017)).

## B. Empirical evidence

Numerous studies examine the empirical relevance of financial imperfections. Some employ microeconomic (firm-, household- and sector-level) data while others consider specific events or episodes. This section summarises the empirical evidence provided by microeconomic data (largely focusing on corporate investment and household consumption). Additional work that considers macroeconomic and time series evidence is presented in Section 3.7.

Research documents a strong association between firm cash flow and investment. Theory predicts that, in environments with no financial market imperfections, a corporation's current cash flow is immaterial to its investment decision. With imperfections, however, a corporation's cash flow can influence investment decisions because the corporation is subject to an external finance premium that stems from financing constraints. As the cash flow increases, so can investment because of the greater availability of internal funds and the lower cost of such funds relative to external funds. Many studies using panel data report that corporate cash flows are indeed correlated with investment decisions. This is especially true for firms that are smaller, do not pay dividends or have poor credit ratings, exactly those firms that are more likely to be subject to imperfections. The first influential paper that presents empirical evidence of this link, by Fazzari et al (1988), has been followed by many others.[89]

The empirical evidence on the link between internal cash flows and investment shows that imperfections play a significant role. Although other factors can also lead to such linkages, studies using various techniques to control for such factors have confirmed the relevance of imperfections.[90] One confounding factor is that firms' current cash flows can be correlated with future profitability. Since prospective returns are relevant to current investment decisions, this can generate a correlation (even without financial market frictions). Evidence shows, however, that imperfections remain important. For example, Blanchard et al (1994) find supporting evidence by analysing how firms adjust their investment in response to "cash windfalls". They argue that such windfalls are unrelated to future profitability.

Other research, using different approaches, also emphasise the importance of financial imperfections. Lamont (1997) analyses internal capital markets of oil

[89] Other studies include Hubbard (1998), Hoshi et al (1991), Whited (1992), Calomiris et al (1995), Gross (1995) and Hubbard et al (1995). Stein (2003) presents a survey of theoretical and empirical work regarding the determinants of firm-level investment dynamics.

[90] For example, Kaplan and Zingales (1997) criticise the approach taken by Fazzari et al (1988) because they do not control for the endogeneity of financing constraints. See further Kaplan and Zingales (2000) on why investment-cash flow sensitivities are not good indicators of financing constraints.

companies and finds that, in response to a sudden drop in oil prices, these companies significantly reduce their non-oil investment compared with other companies. Since this approach controls for the profitability of investments, it provides evidence of the importance of cash flows for investment. A number of other studies, including those on the determinants of inventories and employment, also point to the critical role of imperfections.[91] Another strand of the literature uses information extracted from CEO's public statements and surveys to assess directly whether firms are credit-constrained (Graham and Harvey (2001)).

Imperfections are acutely important for small firms, particularly during times of financial stress. Because such firms have more limited access to financial markets (because they have less collateral or are less transparent to outside investors), imperfections are often more relevant to them (Petersen and Rajan (1995)). Fazzari et al (1988)) find that investment is indeed significantly more sensitive to current cash flows for new and small firms. In a related study, Gertler and Hubbard (1988) report an inverse relationship between firm size and sales variability that stems from imperfections. They also find that the effects of financial market frictions on investment are asymmetric, with larger impacts during downturns than during booms. Fort et al (2013) show that young (typically small) businesses are more sensitive to the cycle than older/larger businesses. Campello et al (2010) and other papers document the adverse implications of financial constraints during a financial crisis (see Peek and Rosengren (2016) for a comparison of supply side effects between the GFC and previous crises).

Other studies also examine the importance of internal cash flow and asset price movements for the investment undertaken by different classes of firms. Gilchrist and Himmelberg (1999), for example, document that internal cash flow is critical for investment, especially for firms that are small, have limited access to credit markets and have relatively weaker balance sheets. They find that investment is responsive to both fundamental and financial factors, as predicted by the theory relating to financial frictions. Their estimates show that financial factors increase the overall response of investment to an expansionary shock by about 25% over the first few years following the initial shock. Chaney et al (2012) and Gan (2007) find a significant impact of asset (real estate) prices on corporate investment in the United States and Japan (see also Lin et al (2011) for the role of ownership structures for financing constraints).

Studies also report that small firms are more likely to be credit-constrained during periods of contractionary monetary policy. Gertler and Gilchrist (1994) examine the behaviour of small and large manufacturing firms in the United States during five periods of contractionary monetary policy and one period of credit crunch. They document that small and large firms behave differently during these periods, with the former group reducing its debt and the latter one increasing it. Small firms experience larger declines in their inventories and sales than large firms (Figure 3.1). They conclude that because large firms have easier access to credit, the impact of adverse credit market shocks is less pronounced for them than it is for smaller firms. Sharpe (1994) provides similar supporting evidence and concludes that the cyclicality of a firm's labour force is inversely related to its size.

The behaviour of households is similarly affected by financial market imperfections. Due to imperfections, including an inability to borrow against one's life time income, households can be subject to borrowing constraints and therefore

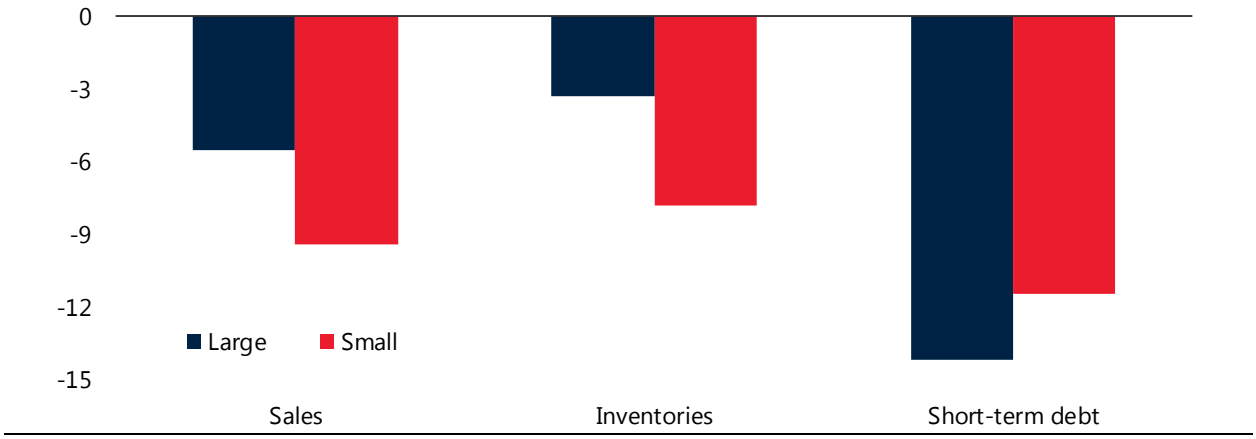
[91] See for additional work, Cantor (1990), Blinder and Maccini (1991), Oliner and Rudebusch (1993), Carpenter et al (1994) and Guiso et al (2013).

undertake more precautionary saving. This can make household consumption highly sensitive to fluctuations in transitory income. A number of empirical studies suggest that changes in aggregate consumption are significantly correlated with lagged or predictable changes in income or credit growth (Flavin (1981), Campbell and Mankiw (1989, 1990) and Deaton (1992); see Jappelli and Pistaferri (2010) for a review). Ludvigson (1999) shows a statistically significant correlation between consumption growth and predictable credit growth.

Behaviour of large and small firms

Around periods of tight money

Figure 3.1




Note: The figure presents the difference between the minimum value of the detrended series in an interval of 12 quarters following an episode of tight money and the peak value of the series. Tight money periods are: Q2 1966, Q4 1968, Q2 1974, Q3 1978, Q4 1979, Q4 1988 and Q2 1994 based on the historical record analysed in Romer and Romer (1989). Small firms are defined as those at or below the 30th percentile of assets and large firms as those above the 30th percentile.

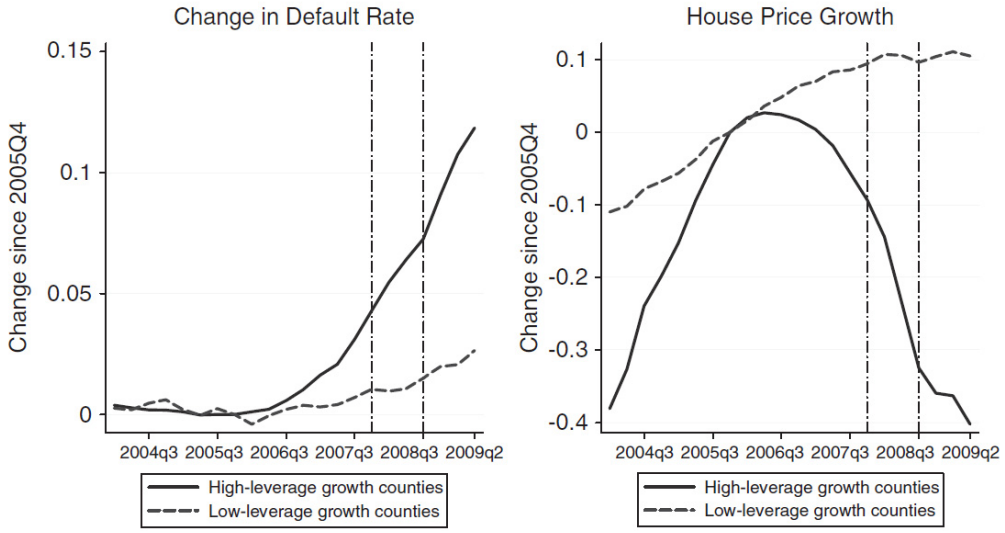
Source: Kudlyak and Sánchez (2017).

Changes in house prices affect household borrowing and spending substantially through their impact on household net worth and cost of credit. Home equity is often a large part of household net worth. A variety of micro-based empirical studies document that household consumption is affected more by changes in house prices than what simple life-time consumption models would predict (see Chapter 2). Lamont and Stein (1999) report that US households with weak balance sheets adjust their housing demand more strongly in the face of income shocks, consistent with a role for borrowing constraints. Other studies also show that households face an external finance premium, which is lower when their financial position is stronger (Almeida et al (2006)).

Financial imperfections associated with housing markets are shown to have implications beyond their impact on individual households. Using regional-level data for the United States, Mian and Sufi (2010) show that the local variation in house price appreciation in the 2000s, and related subprime expansion and securitisation, led to a disassociation of local mortgage credit from income as borrowing constraints became (excessively) relaxed. Credit extension was driven by expectations of house price appreciation but this was followed by a wave of mortgage defaults when prices started to decline (Figures 3.2 and 3.3). In the regions affected, this triggered subsequent large adjustments in durables consumption (proxied by auto sales) and a rapid increase in unemployment (Mian and Sufi (2014b) and Loutskina and Strahan (2015); see also Benmelech et al (2017) on the important role of credit supply shocks in the auto loan market during the GFC).

Default rates and growth of house prices in countries with low and high leverage growth

Figure 3.2

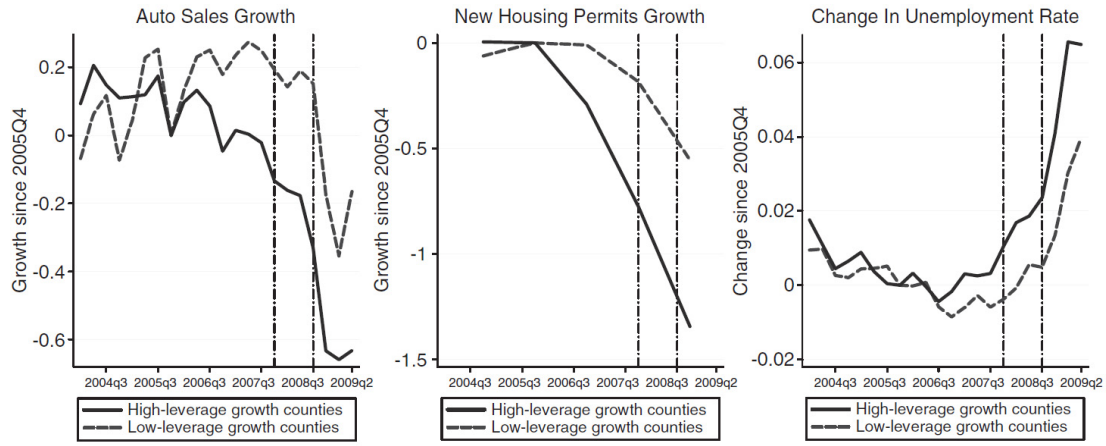



Note: High-leverage growth counties are defined as the top 10% of counties in terms of the increase in the debt to income ratio from Q4 2002 to Q4 2006. Low-leverage growth counties are in the bottom 10% of the same measure. The left panel plots the change in the default rate for high- and low-leverage growth countries and the right panel plots the growth rate for high- and low-leverage growth countries.

Source: Mian and Sufi (2010).

Auto sales, new home building and unemployment rates in high- and low-leverage growth countries

Figure 3.3




Note: High-leverage growth countries are defined as the top 10% of countries by the increase in the debt to income ratio from Q4 2002 to Q4 2006. Low-leverage growth countries are in the bottom 10% based on the same measure. The left panel plots the growth in auto sales, the middle panel plots the growth in new housing permits, and the right panel plots the change in the unemployment rate.

Source: Mian and Sufi (2010).

However, some question the potential role of imperfections in explaining the behaviour of households and firms. They argue that the close association between income and consumption may not be entirely due to imperfections. Others point out the general difficulty in separating real effects from balance sheet effects. Factors, such as the expected rate of return, while difficult to measure, also affect firm and household access to finance. Some consequently argue that changes in cash flows

represent a set of factors that is different from the strength of balance sheets (Eberly et al (2008)). Carroll (1997), for example, suggests that the excess sensitivity of consumption growth to forecastable income growth is explained by non-linearities of the marginal utility function rather than by borrowing constraints.

The quantitative importance of financial frictions for small firms has been under scrutiny as well. Chari et al (2008) challenge the findings of Gertler and Gilchrist (1994) and report that the behaviour of small and large firms is not significantly different during US recessions than it is during other times. Kudlyak and Sánchez (2017) consider how the debt, sales and inventories of small and large firms evolved during the third quarter of 2008, a period of elevated financial stress. They report that large firms experienced bigger declines in sales and short-term debt than small ones (Table 3.1). They also document similar patterns for earlier recessions. Others argue that even if smaller firms tend to face significant external finance premia, the role of such firms in explaining business cycles may be small (Cummins et al (2006)). Srinivasan (1986) shows that small- and medium-size manufacturing firms depend more on internal finance than large firms, potentially making the costs of external finance less relevant in the aggregate.

Behaviour of small and large firms during recessions and tight money periods

Percent change — Table 3.1

| | Sales | | Inventories | | Short-term debt | |
|---|---|---|---|---|---|---|
| | Large | Small | Large | Small | Large | Small |
| 2007-2009 recession[1/] | -24.62 | -20.24 | -14.18 | -15.36 | -38.24 | -19.83 |
| 2001 recession[2/] | -14.64 | -6.92 | -12.65 | -9.28 | -35.95 | -12.13 |
| All recessions pre-2001[3/] | -7.59 | -10.15 | -5.67 | -9.11 | -24.48 | -12.62 |
| Tight money dates[4/] | -5.50 | -9.39 | -3.30 | -7.78 | -14.15 | -11.45 |

Note: The table shows the difference between the minimum value of the detrended series in an interval of 12 quarters following the episode and the peak value of the series.

[1/] The peak of the recession is Q4 2007.
[2/] The peak of the recession is Q1 2001.
[3/] The peaks of the recessions covered are: Q4 1969, Q4 1973, Q1 1980, Q3 1981 and Q3 1990.
[4/] The periods of tight money are Q2 1966, Q4 1968, Q2 1974, Q3 1978, Q4 1979, Q4 1988 and Q2 1994.

Source: Kudlyak and Sánchez (2017).

It has also been shown that large firms are affected by imperfections, especially during times of financial stress. Even relatively large firms, including publicly-listed corporations, have been shown to face external finance premia, as predicted by theories premised upon imperfections (see Levin and Natalucci (2005) and Levin et al (2004)). When large firms suffer from adverse shocks to their balance sheets, their investments are also negatively affected, especially during recessionary and stressed periods (Aguiar (2005) and Gilchrist and Sim (2007)). Almeida and Campello (2010) find that large firms can also face high external financial costs.

On balance, many studies confirm the role of imperfections for outcomes associated with the behaviour of firms and households. This is particularly true of studies based on microeconomic data. However, few studies cover the universe of firms or households and only a small number of studies analyse the aggregate quantitative importance of financial frictions in a rigorous fashion. Consequently, they are less clear about the aggregate impact of imperfections. The next section turns therefore to studies that focus on the aggregate impact of imperfections and how such imperfections give rise to the financial accelerator mechanism.

## 3.3 Financial imperfections in general equilibrium

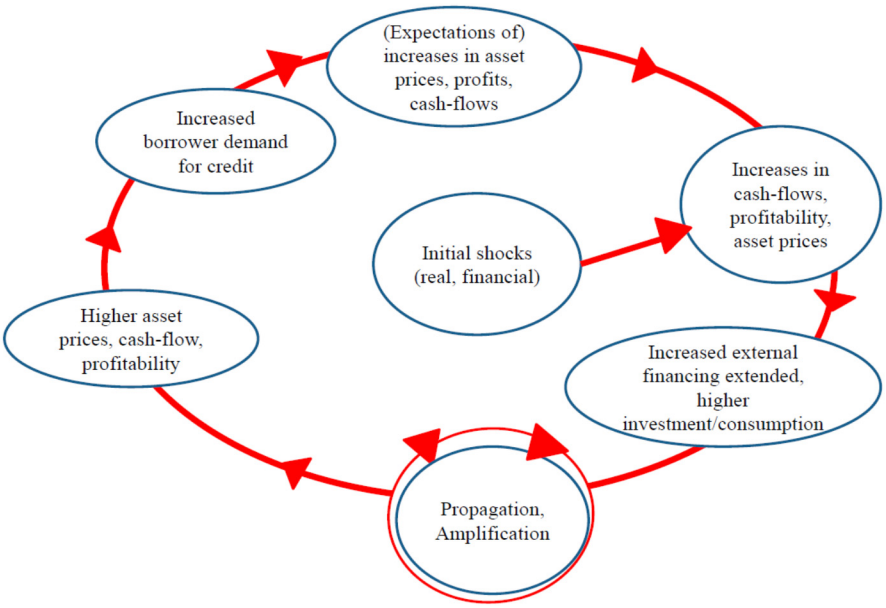
This section describes how financial imperfections can lead to more pronounced macroeconomic fluctuations. It first introduces the financial accelerator mechanism through which financial imperfections amplify and propagate aggregate cyclical fluctuations. In general, equilibrium models featuring this mechanism display that real, monetary and financial shocks can have a magnified effect on the real economy because borrowers adjust their investment in response to changes in external financing. The section then presents a summary discussion of the empirical evidence on the quantitative importance of the various types of financial accelerator mechanism, mostly in the context of DSGE models.

### A. The financial accelerator

How does the financial accelerator work? The relationships described above, between the amount of external financing and its cost (premium), on one hand, and the strength of borrowers' balance sheets and cash flow positions, on the other, lead to an *amplification* mechanism where small shocks can result in large economy-wide adjustments to investment and consumption. Since wealth is a state (or given) variable and economic agents cannot quickly (or optimally) adjust their investment/saving plans (as they face costs of doing so), this mechanism persists over time, causing short-lived shocks to real or financial variables to have longer-lasting effects on the real economy. This *propagation* mechanism can also have general equilibrium effects as individual agents' actions affect other agents' behaviour in a mutually reinforcing fashion (see Figures 3.4A and 3.4B).[92]

Financial accelerator mechanism: demand side

Virtuous circle — Figure 3.4A



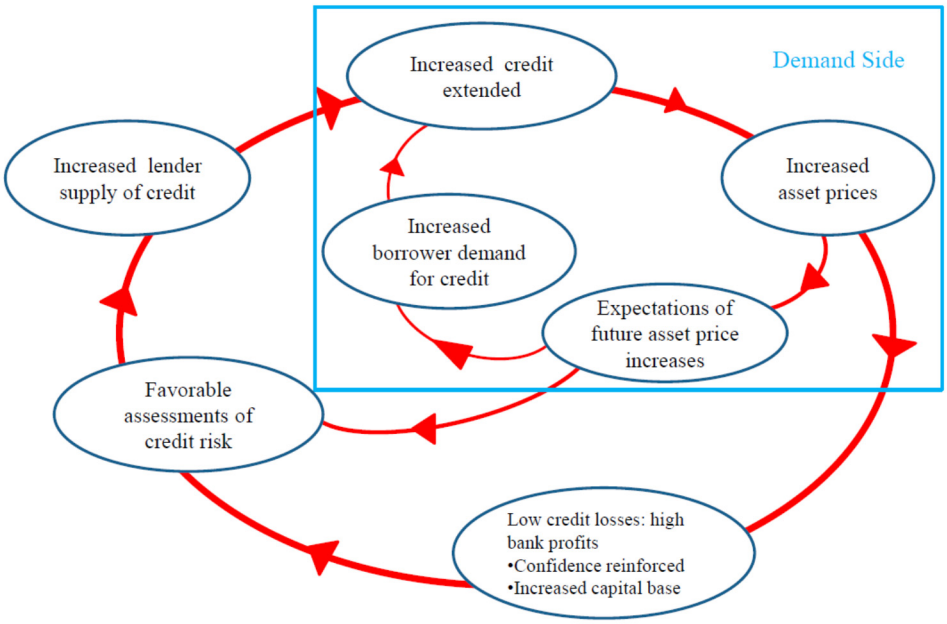

Note: The chart depicts the financial accelerator mechanism by which shocks to the economy may be amplified by changes in access to external financing, which then translates into changes in economic agents' investment and consumption spending. In turn, these changes are propagated and reinforced as asset prices and economic activity fluctuate, which then affects the demand and availability of external financing. This creates further feedback loops that are propagated through financial markets and the real economy.

[92] For surveys describing variants of the financial accelerator mechanism, see Antony and Broer (2010), BCBS (2011), Coric (2011) and Quadrini (2011).

Financial accelerator mechanism: supply side

Virtuous circle

Figure 3.4B




Note: The chart depicts both the demand (as in Figure 3.4A) and the supply sides of the financial accelerator mechanism. As financial institutions' balance sheets and profitability increase and asset prices rise, the assessment of economic prospects is viewed more positively and the supply of external financing expands. This then translates into changes in investment that enhance the feedback loops between financial markets and the real economy.

### *The basic mechanism*

Although narratives of the propagation mechanisms had been around for a long time, Bernanke and Gertler (1989) presented the first formal model featuring the financial accelerator mechanism.[93] In their model, a negative productivity shock weakens the cash flow and balance sheet positions of corporations. In turn, this reduces their access to external finance and increases the premium on such finance, as in standard corporate finance models. One of the innovations of their model is the use of a dynamic framework. In particular, they introduced an overlapping generations model in which only entrepreneurs could costlessly observe the returns on their individual projects. But outside lenders have to incur a fixed cost to observe those returns (this "costly state verification" mechanism was first developed by Townsend (1979, 1988)). As firms' balance sheets and cash flows worsen, they start facing limits on their access to external finance in ensuing periods. This, in turn, leads them to reduce investment even after the initial productivity shock dissipates, thus leading to a persistence of shocks at the firm level.

While movements in cash flows play a key role in driving changes in access to credit and corporate balance sheets more generally in the model developed by Bernanke and Gertler (1989), fluctuations in credit and asset prices can also play important roles in amplifying shocks over time. For example, Kiyotaki and Moore (1997) focus on the role of asset prices. In their analysis, declines in asset prices

[93] Earlier general equilibrium models often featured incomplete financial markets (rather than market imperfections). Farmer (1984), for example, presents a setting where a complete set of futures markets does not exist because traders have finite lives.

constrain the ability of corporations to obtain new loans, with subsequent effects on investment and ultimately on output. They show that by allowing for the endogenous determination of asset prices, a small negative shock leading to an asset price decline gets amplified as it reduces the value of collateral for all borrowers and thereby reduces the aggregate availability of loans. This further depresses demand for the asset and its price, which then further reduces access to external financing.

In these models, shocks persist and amplify over time and also spill over to other corporations or sectors. The interactions between credit limits and cash flows or asset prices become the transmission mechanism by which small or temporary shocks – whether from technology, or other real factors, policies or income distribution – can generate large, persistent fluctuations. In these models, durable assets play a dual role: not only are they factors of production but they also serve as collateral.

### *Many dimensions of the financial accelerator*

A number of studies have shown how various types of financial imperfection can lead to different propagation and amplification mechanisms. Some models provide complementary explanations of how such mechanisms can operate. In most models, cash flows, asset prices and balance sheets tend to be depressed during recessions.[94] Although the mechanisms (and/or channels) vary – running from cash flow, default risk, capital allocation across firms, technological change and information asymmetry to the functioning of labour and housing markets – the overall impact of amplification on macroeconomic outcomes is quite similar. Box 3.1 presents a summary of these mechanisms.[95]

Box 3.1

## Financial accelerator mechanisms

Although there are many variants of the financial accelerator mechanism, they tend to describe similar channels of transmission and propagation. A number of theoretical studies show that the mechanism can play an important role in accentuating macroeconomic fluctuations. This Box presents a summary of the various mechanisms found in the literature (see Quadrini (2011) for a systematic analytical review of the causes of financial frictions and the types of accelerator model; Gerke et al (2013) also compare the various models that feature a financial accelerator mechanism and collateral constraints).

One mechanism works through changes in cash flows that depend on the overall state of the economy. Greenwald and Stiglitz (1993) develop a dynamic model in which changes in corporate cash flows play a critical role in propagating financial market disturbances to real sector variables, including employment and inventories. Another mechanism acts through changes in the intensity of adverse selection in credit markets. Azariadis and Smith (1998) show that the presence of adverse selection can create indeterminacy, with the economy fluctuating between Walrasian and credit rationing regimes, and with cyclical downturns exhibiting declines in real interest rates and increases in credit rationing (see also Mankiw (1986)).

[94] Each model has its specific advantages and limitations. Some models assume that agents are short-lived, as in the overlapping generations model of Bernanke and Gertler (1990) and Suarez and Sussman (1997). The model by Kiyotaki and Moore (1997) is dynamic with long-lived agents but, as Suarez and Sussman (1997) highlight, it rules out price indexation as a way of insuring against unanticipated shocks.

[95] See also Bernanke and Gertler (2000) and Cecchetti et al (2000) for a discussion of different mechanisms, including those working through asset prices.

Changes in default probabilities over the cycle can also amplify cyclical fluctuations. During the upswing of a cycle, default probabilities decline, allowing investors to lend greater sums of money, as predicted by the Stiglitz-Weiss model (1981) of lending under asymmetric information and moral hazard. This fuels the upswing. On the downswing, the mechanism works in reverse, leading to sharp declines in available external financing. The general equilibrium implication of this mechanism is modelled by Suarez and Sussman (1997) using an overlapping generations model. In particular, during booms old entrepreneurs sell larger quantities and prices fall, implying that young entrepreneurs must rely to a greater extent on external sources of financing. Since external financing can generate excessive risk-taking, booms are often followed by higher failure rates. Fire sales by bankrupt corporations during such periods then lead to asset price declines, which, in turn, generate macroeconomic fluctuations.

The allocation of capital across heterogeneous firms can, in the presence of financial imperfections, also create procyclicality. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) focus on the impact of financial imperfections on aggregate investment and employment but neglect the effects of the reallocation of inputs across heterogeneous firms. Recent studies try to fill this gap. Eisfeldt and Rampini (2006) find that the costs of capital reallocation, such as those induced by financial frictions, need to be countercyclical to be consistent with the cyclical dynamics of capital reallocation and productivity dispersion. Moll (2014), in a model where entrepreneurs are subject to borrowing constraints and idiosyncratic productivity shocks, shows with plant-level panel data that financial frictions can explain aggregate productivity losses in two EMEs that are 20% larger than in the United States. In related research, Khan and Thomas (2013), using a DSGE model in which capital reallocation across firms is distorted by frictions, show that a shock can be amplified and propagated through disruptions to the distribution of capital across firms. Herrera et al (2011), in their study of US firms and the dynamic properties of gross credit flows relative to macroeconomic variables, find that financial frictions can impact aggregate productivity by hindering the inter-firm reallocation of credit.

Project choice and technological change can also lead to financial accelerator mechanisms. The literature on the accelerator often emphasises the impact of imperfections on the volume of investment or consumption. However, imperfections can also propagate and amplify shocks by triggering changes in the quality and productivity of projects undertaken. Some studies argue that financial frictions that are made worse by recessions induce firms to switch to lower quality and lower productivity projects (Barlevy (2003)). Aghion et al (2010) show how recession-induced credit constraints can make firms choose short-term investments with low liquidity risk, making the share of long-term but more productive projects procyclical. In other studies, though, recessions have a cleansing effect, stimulating the adoption of more productive technologies. Araujo and Minetti (2011) document that, while firms' collateral and credit relationships ease their access to credit and investment, such relationships can also inhibit restructuring activity (ie the transition to new and more productive technologies).

Financial imperfections affecting large firms also can result in accelerator-type effects. While the literature generally stresses that small firms are especially exposed to financial imperfections, frictions can also affect large firms. As is well documented in the corporate finance literature, large firms, especially those that are widely held, face more acute agency problems. Managers of large firms can have incentives to allocate cash inefficiently, for example, by empire building (Jensen and Meckling (1976) and Jensen (1986)). Dow et al (2005) integrate this problem into a dynamic equilibrium model and show how cash flow shocks can affect investment and be propagated over time.

Philippon (2006) models how managers tend to overinvest and how shareholders show greater tolerance for such behaviour more during booms, with the cyclical behaviour related to the quality of governance. Martin and Ventura (2011) consider a financial accelerator model in which bubbles in asset prices drive changes in borrowers' net worth and the tightness of credit constraints (see also Martin and Ventura (2015)). Note also that firm demand for external financing appears to deviate from the behaviour predicted by standard models (Baker and Wurgler (2013) survey theory and evidence on behavioural corporate finance).

Information asymmetries can be a source of asset price booms, bubbles and busts. Models à la Kiyotaki and Moore (1997) assume that agents participating in asset markets are equally informed. However, financial frictions can also generate confusion about the fundamental value of assets. When agents are asymmetrically informed about the fundamental value of assets, Yuan (2005) shows that credit constraints can contribute to uncertainty and exacerbate the volatility of asset prices. Iacoviello and Minetti (2010) show that opening an economy to foreign agents (such as lenders) that have less information about traded collateral assets, can lead to higher volatility of asset prices, credit and output. Gorton and Ordoñez (2013, 2014) show that when an economy relies on informationally-insensitive debt, a credit boom can follow during which firms with low quality collateral start borrowing. Since this is associated with a

more fragile environment, a small shock can trigger a large change in the information set, leading to a drop in asset prices and a sharp decline in output and consumption. A distinct but related area of research explores the role of distortions, such as moral hazard or weak corporate governance, in generating asset price bubbles (Allen and Gale (2000) and Barlevy (2014)).

Moreover, financial imperfections can propagate adverse shocks through labour markets, for instance, by hindering the job search process. Motivated by the GFC, Sterk (2015) presents a business cycle model in which a fall in house prices reduces geographical mobility because credit-constrained homeowners experience a decline in their home equity, creating distortions in the labour market. The model can explain much of the joint cyclical fluctuations in US housing and labour market variables, including the events that took place in 2009. Andrés et al (2010) explore a similar propagation channel involving credit frictions and labour markets. They are able to explain the co-movements of US house prices with output, investment and consumption. Burnside et al (2016) provide a model in which agents' interactions create "fads" about asset price prospects. This process, in turn, generates boom-busts cycles or protracted booms that are similar to those observed for house prices.

## B. Quantitative importance of the financial accelerator

Research, using a variety of approaches, documents the quantitative importance of the financial accelerator mechanism. This sub-section looks at two distinct groups of studies. The first employs DSGE models to evaluate the quantitative importance of the financial accelerator for the business cycle. The second group considers the role of the financial accelerator mechanism within the context of monetary policy. The sub-section concludes with a discussion of studies that challenge the quantitative importance of the financial accelerator.

### *Studies employing DSGE models*

In one of the first DSGE models with financial market imperfections, Carlstrom and Fuerst (1997) show the importance of endogenous agency costs in accounting for business cycles. They employ a setup featuring a financial accelerator mechanism with long-lived entrepreneurs. Their model can replicate the empirical observation that output growth displays a hump-shaped behaviour in response to negative shocks as households delay their investment decisions until agency costs are at their lowest (several periods after the initial shock).

Bernanke et al (1999) represent the seminal DSGE model involving the financial accelerator. They show that endogenous fluctuations in balance sheets can propagate the impact of relatively small exogenous disturbances and lead to larger and longer-lasting effects on the real economy. Looking at how monetary policy shocks can get amplified, they find that the impact on investment of a 25 basis point decline in interest rates is almost doubled by the financial accelerator because the reduction is reinforced by an additional decline in the external finance premium. The initial response of output to such an interest rate decline is also about 50% greater due to financial accelerator effects. It is also more persistent because of agency problems between borrowers and lenders.

DSGE models and their many variants show how adding imperfections can help explain business cycles. Models including imperfections on the demand side – featuring external finance premia, balance sheet constraints on borrowing and liquidity shortages – are able to replicate to a significant degree the behaviour of key macroeconomic variables. Christiano et al (2008), for example, show that financial factors play an important role in explaining business cycles during the past two decades in the United States and Europe. Von Heideken (2009) documents that the financial accelerator greatly improves the ability of standard models, even those with

an elaborate set of real and nominal frictions, to mimic the main features of business cycles in the United States and the euro area. Using the Bernanke et al (1999) financial accelerator framework, Nolan and Thoenissen (2009) show that shocks to the efficiency of the financial sector play an important role in explaining business cycles in the United States.[96]

DSGE models combining microeconomic and asset price data with macroeconomic variables, such as investment and consumption, further confirm the critical role of imperfections. Gilchrist et al (2009) demonstrate the quantitative importance of imperfections by examining credit spreads on the senior unsecured debt issued by a large panel of non-financial firms. Estimating a DSGE model that links balance sheet conditions to the real economy through movements in the external finance premium (using credit spreads as proxy), they show that rising external finance premia are related to subsequent declines in investment and output. They also show that credit market shocks contributed significantly to US economic fluctuations during 1990–2008. In related studies, Gerali et al (2010) and Atta-Mensah and Dib (2008) incorporate credit risk into standard DSGE models and quantify the role of frictions in business cycle fluctuations.

Studies using DSGE models have also shown how endogenous developments in housing markets can magnify and transmit shocks. Aoki et al (2004) quantify the effects of shocks to housing investment, housing prices and consumption in a model in which houses serve as collateral to reduce borrowing-related agency costs. Campbell and Hercowitz (2009) investigate the impact of mortgage market deregulation in a calibrated general equilibrium framework with borrowing-constrained households. Iacoviello (2005) constructs a model in which households' collateral constraints are connected to real estate, and finds that collateral and accelerator effects are critical in replicating the changes in consumption resulting from movements in house prices.[97] Aspachs-Bracons and Rabanal (2010) report that, while labour market frictions are critical in accounting for the main features of housing cycles in Spain, financial frictions associated with collateral constraints appear less important.

Using a framework in which house prices and business investment are linked, recent studies show how credit constraints affect macroeconomic fluctuations. For example, Liu et al (2013) study the close relationship between land prices and business investment. They focus on land prices because most of the fluctuations in house prices are driven by land prices rather than by the cost of construction (Davis and Heathcote (2007)). They introduce land as a collateral asset in firms' credit constraints and identify a shock that drives most of the observed fluctuations in land prices. Since firms are credit-constrained by land value, a shock to housing demand originating in the household sector triggers competing demands for land between

[96] Other papers employing general equilibrium models (with the financial accelerator) discuss how financial institutions fit into broader real activity, including Christiano et al (2003), Christensen and Dib (2008) and De Graeve (2008).

[97] Guerrieri and Iacoviello (2013) present a model with collateral constraints that displays asymmetric responses to house price changes. In their model, collateral constraints become muted when housing wealth is high (shocks to house prices lead to small and positive changes in consumption and hours worked). However, collateral constraints become tight when housing wealth is low (shocks to house prices translate into negative and large changes in consumption and hours worked). Kannan et al (2012) consider the importance of credit constraints in driving the linkages between house prices and macroeconomic fluctuations. Iacoviello and Pavan (2013) and Iacoviello (2004, 2015) also consider the role of housing markets in explaining business cycles. Wachter et al (2014) present a collection of papers on the role of housing markets during the GFC.

the household and business sectors. This sets off a financial spiral that drives large fluctuations in land prices and strong co-movements between land prices and investment, consumption and hours worked.

Some other studies, using DSGE models, analyse the importance of disturbances in housing markets in explaining certain features of business cycles. Monacelli (2009) shows that a borrowing constraint, where durables play the role of collateral asset, improves on a standard New Keynesian model's ability to match the positive co-movement of durable and non-durable spending and the large response of durable spending to shocks. Davis and Heathcote (2005) show how a multi-sector growth model – with housing affecting household borrowing and spending – matches many empirical facts: consumption, residential investment and nonresidential investment co-move and residential investment is more than twice as volatile as business investment.

Research also shows how disturbances in housing markets can have differential effects on the real economy depending on institutional and other country-specific features. Iacoviello and Minetti (2006b) show that the impact of house prices on borrowing constraints is stronger in countries with more liberalised credit markets. Iacoviello and Minetti (2008) explain the intensity of the broad credit channel of monetary policy with variables capturing the efficiency of housing finance and the type of institutions active in mortgage provision in four European countries. Cardarelli et al (2008) show how housing finance and house price shocks relate to business cycles in OECD countries and that spillovers from the housing sector to the rest of the economy are larger in economies where it is easier to access mortgage credit and use homes as collateral.

### *Financial accelerator and monetary policy*

The financial accelerator mechanism is also critical in understanding one of the major channels of monetary policy transmission. In addition to the direct interest rate channel (ie the effect of interest rate changes on asset prices and, through related channels, consumption and investment), monetary policy affects the real economy through its impact on the balance sheets of corporations and households.[98] This so-called "balance sheet channel of monetary policy transmission" is closely related to the financial accelerator mechanism. Bernanke et al (1999) and Cordoba and Ripoll (2004a), for example, extend the Kiyotaki and Moore (1997) framework to environments with money and investigate the role of monetary policy.

Changes in monetary policy can have much larger effects on real macroeconomic aggregates than those resulting alone from traditional, direct interest rate and asset price channels. Interest rate movements affect the external finance premium and the severity of financing constraints faced by corporations and households because they influence cash flows and balance sheets, including net worth (through asset price effects). To illustrate, contractionary monetary policy is typically associated with a drop in asset prices and thus results in a decline in the net worth of corporations and households. This leads to an increase in their external finance premium and weakens their borrowing ability. This, in turn, constrains their spending on investment and consumption (Bernanke and Gertler (1995)).

[98] For a review of the relevance of the corporate finance literature for monetary policy, see Trichet (2006).

The balance sheet channel of monetary transmission, also called the "broad credit channel", has been studied extensively. A number of papers consider different dimensions of this channel in various settings (see Boivin et al (2011) for a summary of this literature).[99] These papers typically find that monetary policy has an impact on the balance sheets of borrowers and on the distribution of income between borrowers and lenders. A change in policy rates can therefore have an effect on the real economy that is larger than what would be suggested by the direct channels alone. Section 3.5 discusses a similar channel but in relation to the supply side: the bank lending channel, which refers to the effect of monetary policy on the supply of loans.

### *Debate about the importance of the financial accelerator mechanism*

Some studies question the quantitative importance of the financial accelerator mechanism and suggest that other mechanisms might be more important. Chari et al (2007) analyse financial and other frictions with data for the US Great Depression and the 1982 recession. Their results suggest that labour wedges – differences between what firms are willing to pay given the marginal product of labour and what workers are willing to accept in wages given their marginal rate of substitution vis-à-vis leisure – account for most of the fluctuations (see also Buera and Moll (2015)).[100] Meier and Muller (2006) estimate a model with a financial accelerator for the United States, matching the impulse response functions after a monetary policy shock. They claim that financial frictions do not play a significant role. Bacchetta and Caminal (2000), using a stylistic model of credit markets, show that the impact of anticipated productivity and fiscal or saving shocks on output fluctuations is usually not amplified but may rather be dampened because of credit market imperfections.

Other researchers also argue that the quantitative relevance of imperfections associated with credit constraints, such as those studied by Kiyotaki and Moore (1997), can be small. For example, Kocherlakota (2000) shows that the degree of amplification provided by credit constraints depends crucially on the parameters of the economy. In a related paper, Cordoba and Ripoll (2004b) argue that the amplification mechanism in Kiyotaki and Moore (1997) relies heavily on their underlying assumptions. They consider a more standard setting and argue that while collateral constraints can help amplify small unexpected shocks to the real economy, their quantitative impact is small. In his review, Quadrini (2011) also highlights the generally weak amplification of collateral-based financial accelerator models as regards investment, suggesting instead to focus more closely on how financing constraints affect working capital rather than investment.

[99] See, for example, Faia and Monacelli (2007), Iacoviello and Minetti (2008), Christiano et al (2008), Carlstrom et al (2009), De Fiore and Tristani (2011), Eggertsson and Krugman (2012) and Cúrdia and Woodford (2016). Woodford (2011) reviews this abundant literature. Considering balance sheet effects, Taylor (2008) proposes a modified Taylor rule that adjusts the short-term interest rate to observed increases in credit spreads. Kannan et al (2012) provide evidence of how the inclusion of house price movements in the conduct of monetary policy can help stabilise the economy in the face of pressures in the housing market.

[100] Christiano and Davis (2006) claim that the result by Chari et al (2007) is not warranted if spillovers across wedges are taken into consideration (see also Justiniano et al (2010, 2011)). Ajello (2016) finds evidence that a significant fraction of US output and investment volatility is driven by shocks to financial intermediation spreads.

There has also been a vigorous debate about the importance of financial factors in explaining the Great Depression. While Calomiris (1993) and Bernanke (1995), in their review of various factors explaining the Great Depression, clearly come out favouring financial market imperfections, others do not. For example, Cole and Ohanian (2004) and Ohanian (2009) use general equilibrium models to show that labour policies can account for about 60% of the drop in economic activity in the 1930s and that these policies began to reverse when the economy resumed expansion in 1940. This suggests that financial factors did not play such a large role.[101] Chatterjee (2006) presents a short summary of recent studies, including those employing various types of general equilibrium model. A reflection of this intense debate can also be seen in the discussions on the sources of the post-GFC recession (eg Ohanian (2010), Woodford (2010a) and Caballero (2010)).

## 3.4 Financial imperfections in open economies

The macroeconomic implications of financial market imperfections have also been studied in the context of open economy models. Similar to the case of a corporation or household in a closed economy, a country's ability to borrow is affected by its net worth because of imperfections. Obstfeld and Rogoff (2002) argue that the relevance of imperfections is probably even stronger in an open economy context because contracts are harder to enforce and information asymmetries are greater than is the case in a closed economy setting. As a result, limited pledgeability of output and limited verifiability of borrowers' credit quality and actions influence access to international finance more than domestic finance.

The financial accelerator has been shown to be a quantitatively important mechanism in explaining the real effects of financial stress in open economy models. Gertler et al (2007) employ an open economy version of the model by Bernanke et al (1999) to analyse the behaviour of the Korean economy during the 1997–98 financial crisis. They report that the financial accelerator mechanism explains half of the reduction in output and that credit market frictions amplify the adverse effects of the crisis on investment.

Other research considers the relevance of imperfections in different open economy contexts. Aghion et al (2004), Aoki et al (2010) and Ferraris and Minetti (2013) use general equilibrium small open economy models with credit constraints to investigate the impact of various forms of financial liberalisation (of the capital account or credit markets) for fluctuations in output. Caballero and Krishnamurthy (1998, 2001), Paasche (2001) and Schneider and Tornell (2004) show that sharp fluctuations in credit and asset markets translate into boom-bust cycles in emerging market economies (EMEs) because of balance sheet constraints. Matsuyama (2005) finds that differences in financial market imperfections can lead to capital flowing from developing economies to advanced economies.

An important channel through which shocks can affect macroeconomic fluctuations is the external value of collateral required for financing. Mendoza (2010) constructs a small open DSGE model to examine the implications of a variety of shocks – including imported input prices, the "world interest rate" and productivity shocks – for real activity through collateral constraints. His model shows that when

[101] Using a standard New Keynesian model, Eggertsson (2012) argues that the New Deal policies of the Great Depression were helpful in promoting the recovery. These policies were expansionary because they changed expectations (from deflationary to inflationary), thus eliminating the deflationary spiral of 1929–33. This made lending cheaper and stimulated demand.

borrowing levels are high relative to asset values, shocks can be amplified (as in the debt-deflation mechanism of Fisher (1933)) and have a large impact on output as the collateral constraint cuts access to working capital financing (see Korinek and Mendoza (2014)). These findings help explain why the rapid slowdowns or reversals of capital inflows observed in EMEs ("sudden stops") are often followed by financial stress (see Claessens and Kose (2014)).[102]

Another strand of the literature examines the interactions between financial market imperfections and exchange rates. Krugman (1999) and Aghion et al (2000) show that the combination of imperfections and currency mismatches can lead to highly volatile business cycle fluctuations, especially in EMEs. Céspedes et al (2004) use the financial accelerator construct of Bernanke et al (1999) in an open economy model, and find that a negative external shock can have a magnified impact on output because of the effects of a real devaluation on corporate sector balance sheets. In their model, devaluation lowers the real value of assets and adversely affects entrepreneurs' net worth. This leads to an increase in the cost of external credit and, in turn, further constrains investment, thereby amplifying the impact of the initial shock on the broader economy. Cook (2004), using a small open economy model calibrated to reflect the characteristics of East Asian EMEs, shows that a combination of currency mismatches and exchange rate depreciation can increase the cost of capital and reduce investment by adversely impacting firms' balance sheets.

Other studies consider the role of different types of financial market imperfection in general equilibrium multi-country settings. Backus et al (1994), Baxter and Crucini (1995), Heathcote and Perri (2002), Kose and Yi (2001, 2006) and many others have built multi-country models of international business cycles. Many such models, however, feature the assumption of financial autarky (ie countries cannot trade financial assets). Kehoe and Perri (2002) present a model in which the debt capacity of a country is tied to the value attributed by the country to its future access to international financial markets. They show that this mechanism can explain the cross-country output correlations observed in the data. Heathcote and Perri (2014) review the literature on various puzzles related to international risk sharing and allocative efficiency across countries and conclude that, even over the long run, allocations appear inefficient because of capital market imperfections.

The role of financial market imperfections in the transmission of business cycles has also been a fertile area of study. Gilchrist et al (2002) consider a model in which firms face credit constraints in borrowing both at home and abroad, which amplify the international transmission of shocks. Iacoviello and Minetti (2006a) develop a DSGE model where firms face a degree of slack with respect to credit constraints that differs according to whether they deal with domestic versus foreign creditors. They argue that this helps capture the observed co-movements of output. Guerrieri et al (2012) examine the implications of default in a currency union with a model comprising banks that are capital constrained.

[102] Since some countries respond to these risks by building up foreign exchange reserves, such precautionary holdings of foreign, liquid assets could turn sudden stops into low-probability events nested within normal cycles, as observed in the data (Mendoza et al (2009), Borio and Disyatat (2011)). Bianchi (2011) studies the implications of credit constraints for overborrowing in a small open economy DSGE model and concludes that raising the cost of borrowing during tranquil times restores constrained efficiency and significantly reduces the incidence and severity of financial crises. Brunnermeier and Sannikov (2015) study a model in which short-term capital flows could be excessive and be a source of financial stress. Kalantzis (2015) study a two-sector model in which large capital inflows lead to financial crises.

Recent research also examines the role of financial market imperfections in explaining the highly synchronised nature of the GFC. Perri and Quadrini (forthcoming) find that the recession that accompanied the GFC, and its global reach in particular, can be explained by shocks in credit markets. Using a two-country DSGE model, they show that positive shocks affect the real sector as they enhance the borrowing capacity of firms and thereby lead to higher employment and production, although at a lower level of labour productivity. They document that, when countries are financially integrated, country-specific shocks to credit markets affect employment and production in other countries by creating significant business cycle spillovers (see also Kalemli-Ozcan et al (2013) and Quadrini (2014)).[103] Moreover, credit shocks that are different from productivity shocks, tend to generate asymmetric business cycles (ie contractions that are sharper than expansions) and more volatile asset prices.[104]

Shocks originating in financial markets appear to be important in explaining global business cycles, especially during periods of global recessions. Helbling et al (2011) analyse the role of disturbances in global credit markets in explaining business cycles in G7 countries using a set of VAR models. Their results indicate that these disturbances can have a significant impact on output and other macroeconomic variables (Table 3.2). In their analysis, credit shocks, for example, account for roughly 11% of the variance of global GDP. In addition, they report that credit shocks account for about as large a share of fluctuations on their own as standard productivity shocks. Credit shocks explain almost 10% of the variance in global productivity and about 11% of the variations in inflation and interest rates. These shares are also close to those obtained for productivity shocks.

Helbling et al (2011) also undertake a series of counterfactual simulations to examine the evolution of global GDP during the GFC and report that credit shocks played an important role. Figure 3.5 shows the difference between the actual cumulative change in the demeaned global GDP factor and the cumulative change in the simulated value in the absence of a global credit shock during the period ranging from Q3 2007 to Q4 2009. The impact of the shock clearly intensified as the recession spread from the United States to other advanced economies. For example, without the credit shock, the global recession would have been about 10% milder, given the difference between actual and simulated cumulative growth in Q3 2009. The bottom panel of Figure 3.5 compares the contributions of credit and productivity shocks to cumulative global GDP growth based on counterfactual simulations. Credit shocks on their own accounted for a larger share of the cumulative decline in the global GDP factor than productivity shocks (for the role of shocks originating in credit markets, see also Huidrom (2014), Bassett et al (2014) and López-Salido et al (2017)).

[103] Devereux and Yetman (2010) and Dedola and Lombardo (2012) also examine how credit market shocks in DSGE models with financial market imperfections can generate international business cycle spillovers. Kollmann et al (2011) introduce a banking sector in an international business cycle model and study how shocks to this sector can generate global spillovers. Bacchetta and van Wincoop (2016) show that national business cycles can become highly synchronised when the world economy is hit by a global panic shock. Rose and Spiegel (2010, 2011) and Kamin and DeMarco (2012) examine this issue using empirical approaches.

[104] Some recent studies emphasise the importance of various imperfections associated with financial shocks, trade credit, and working capital in explaining the sharp decline of trade relative to output during the GFC (Amiti and Weinstein (2011), Chor and Manova (2012) and Bems et al (2013)).

Variance decomposition: VAR with global factors

Fraction of variance explained by respective shock, in percent — Table 3.2

| Shocks | Forecast horizon (quarters) | GDP | Productivity | Inflation | Interest rates | Credit | Credit spread | Default rates |
|---|---|---|---|---|---|---|---|---|
| Credit | 1 | 8.9 | 6.5 | 6.8 | 9.9 | 14.6 | 9.2 | 15.7 |
| | 4 | 9.7 | 8.8 | 9.2 | 10.1 | 13.9 | 9.5 | 14.9 |
| | 8 | 10.6 | 10.3 | 10.6 | 10.5 | 12.5 | 10.9 | 14.2 |
| | 12 | 10.8 | 10.4 | 10.9 | 10.8 | 12.1 | 11.1 | 13.9 |
| Productivity | 1 | 9.3 | 7.1 | 23.5 | 9.1 | 9.1 | 8.5 | 10.7 |
| | 4 | 10.5 | 9.4 | 19.6 | 10.3 | 11.4 | 9.9 | 12.2 |
| | 8 | 12.1 | 11.0 | 16.6 | 11.8 | 13.3 | 11.4 | 12.5 |
| | 12 | 12.3 | 11.4 | 16.3 | 12.3 | 14.5 | 11.8 | 12.5 |

Note: The roles of credit and productivity shocks in explaining global business cycles are shown using a VAR model that includes the estimated global factor of each variable and US credit spreads and default rates. The table reports the fraction of the forecast error variance of these variables that is explained by global credit and productivity shocks for different forecast horizons. Though both shocks are identified simultaneously, the variance decompositions need not add up to 100% because other potentially unidentified shocks make up the rest of the variance. Credit is measured by the aggregate claims on the private sector of deposit money banks and is obtained from the International Financial Statistics (IFS) of the IMF. The default rate series correspond to the monthly rates for US speculative-grade corporate bonds rated by Moody's Investor Service. GDP data are chained volume series from the OECD. The interest rates correspond to nominal short-term government bill rates and are taken from IFS. Labour productivity is defined as real GDP per hours worked and is obtained from the OECD. Inflation corresponds to the change in each country's CPI. The sample includes G7 countries for the period Q1 1988 to Q4 2009.

Source: Helbling et al (2011).

## 3.5 Financial imperfections: the supply side

The process of financial intermediation arises in part from attempts to overcome imperfections, but it can itself also create amplification and propagation effects. The financial accelerator mechanism discussed in the previous sections explains how changes in borrowers' balance sheet and cash flow positions (and certain other features of borrowers) – the *demand side* of finance – can affect their access to financing and thereby lead to an amplification and propagation of shocks. Some of the same and other, similar imperfections also affect the operations of financial intermediaries and markets – the *supply side* of finance. Together, these imperfections imply that the supply side of finance can by itself be a source of shocks and propagation, leading to specific macrofinancial linkages.

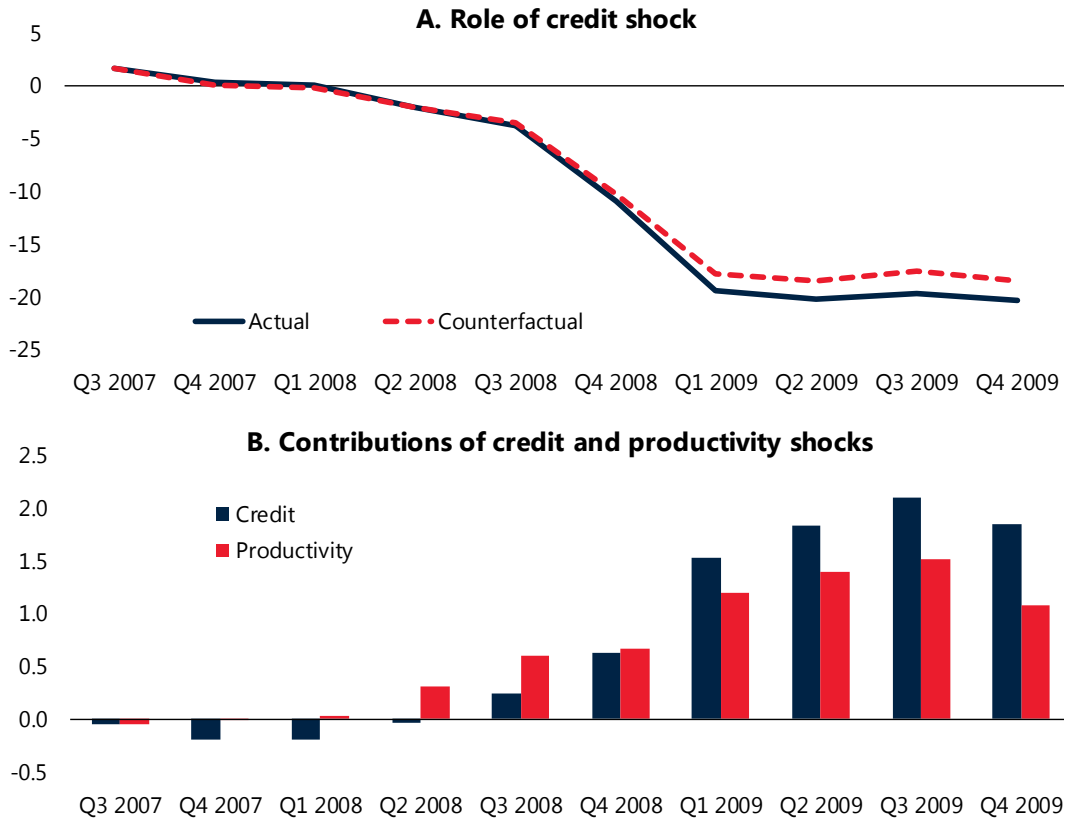
This section presents the three main supply side channels linking financial imperfections to the real economy. The first sub-section analyses the role of *bank lending* in shaping macroeconomic outcomes. Next, the implications of changes in *bank balance* sheets for the real economy are considered. The third one looks at how the channels associated with *leverage, liquidity* and other supply factors can affect real aggregates.

### A. Bank lending channel

The *bank lending* channel, also referred to as the *narrow credit* channel, arises from the special role played by banks in credit extension. As explained in the previous section, certain asymmetric information problems are more likely to be prevalent among households and small firms. This can limit their access to financial services, even when households have adequate income or when firms have projects with reasonably high risk-adjusted returns. Banks invest in information acquisition and

monitoring and can thereby (partially) overcome the problems arising from information asymmetry (and other "contracting" problems).[105] However, during this process, some households and smaller firms may become bank-dependent in that they are unable to substitute with ease other forms of finance for bank loans (or whatever financial services they obtain from a bank). Larger firms, by contrast, may be less affected by such lock-in effects because they are less subject to information asymmetries and do not depend as much on banks. In addition to retained earnings, they can finance investment by issuing equities and bonds in capital markets or by raising other forms of external financing.[106]

Evolution of global GDP: Q3 2007–Q4 2009 Figure 3.5




Note: Panel A compares the results of counterfactual simulations for the global GDP factor during the GFC. The solid line represents the actual global GDP factor and the dashed line represents the counterfactual when the global credit shock is set to zero during the period considered. Panel B compares the contributions of credit and productivity shocks to cumulative global GDP growth based on the counterfactual simulations. The bars represent the median difference. A positive (negative) bar captures how the decrease in the global GDP factor would have been smaller (greater) in the absence of the respective shocks. Credit is defined as the aggregate claims on the private sector by deposit money banks and is obtained from the IFS. Labour productivity is defined as real GDP per hours worked and is obtained from the OECD.

Source: Helbling et al (2011).

[105] Many studies examine the special roles of banks (Freixas and Rochet (2008) and BCBS (2016) review the literature). For example, banks can screen potential borrowers, acquire information on firms' collateral (Rajan and Winton (1995) and Diamond and Rajan (2001)) or directly monitor borrowers' actions in order to prevent problems associated with moral hazard (Repullo and Suarez (2000) and Holmström and Tirole (1997)). Earlier contributions include Brunner and Meltzer (1963) and Bernanke (1983b), and Rajan (1998) provides a comprehensive review of the functions of banks.

[106] Bernanke and Blinder (1988) provide a stylised discussion of the lending channel using an IS/LM type framework. Stein (1998) provides a "micro-founded" adverse selection model of bank asset and liability management that generates a lending channel. For an early overview of the theory and empirical evidence relating to the bank lending channel, see Kashyap and Stein (1994).

Liquidity provision, which takes the form of credit lines and backup facilities (targeted at firms and including capital market instruments, such as commercial paper) is another reason for the special role of banks. Indeed, banks play a special role in maturity transformation and liquidity provision (see Diamond and Dybvig (1983) and Holmström and Tirole (1997)). The traditional function of a bank is to borrow short (eg collect households deposits) and lend long (eg extend loans to firms and mortgages to households). In doing so, a bank provides valuable external financing. Banks also provide liquidity services to firms and households. Through the raising of wholesale funds, for example, a bank can quickly make liquidity available to corporations. Although other financial institutions perform similar functions, the ability of banks to provide liquidity at short notice is not easily matched by other forms of financial intermediation.

The dependence of firms and households on banks for credit and liquidity has consequences for the real economy. Since some firms and households cannot easily substitute for bank loans and liquidity, banks play a central role in the propagation of economic fluctuations. Real and financial shocks affecting banks' ability to lend and provide liquidity then influence the real sector. Shocks can arise from changes in regulation, supervision, technology or preferences. For example, a regulatory change can require banks to keep higher reserves. If they cannot raise funds quickly, banks may need to adjust their lending, an adjustment that is more likely to affect bank-dependent borrowers, such as smaller firms and households. When faced with an adverse shock, a change in lending is also more likely for small banks because of their limited access to other forms of funding (such as certificates of deposit). Since such banks are also more likely to have a higher proportion of bank-dependent clients, it can again disproportionally affect smaller firms and households.

A number of studies have formally analysed the possible general equilibrium effects of the special role of banks. In Diamond and Rajan (2005), banks create value added because they have superior skills in assessing entrepreneurs' collateral and commit to using those skills on behalf of investors by issuing demand deposits.[107] Negative shocks can undermine this role, shrinking the common pool of liquidity and thereby creating spill-overs to other banks and exacerbating overall liquidity shortages. The interbank market, in particular the possibility that it may freeze, is crucial to their model. Other research develops models that also analyse the occurrence of interbank market freezes and the role of such freezes in inducing credit crunches (Freixas and Jorge (2008) and Bruche and Suarez (2010)). Diamond and Rajan (2011) construct a model showing that the possibility of future fire sales means that deep-pocketed investors are willing to buy bank assets only at a low price. With banks preferring to hold on to their assets, the credit crunch is exacerbated.[108]

[107] Holmström and Tirole (1998) represents the pioneering study of the special role of banks in a general equilibrium environment. For models that endogenise the superior skills of banks in collecting entrepreneurs' collateral, see Habib and Johnsen (1999) and Araujo and Minetti (2007).

[108] Gorton and Huang (2004) show how, in an environment in which private investors make inefficient project choices (eg as they cannot accumulate the liquidity needed to buy the assets of distressed financial institutions), the government can provide liquidity and help mitigate such inefficient choices. Lorenzoni (2007) shows that competitive financial contracts can result in excessive borrowing *ex ante* and excessive volatility *ex post* in an economy with financial frictions and hit by aggregate shocks.

The dependence of firms on bank financing influences how monetary policy is transmitted to the real economy through the *bank lending channel*.[109] Monetary policy actions can affect the ability of banks to lend since it influences the supply of funds that a bank has access to – by affecting the availability of deposit funds and its funding costs more generally – and consequently the amount of loans a bank can make. A monetary contraction, for example will act to increase bank's funding costs. This will then induce banks to reduce their supply of loans. The decline in the supply of loans, if not offset by firms and households obtaining other forms of financing, in turn, negatively impacts aggregate output because it constraints households' consumption and (small) firms' investment. The bank lending channel can thus explain why policy rate decisions affect the supply and cost of credit by more than the sole impact of the policy rate move (see Chapter 2 for a discussion of the interest rate channel).

The credit and liquidity roles of banks also have implications for banks' organisation as well as their regulation and supervision (see BCBS (2016) for a review). A unique aspect of banks' maturity transformation and liquidity provision process is their use of demand deposits that are "redeemable" at par and on request.[110] This makes banks vulnerable to liquidity runs (Diamond and Dybvig (1983)). While banks also have access to wholesale funding, as the GFC has shown, this access can be subject to sudden withdrawals too (Gertler et al (2016)). These unique credit and liquidity provision functions and the possibility of runs have implications for the way banks are organised, governed and treated by the government (including through regulation and supervision). It also has implications for the provision of public safety nets and for crisis management.[111]

## B. Bank capital channel

The health of a financial intermediary's balance sheet can influence its lending and other intermediation activities. Balance sheet positions, especially net worth, matter for financial intermediaries just as is the case for non-financial corporations. Net worth has an impact on financial intermediaries' access to funds and their liquidity positions and thereby affects their lending activities. Banks also need to satisfy capital adequacy requirements (whether market- or regulation-driven). Given the costs associated with

[109] Early surveys of the literature on the bank lending channel include Bernanke (1993), Bernanke and Gertler (1995), Cecchetti (1995), Hubbard (1995) and Peek and Rosengren (1995a). As discussed later, there are also studies highlighting the importance of risk-taking by banks in their lending decisions (eg Disyatat (2011) and Borio and Zhu (2012)).

[110] A number of studies (Calomiris and Kahn (1991), Kashyap et al (2002), Diamond and Rajan (2001) and Huberman and Repullo (2014)) explain why banks fund themselves with short maturities given those risks. These models generally rely on the disciplining features of short-term debt and the beneficial tension between making illiquid loans to borrowers and providing liquidity on demand to depositors. While other intermediaries, such as money market funds, are also vulnerable to runs, as seen during the GFC (Schmidt et al (2016) and Covitz et al (2013)), they generally do not lend and take short-term on-demand deposits at the same time. They are also thought to be "less special," in that their intermediation functions can be more easily replaced, although the GFC raised questions about such an assumption.

[111] Some of these issues are discussed further in Claessens and Kose (2014). Acharya et al (2011a, 2011b) model "freezes" in the market for bank assets. In their models, depending on the information environment and the nature of liquidation costs, small shocks can lead to sudden interruptions in financial institutions' ability to roll over their *liabilities. Bank liquidity may also be countercyclical, that is, inefficiently high during booms but excessively low during crises,* making *interventions to resolve banking crises desirable ex post but not ex ante (Farhi and Tirole (2012)). See further Tirole (2011) for a review of various aspects of illiquidity and Holmström and Tirole (2011) for an extensive analysis of (private and public) forms of liquidity.*

raising new capital quickly on the open market, a bank's net worth depends over the short run on changes in the quality of its loan portfolio and the value of its other assets, including securities.

Consequently, changes in the value of a bank's assets will affect its access to and cost of funding and its ability to make new loans. A decline in loan quality, for example, or a fall in the value of tradable assets, can lead to a drop in a bank's capital. This can make its funding more costly or make its capital adequacy requirements binding, forcing the bank to shrink its loan book. When these shocks take place simultaneously at many banks, they can lead to systemic consequences, especially when alternative sources of external financing are limited.

These effects can be a source of aggregate cyclical fluctuations through what has been called *the bank capital channel* (Greenwald and Stiglitz (1993); see Borio and Zhu (2012) for further references). When many banks are affected by the same capital shock, aggregate effects can occur. For example, during a recession, the quality of bank loan portfolios tends to weaken, adversely impacting banks' balance sheets. In order to shore up their relative capital positions (as desired by the market or to satisfy regulatory requirements) – but unlikely to be able to raise capital quickly – banks may need to tighten their lending standards and reduce the volume of risky credit they provide.[112] Since borrowers who rely on banks for their external funding needs have a limited set of alternatives, this can lead to a slowdown in economic activity, or even a recession, with a higher proportion of non-performing loans and deteriorating bank balance sheets. The decline in bank lending induced by such a "capital crunch" can affect (and interact with) economic activity through various channels (see Bernanke and Lown (1991), Holmström and Tirole (1997), Repullo and Suarez (2000) and Van den Heuvel (2006, 2008)). With this mechanism, a strong link can arise between bank capital, the supply of bank financing and macroeconomic outcomes.

The interaction between bank capital and firm liquidity matters in various ways, especially when firms are locked into credit relationships with banks. Den Haan et al (2003) and Minetti (2007) show that a capital crunch can induce firms to abandon high quality projects or break up credit relationships. Thus, a capital crunch depresses not only the volume of investment but also its average productivity. Chen (2001) shows that a capital crunch can cause a drop in asset prices (eg real estate), which can, in turn, have feedback effects, including a contraction in bank capital. Minetti and Peng (2013) investigate the mechanics of the bank capital channel in an open economy model (calibrated for Argentina) and show that real interest rate shocks generate large fluctuations in output and real estate prices.

Some recent studies employing DSGE models help gauge the quantitative importance of the bank capital channel. Gertler and Kiyotaki (2011, 2015) and Gertler and Karadi (2011, 2013) develop models that exhibit moral hazard in the financial sector and thus provide a role for bank capital. They find that, under reasonable assumptions about efficiency costs, banks limit their deposit taking in response to a decline in net worth. These studies also explore how unconventional monetary policy (UMP) – specifically direct intervention in credit markets – can attenuate the bank capital channel. Christiano and Ikeda (2013) show how these and other models with financial frictions allow for quantitative analyses of the channels by which

[112] Repullo and Suarez (2013) provide a model in which banks are subject to regulatory capital requirements and have limited access to equity markets. Gorton and Winton (2017) present a general equilibrium model to study the private and social costs of bank capital.

unconventional policies can affect financial and economic outcomes in times of financial stress. They find that the net welfare benefits of such intervention during a financial crisis is large and increases with the severity of a crisis.[113]

The bank capital channel also matters for the conduct of monetary policy. Monetary policy may have a limited impact (including through the bank lending channel) when shortfalls in bank capital constrain loan supply and already dampen economic activity. The potency of the bank capital channel also hinges on the degree to which non-bank financial institutions may be capital-constrained (or otherwise) themselves and the extent to which firms and households are bank-dependent (Gilchrist and Zakrajšek (2012)). Even well developed and adequately capitalised non-banks may not be able to offset a decline in banks' supply of loans since their financing can be imperfect substitutes for bank loans. This means that, in practice, central banks consider the state of all intermediaries' balance sheets (even though they tend to focus on those of banks).

## C. Leverage and liquidity channels

Leverage, defined as the ratio of total assets to shareholder equity, has received much attention recently because of its role in the GFC. Fluctuations in the leverage of financial institutions (and other agents) relate to changes in asset prices through both simple accounting and the behaviour of agents. The basic accounting relationship between movements in asset values and changes in leverage is negative, ie rising asset prices boosts net worth and thereby makes measured leverage drop, ie leverage is countercyclical. Similar to the financial accelerator mechanism, this means that financial institutions and other agents can fund themselves easier in times of rising asset prices, and consequently lend more to others, even without raising their leverage.

In practice, as Adrian and Shin (2008) show, leverage is not countercyclical (or even acyclical), but procyclical, at least for broker-dealers; it increases when asset prices rise and falls when asset prices decline. And, in financial markets, as Geanakoplos (2010) shows, margins (or haircuts), which dictate the share of financing available for a unit of collateral, are procyclical too, ie lower during booms and higher in busts. While the exact mechanisms remain unclear, many attribute this procyclicality to perverse incentive structures, incomplete corporate governance arrangements, herding behaviour and other agency issues (see Borio et al (2001); Claessens and Kodres (2017)).

As leverage fluctuates, it affects the supply of financing. When leverage is high, supply can be expected to be more ample since it means that intermediaries face fewer constraints in credit extension. Conversely, when leverage is low, financing tends to be more constrained. When a number of financial institutions exhibit acylical or procyclical leverage rather than countercyclical leverage, aggregate financing and liquidity conditions are affected. This behaviour leads to a feedback effect: stronger balance sheets fuel greater demand for assets and this, in turn, raises asset prices and further strengthens balance sheets and demand for assets.

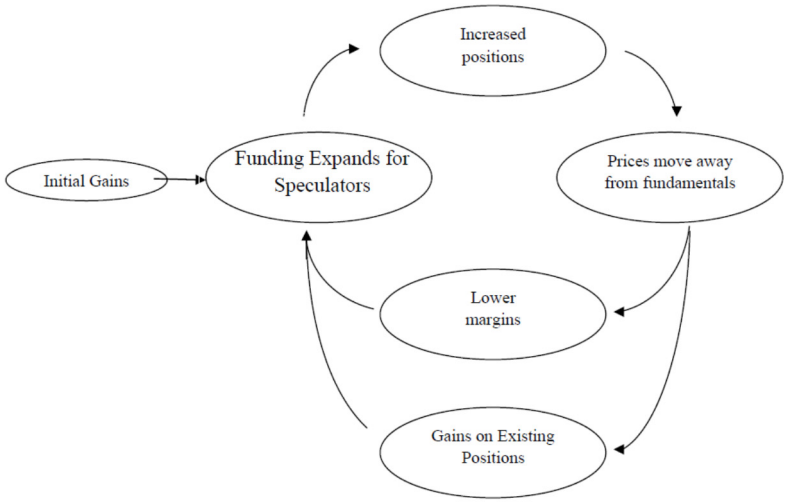
Consequently, since there is more, rather than less – as in other markets – buying of an asset when its price rises, leverage does not necessarily decrease during an asset

[113] There is a large literature on the effectiveness of UMPs that uses various approaches, see Eggertsson and Woodford (2003), Krishnamurthy and Vissing-Jorgensen (2011), Farmer (2012), Woodford (2012b), Bauer and Rudebusch (2014), Baumeister and Benati (2013), Swanson and Williams (2014), Arteta et al (2015, 2016), World Bank (2015a), Farmer and Zabczyk (2016), and Borio and Zabai (2016).

price boom and can even increase (Drehmann and Juselius (2012) document that, while in practice increases in market values outstrip debt increases at the aggregate and sectoral level, there is procyclicality). Conversely, during a bust, the mechanism works in reverse, balance sheets weaken due to asset price drops, leverage decreases and pressures arise to curtail the supply of financing. In turn, this leads to additional declines in asset prices, possibly affecting a broader array of institutions and activities, further weakening balance sheets and reducing leverage. These reductions in leverage can also be associated with increases in asset price volatility, which is in part related to the arrival of adverse information (Fostel and Geanakoplos (2012)). Figures 3.6A and 3.6B summarise conceptually the mechanisms and dynamics of the leverage cycle during upward and downward phases.[114]

Conceptual representation of liquidity and leverage cycles: gains

Virtuous circle — Figure 3.6A




Note: The figure depicts a situation where initial gains trigger a virtuous loop of increased asset prices and further gains. The underlying mechanism is similar to that of the financial accelerator where higher asset prices lead to increases in capitalisation, which then enhances the demand for assets, (further) driving up prices. The mechanism is in part reinforced by lower margins/haircuts on assets used as collateral, which allows for greater leverage.

Source: Brunnermeier and Pedersen (2009).

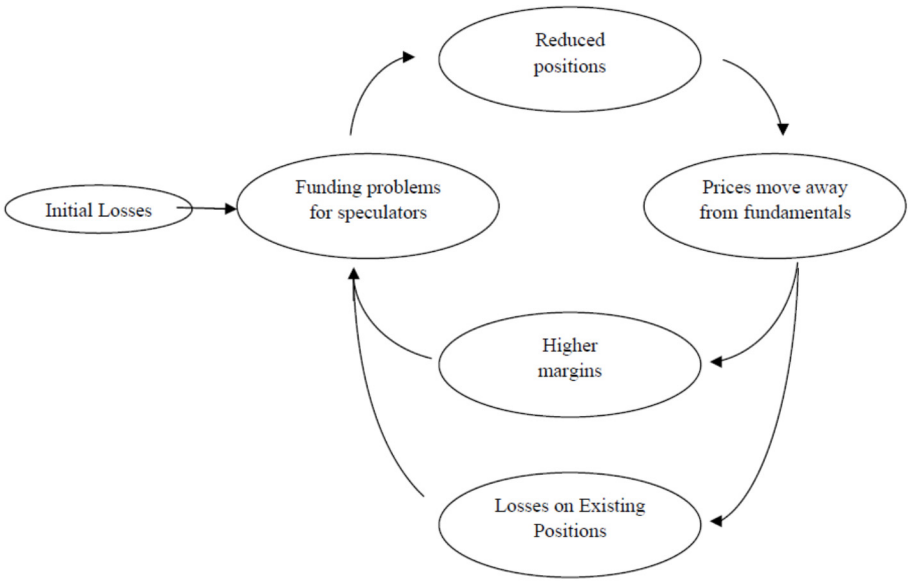
The leverage channel operates in ways that are very similar to the bank capital channel (see Adrian and Shin (2011a)). The difference is that the aggregate leverage channel is not limited to banks or related to the special nature of banking. Rather, it can operate at the level of the overall financial system, when the various actors (including hedge funds, institutional and other investors) experience limits on their

[114] The leverage cycle can relate to the presence of asset price bubbles, which can be rational or irrational. Either type can be welfare enhancing or reducing (see further Chapter 2 on asset bubbles). Nuño and Thomas (2017) document that leverage has contributed more than equity to fluctuations in total assets and that it is positively correlated with assets and GDP but negatively correlated with equity (see also Halling et al (2016)). He and Krishnamurthy (2013) develop a model of financial intermediaries to study the linkage between risk premia and leverage.

ability to undertake transactions. It can also affect the so-called shadow banking system.[115]

Conceptual representation of liquidity and leverage cycles: losses

Virtuous circle Figure 3.6B




Note: The figure depicts a situation where initial losses initiate a vicious circle of declining asset prices and losses. The underlying mechanism is that of a fire sale, which is essentially the forced sale of an asset at a dislocated, low price. It is in part triggered by an increase in the margins/haircuts on assets used as collateral, which allows for reduced leverage.

Source: Brunnermeier and Pedersen (2009).

The leverage channel can lead to more pronounced financial and business cycles, possibly associated with bubbles and other asset price anomalies. Because of the net worth and other related balance sheet channels, changes in leverage affect asset prices and influence the availability of external financing for all types of borrower. In other words, the degree of leverage becomes an indicator of the buoyancy of external financing and risk-taking. Through feedback effects, such as changes in asset prices, the leverage channel can then lead to stronger two-way linkages between the real and financial sectors. The leverage channel is also closely related to the overall state of liquidity, with asset prices possibly deviating from "fundamentals" over the leverage cycle (see Shleifer and Vishny (1997) and further Box 3.2).[116]

[115] See Adrian and Ashcraft (2016) for an overview of the shadow banking system, its growth and functioning; Claessens et al (2012b) for a review of the functions performed by shadow banking systems; Gennaioli et al (2013), Gertler et al (2016) and Begenau and Landvoigt (2017) for analytical models of shadow banking; and Gorton and Ordoñez (2013) on how an economy can become fragile if it relies extensively on privately-produced safe assets, such as those generated by shadow banking. See further Gorton (2017) and Golec and Perotti (2017) for reviews of the literature on safe assets with a domestic focus and Gourinchas and Rey (2016) for an analysis of the role and effects of safe assets globally.

[116] Bruno and Shin (2015) study the dynamics linking monetary policy and bank leverage. They construct a model of the risk-taking channel of monetary policy in an international context. The model rests on a feedback loop between global banks' increased leverage and capital flows amid currency appreciation for capital recipient economies. It shows that adjustments to leverage act as a linchpin between fluctuations in risk-taking and monetary transmission.

Box 3.2

## Understanding liquidity and leverage cycles

Liquidity, a key concept for macroeconomic and financial developments, is difficult to define, in part as it is multi-faceted (see further Holmström and Tirole (2011) and Tirole (2011)). Liquidity is often considered in relation to the price of credit. It can correspondingly be measured by short-term interest rates, with lower rates being associated with ampler liquidity. While the underlying theoretical motivations are not always entirely clear, some studies also employ quantity-based measures – such as the aggregate quantity of money or "excess" money growth (money growth less nominal GDP growth). Both concepts tend to move in the same direction. They are also closely related to the monetary transmission channels of interest rates and asset prices.

Narrower definitions of liquidity in the finance literature relate to the tradability of specific assets while broader definitions refer to banks' role in liquidity provision. A liquid asset is said to have the following features: it can be sold rapidly, with minimal loss of value (close to the true present value of its discounted cash flows) within a short period of time (minutes or hours). Conversely, an illiquid asset is not readily saleable. This type of liquidity depends on various factors. For example, an asset can be illiquid because of uncertainty about its value or because there is no market in which it can easily be traded. Liquidity creation is also seen as a core function of banks (see Bouwman (2014) for a review of the literature on (private) liquidity creation by commercial banks and its regulation).

Recently, the literature has introduced new classifications of liquidity formally. Specifically, Brunnermeier and Pedersen (2009) categorise liquidity into two forms: *market* and *funding liquidity* (among practitioners these concepts had been familiar for some time; see for example Borio (2000, 2004)). *Market liquidity* is defined as the ease with which money can be raised by selling assets at reasonable prices. A liquid (or deep) market is one with willing buyers and sellers at all times for large quantities and with orders that are not strongly influencing prices (the probability that the next trade is executed at a price equal or close to the last one is high; see Vayanos and Wang (2013) for a review of the theoretical and empirical literature on market liquidity).

*Funding liquidity* describes the ease with which financial institutions, investors or arbitrageurs can obtain funding. It is high, ie markets are "awash with liquidity", when it is easy to raise money. Funding liquidity is affected by the strength of fund-seekers' balance sheets and cash flows. This strength is, in turn, affected by asset prices: when collateral values are high (and/or rising) and margins are low, funding liquidity can be ampler (as in the case of repos). As such, market and funding liquidity are closely related. And, there is a strong parallel to the financial accelerator mechanism of Kiyotaki and Moore (1997) that focuses on how changes in asset prices affect firms' ability to raise external financing.

Liquidity can be influenced by two distinct leverage spirals: the valuation and the margin/haircut spirals, both of which relate to the soundness and funding positions of financial institutions. The *valuation spiral* is driven by asset price effects. If many financial institutions suffer a similar shock – say a drop in the value of mortgage-backed securities – all of them have to cut back their asset positions. This depresses asset prices further, leading to an additional erosion of capital, which then forces institutions to cut back on their positions even more. With mark-to-market accounting rules and market discipline, leveraged financial institutions cannot defer these losses individually. Moreover, when markets are illiquid, selling assets depresses prices further.

The *margin/haircut spiral* can come on top of the *valuation spiral*. It arises when many institutions finance their asset positions with (short-term) borrowed money (repos) and have to put up margins in cash or are imposed a discount (haircut) on the assets they provide as collateral. These margins/haircuts increase in times of price declines – as lenders want better protection – and thereby lead to a general tightening of lending conditions (margins and haircuts implicitly determine the maximum leverage that a financial institution can adopt). The margin/haircut spiral then reinforces the valuation spiral in forcing institutions to reduce their leverage.

These mutually reinforcing effects create virtuous or vicious cycles, with real economic impacts. Brunnermeier and Pedersen (2009), Adrian and Shin (2008, 2010a) and Geanakoplos (2010) point out how these mechanisms can affect liquidity and leverage, which, in turn, affect financial and economic cycles. During a virtuous cycle, these mechanisms can lead to rising asset prices (even bubbles). In a vicious cycle, they can create fire sales. Importantly, these cycles can be triggered by relatively small shocks. In particular, even a temporary lack of liquidity may create adverse effects for a highly leveraged financial institution. Liquidity shocks can also be aggravated through various channels, including the hoarding of funds, runs on financial institutions and network effects (via counterparty credit risk). Because of these spirals, small shocks can force the economy into a process of deleveraging and fire sales. This can have a substantial impact on the real economy, as happened during the Asian financial crisis of the late 1990s and the GFC (see Shleifer and Vishny (2011) for a review of the literature on fire sales and macroeconomics).

Recent studies examine the interaction between leverage and boom-bust cycles through the lens of externalities. Lorenzoni (2008) and Jeanne and Korinek (2010) model how firms that set leverage during booms do not account for the impact that their leverage has on the price of collateral assets during busts (see also Dávilla and Korinek (2017)). Such externalities can, in turn, lead to excess leverage. Other studies emphasise the role of strategic interactions and complementarities among banks in pursing collectively risky strategies *ex ante* (Farhi and Tirole (2012)) and inducing credit crunches *ex post* (Rajan (1994) and Gorton and He (2008)).[117]

## 3.6 Evidence relating to the supply side channels

The supply side of finance can have a significant influence on macroeconomic outcomes through various mechanisms. Empirical evidence suggests that the behaviour of financial institutions can have an impact on the supply of external financing and overall liquidity. Studies also show that supply side factors can affect the evolution of asset prices, with the potential for virtuous and vicious feedback loops between real and financial markets. In addition, recent research documents that the supply side can influence macroeconomic outcomes through deleveraging and liquidity hoarding, especially during periods of financial stress. While it is hard to separate empirically the roles of different channels – liquidity shortfalls, for example, are often related to adverse shocks to capitalisation – this section attempts to survey the empirical literature relating to these three channels.

### A. Bank lending channel

The bank lending channel has been extensively studied empirically, at least as regards the effect of changes in bank liquidity conditions. There is intense debate about whether this channel can be identified with macroeconomic data – given the difficulty of separating factors driving demand from those driving supply. Some studies look at credit market indicators, such as the ratio between bank lending and commercial paper, showing that tighter monetary policy leads to a decline of the ratio (Kashyap et al (1993) and Ludvigson (1998)). Oliner and Rudebusch (1996) argue that a change in the mix of finance can capture the bigger decline in the amount of credit granted to small firms compared with large firms. Others question the potency of the bank lending channel in relation to monetary policy, especially for the United States. Some studies argue that since banks can accumulate deposits by issuing money market liabilities, such as certificates of deposits, monetary policy has a limited impact on bank lending (see Romer and Romer (1989) and Ramey (1993)). A number of studies, though, find evidence supporting the relevance of the bank lending channel.[118]

Other work finds that the bank lending channel plays a role for small banks but has a limited overall impact. Kashyap and Stein (2000), using US bank data, find the impact of monetary policy on lending to be stronger for banks with less liquid balance sheets, with the pattern largely attributable to smaller banks. This evidence supports the bank lending channel since these banks are likely to have fewer external financing

[117] Other research aimed at understanding how externalities can carry the seeds of ensuing busts includes Dell'Ariccia and Marquez (2006) who show how lending standards tend to weaken during booms as adverse selection is less severe and lenders find it optimal to weaken screening and lending standards (with the objective of trading quality for market share). This leads to deteriorating portfolios, lower profits and a higher probability of a downward correction.

[118] See Gertler and Gilchrist (1993, 1994), Friedman and Kuttner (1993), Kashyap and Stein (1995), Peek and Rosengren (1995b) and Kakes and Sturm (2002).

options. Others question this view (Bernanke (2007)). Given the growing depth and variety of capital markets, they argue that even small banks have gained access to a multitude of funding sources in addition to retail deposits. Moreover, even if the bank lending channel is important for smaller banks, these banks constitute only a minor share of total US lending. Consistently, Lown and Morgan (2002) report results suggesting that while bank lending may play an important role in macroeconomic fluctuations, the magnitude of the bank lending channel for monetary policy changes may be quite small.

Empirical evidence also suggests that the importance of the transmission channels varies by type of loans and changes over time. Recent studies of the bank lending channel attempt to establish which types of bank loan are more likely to be affected by nominal or real shocks. Den Haan et al (2007), employing a reduced-form VAR model to identify monetary policy shocks, find that after a monetary tightening, real estate and consumer loans decline sharply while commercial and industrial (C&I) loans respond positively and often significantly. By contrast, after a non-monetary negative shock, C&I loans decline sharply, while real estate and consumer loans display no decrease. Boivin et al (2011) report that US transmission channels have evolved over time due to structural changes in the economy, particularly in credit markets, and changes in the relationship between monetary policy and expectations formation. As a consequence, monetary policy innovations have had a more muted effect on real activity and inflation in recent decades relative to before 1980.

The potency of this channel also varies across countries and appears to be more influential in bank-dominated systems. In market-based systems, such as those of the United States and the United Kingdom, where the role of capital markets is relatively important, firms and households enjoy a variety of external financing alternatives whereas in bank-based systems, such as those of Germany and Japan, fewer options exist. This implies that the bank lending channel is expected to be more influential.

Evidence from outside the United States appears indeed to be more clearly supportive of the bank lending channel. Research relating to some European countries show that banks play a more prominent role in financial intermediation (see Ehrmann et al (2003) and Iacoviello and Minetti (2008)). Jiménez et al (2012) use Spanish data on loan applications and loans granted and find that tighter monetary conditions and worse economic conditions weaken loan extension (especially to firms). This is also the case for lending from banks with lower capital or liquidity ratios. Their results suggest that firms cannot offset the impact of credit restrictions by simply switching to other banks (or other forms of financing). The channel might be weakening over time though, as many financial systems have become more market-based (Altunbas et al (2010), Claessens (2016)).

## B. Bank capital channel

A number of studies find empirical support for the bank capital channel, especially during periods of substantial capital shortage, leading to so-called credit crunches. For example, Lown and Morgan (2006) show for the United States that surveys of senior loan officers, which partly reflect supply conditions, provide significant explanatory power for US real activity. De Bondt et al (2010) show how similar lending surveys, especially those relating to enterprises, are a significant leading indicator of bank credit and real GDP growth in the euro area. Some studies report that credit losses at commercial banks had some, albeit not large, regional effects on the US recovery from the 1990–91 recession (Bernanke and Lown (1991), Hancock and

Wilcox (1993, 1994), Berger and Udell (1994) and Peek and Rosengren (1994)).[119] These studies found multipliers, that is the effect of a 1% change in bank capital on the percent change in lending, ranged from 1.5 to 2.7. Ashcraft (2006) also found some small effects of variations in commercial bank loans on real activity in normal times. Gambacorta and Marques-Ibanez (2011) show that weaker banks in the United States and Europe restricted loan supply more strongly during the GFC than other banks.

Other studies document varying effects. Bayoumi and Melander (2008) employ a VAR model and report that an exogenous fall in the bank capital/asset ratio of one percentage point reduces real US GDP by some 1.5% through weaker credit availability. Moreover, an exogenous fall in demand of 1% of GDP is gradually magnified to about 2% through financial feedback effects. Greenlaw et al (2008) regress the log difference of GDP on the lagged four quarter (log) change of domestic non-financial debt, using as instruments TED spreads and lending standards. They find a change in credit growth of 1% to affect real GDP growth by about 0.34% in the short run and 0.47% in the long run. By contrast, Berrospide and Edge (2010), who update studies from the early 1990s using panel regression techniques, find a modest effect on lending: capital shortfalls affect the extension of new loans with a range of 0.7% to 1.2% and not significant changes in GDP growth (however, in a VAR setting they do find bank capital shocks to affect GDP growth up to 2.75%). Francis and Osborne (2010) also report a smaller effect for UK banks.

Effects can vary by bank capitalisation and by the state of the business/financial cycles. Bernanke (1992) and Meh and Moran (2010) find that the health of banks plays an important role during recessions and subsequent recoveries because bank capital can (or cannot) cushion shocks (see also Berger and Bouwman (2013)). Other studies also find a greater role for bank capital during periods of significant credit losses or outright shortages of bank capital. Some report that during such periods, weakly capitalised banks limit their lending much more than highly capitalised banks (Peek and Rosengren (1995b) and Woo (2003)). In a related paper, Ashcraft (2005) finds, however, that it is the closure of commercial banks rather than shocks to their capital base that leads to large and persistent negative effects on real output. He reports a decline in real income growth of about 3% to 6% in counties where subsidiaries of failed US banks are located.

Sectoral and event-based studies provide more direct (and sometimes clearer causal) evidence linking bank capital to economic fluctuations. Calomiris and Mason (2004) find that bank loan supply shocks have an impact on local area income over the 1930–32 period, using as instrument variables measured at the end of 1929 (before the Great Depression produced changes in bank loan foreclosures and net worth). Peek and Rosengren (1997, 2000) find a response of up to 3% in semiannual lending growth by Japanese branches in the United States in response to a decline of one percentage point in the capital of parent banks, which, in turn, has consequences for real activity. Since they also use instrumental variables for lending (asset quality and bank capitalisation of Japanese parent banks as well as changes in land prices in Japan), they can claim evidence of causality (see also Haltenhof et al (2014)).

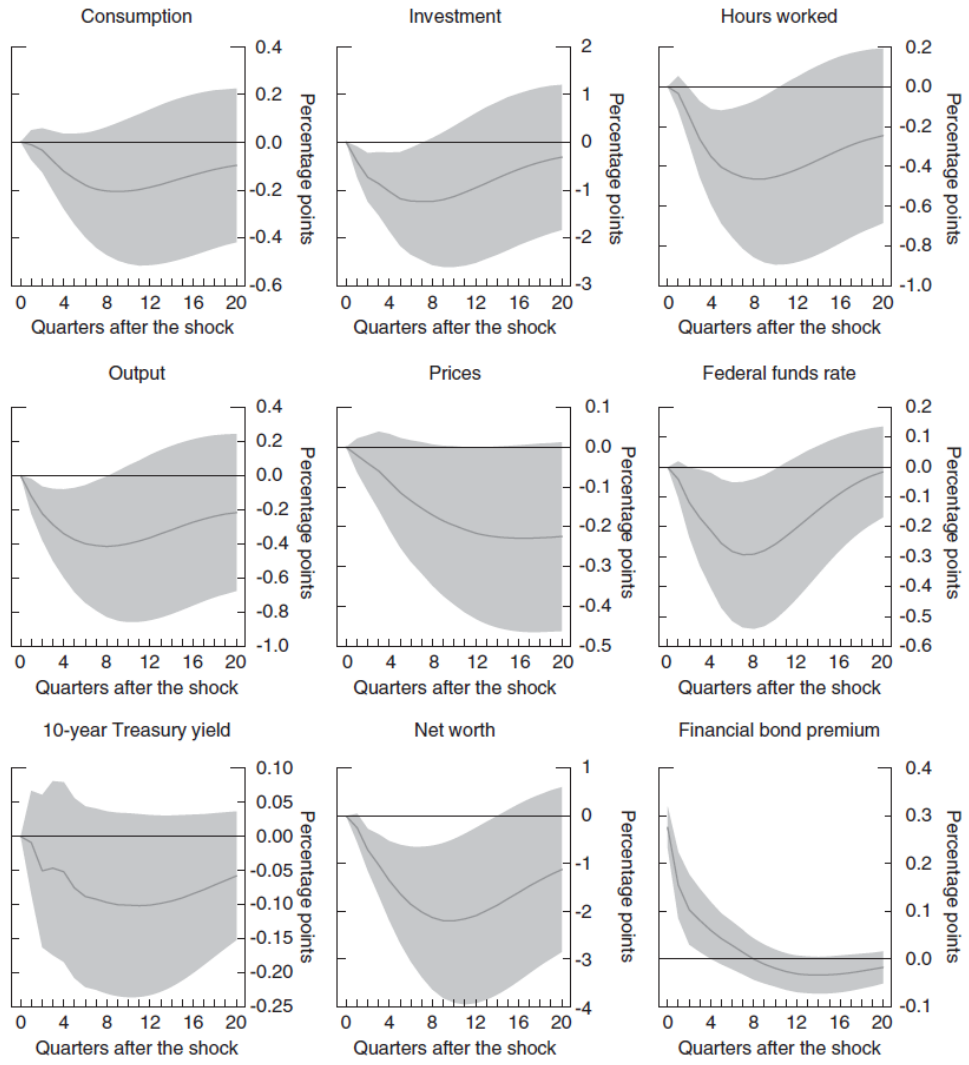
Firm-focused and other microeconomic research also lends support to the important role played by bank capital. In particular, loans from banks that have a weak capital base are more sensitive to changes in market interest rates than loans from

[119] Hancock and Wilcox (1994) investigate the impact of the bank capital channel on the US housing market and find significant effects of the early 1990s capital crunch on commercial and residential real estate activity.

better capitalised banks (Kishan and Opiela (2000, 2006) and Gambacorta (2005)). Conversely, bank capital matters for the conduct of monetary policy (Gambacorta and Shin, forthcoming). In addition, evidence suggests an inverse relationship between bank capital and the interest rate charged on loans, even after accounting for the characteristics of borrowers, banks and various contract terms (Hubbard et al (2002)). Using firm-specific data on the use of bank debt and public bond financing from 1990 to 2014, Becker and Ivashina (2014) show that the close link between bank credit supply and business cycle evolution is driven by external financing/supply effects and especially impacts small firms. Conversely, Laeven and Valencia (2013) and Giannetti and Simonov (2013) find important positive effects of bank recapitalisations on the growth of firms' real value added and borrowing.

Macroeconomic implications of financial shocks

Figure 3.7




Note: The figure depicts the impulse response function of a nine variable VAR model to a one standard deviation orthogonalised shock to the financial bond premium over the period Q1 1985 to Q2 2010. Shaded bands denote 95% confidence intervals based on 1000 bootstrap replications.

Source: Gilchrist and Zakrajšek (2011).

Some recent studies with DSGE models have incorporated capital shortfall shocks to the supply of finance. Jermann and Quadrini (2012), after documenting the cyclical

properties of US firms' financial flows, show how adding financial shocks to a model with standard productivity shocks can much better explain movements in real and financial variables, including during periods of financial stress. Financial imperfection arises in their setup from the limited ability of firms to borrow (due to an enforcement constraint). Gilchrist and Zakrajšek (2011) show in a DSGE model how credit spreads for financial institutions, likely related to their soundness, significantly impact US business cycles during the period 1985–2010 (Figure 3.7).[120]

## C. Leverage and liquidity channels

Financial system leverage is often procyclical. There is much empirical evidence relating to leverage and liquidity mechanisms during booms, including the recent ones in advanced countries. During the early to mid-2000s, the rapid increase in asset prices in the United States and in other advanced countries led to more abundant liquidity and allowed for greater financial sector leverage. This, in turn, led to a greater supply of external financing and further asset price increases, creating a virtuous cycle, with increasing asset prices and higher collateral values. For the United States, Adrian and Shin (2008, 2011b) show that this procyclical behaviour of leverage was more prevalent among broker-dealers, while households, non-financial non-farm firms and commercial banks exhibited less or no cyclicality (Figure 3.8).

Some of these effects also operate in an international context. Shin (2012), Gourinchas (2011) and Rey (2015) highlight how changes in liquidity intermediated globally by banks (and interacting with global imbalances and monetary policy in key countries, notably the United States) can lead to more pronounced and synchronised national cycles, as witnessed very clearly before, during and after the GFC.[121]

There is also ample evidence pertaining to the leverage cycle during busts, which relates to the increase in margins (haircuts) charged on collateralised lending. In the fall of 2008, as the cycle swung down, asset prices declined and financial institutions incurred large capital losses. Funding and leverage constraints forced institutions to sell off (securitised) assets. Not just investment banks, but also commercial banks that relied less on core deposits and equity financing, had to cut back lending as their funding and balance sheet positions were strained (Cornet et al (2011)). These fire sales were associated with higher margins (or haircuts). Geanakoplos (2010) shows that haircuts on repurchase agreements (repos) increased from 10% at the end of 2006 to more than 40% when the GFC started (see also Gorton and Metrick (2010)). The sharp increase in haircuts meant that banks had less collateral to offer and had to absorb more losses. In turn, this forced banks and other financial institutions to

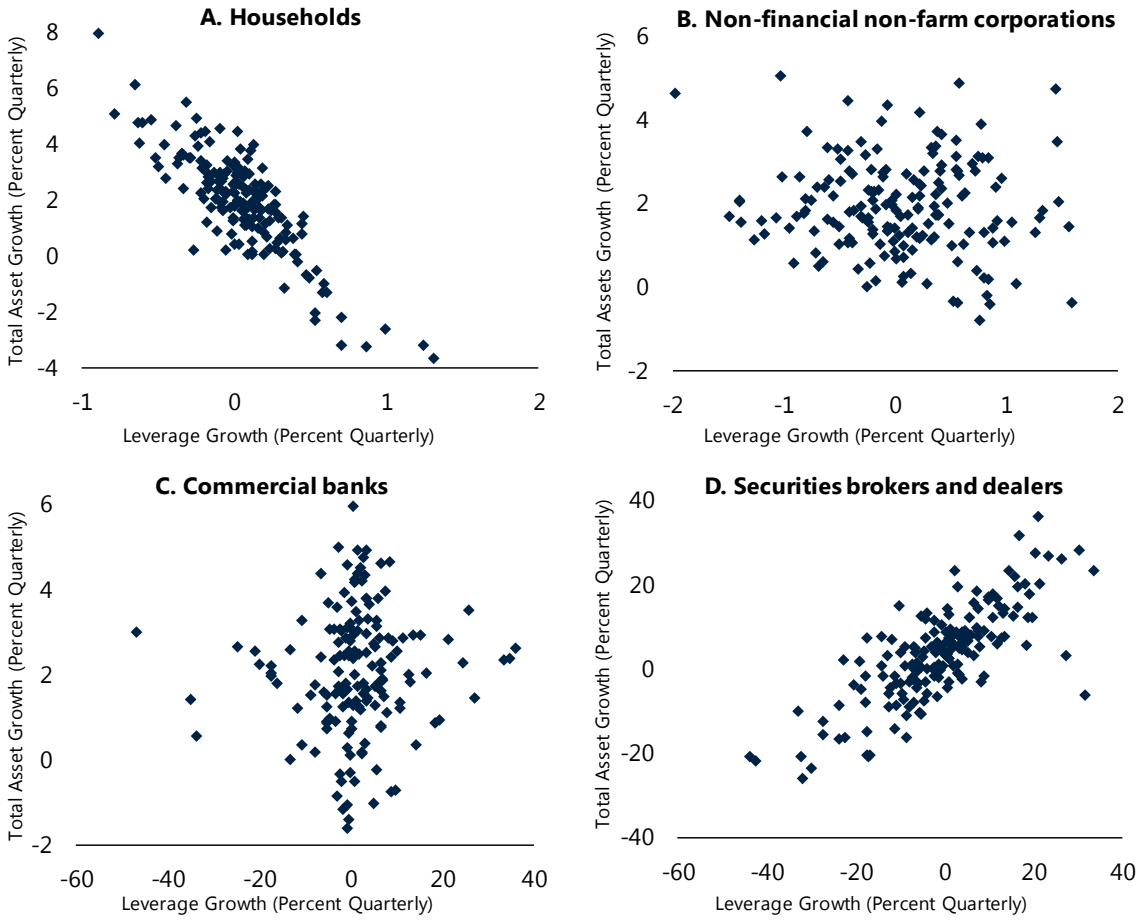
[120] The potency of the bank capital channel also depends on accounting standards and the recognition of capital losses. In particular, the speed at which loan losses are recognised in banks' balance sheets and, consequently, their capital positions, determines in part the pace at which banks may amplify negative aggregate shocks by cutting back on lending. At the same time, the lack of prompt recognition of loan losses may distort banks' incentives, inducing them to direct funds to inefficient borrowers. Caballero et al (2008b), for example, find evidence that the limited recognition of capital depletion in Japanese banks slowed Japan's recovery from the early 1990s recession.

[121] See also Cerutti et al (2017a) on the role of global factors in driving capital flows and Cerutti et al (2015) on how dependence on specific lenders and investors can affect countries' exposure to such global factors. See also Cerutti et al (2017b) for a recent empirical assessment. Landau (2013) and Hartmann (2017) provide general reviews of global and international liquidity, as provided by the private sector or by central banks, and how it relates to the designs of the international monetary and financial systems.

shed assets, further depressing prices, which led to even greater capital and funding problems.[122]

## Total assets and leverage

Leverage and asset growth move together for securities brokers and dealers — Figure 3.8




Note: Panel A plots the quarterly changes in total household assets to quarterly changes in household leverage as extracted from the US Financial Accounts (formerly called Flow of Funds). Panel B plots the change in leverage and change in total assets of non-financial, non-farm corporations drawn from the US Flow of Funds Accounts. Panel C plots the changes in leverage against the changes in the total assets of US commercial banks. Panel D plots the same for US securities brokers and dealers. The data are from 1963 to 2006.

Source: Adrian and Shin (2008).

Variations in the supply of external financing can also show up in the debt and equity issuance of non-financial firms. Covas and Den Haan (2011) document that most size-sorted categories of US firms display a procyclical issuance pattern of debt and equity, with the procyclicality decreasing with firm size.[123] Research also reports

[122] A fire sale spiral, as first pointed out by Stiglitz (1982) and Geanakoplos and Polemarchakis (1986), creates a negative externality and a possible rationale for regulation. Because each institution does not bear the full cost of its own actions, it will not fully take into account the price impact of its own fire sales on asset prices. See further Brunnermeier and Pedersen (2009), Gorton (2010) and Choi and Cook (2012) for models of fire sales. Brunnermeier and Oehmke (2013) review the related literature on bubbles.

[123] More generally, heterogeneity among firms (and households) and specific patterns of external financing are likely to be important factors in explaining why financial frictions can lead to relatively large effects on business cycles (Zetlin-Jones and Shourideh (2017)).

that initial public offering (IPO) markets can be "hot", with periods of heavy issuance or "cold", with a dearth of offerings (see Ritter (1984)). This cyclicality seems in part related to the state of investor supply. Helwege and Liang (2004) show that hot markets are largely driven by greater investor optimism rather than by changes in adverse selection costs, managerial optimism or technology. More generally, the supply of external financing, with related effects on asset prices, seems to vary for reasons that are unrelated to the real economy. While often not explicitly investigated, some of these variations seem to have large real consequences (see Titman (2013), for an overview of how various shocks to debt and equity markets and other market segments can affect real activity, among others, through corporate investment-related externalities).

The impact of procyclical leverage on the real economy can be especially perverse in times of stress, when financial institutions and markets cut back on financing and asset prices drop sharply. Almeida et al (2012) show how the GFC led to a reduction in investment for firms for which long-term debt happened to mature in the third quarter of 2007 (of several percentage points relative other firms). Using a DSGE model, Mendoza (2005) shows that as leverage drops from 15% to 11% during a crisis, a 2% wealth-neutral shock leads to about a 4% drop in consumption and investment and a 1.3% decline in output (see also Adrian et al (2012) and Adrian and Shin (2014)).

These variations seem to relate to countries' institutional environment. For example, countries, with market-based financial systems tend to exhibit greater cyclicality in leverage. In market-based systems, the effective use of collateralisation and the development of more sophisticated risk management and information-sharing mechanisms mean that leverage can be increased with greater ease. In bank-oriented systems, in contrast, leverage is more restricted, in part due to regulations. Consequently, leverage and asset price cycles more likely arise in market-based systems (IMF (2009)). As changes in leverage and liquidity within the financial system affect the real economy, shocks to asset prices can consequently have a greater real impact.

Because short-term collateralised borrowing is the chief tool used by financial institutions to adjust their leverage, the leverage channel relates to (and affects) monetary policy. Adrian and Shin (2008) show that repos and reverse repos transactions, in which borrowers provide securities as collateral, are used heavily to adjust leverage. Since the growth of repo transactions is closely associated with the ease or restrictiveness of monetary policy, a strong connection arises between monetary policy and liquidity. When monetary policy is "loose" ("tight"), there is more likely to be rapid (slow) growth in repos and financial market liquidity tends to be high (low). Furthermore, as Geanakoplos (2003) shows, not only does leverage display endogenous cycles but the interest rate becomes endogenous. With both leverage and interest rates adjusting, this can lead to further procyclical supply side behaviour (see Geanakoplos (2010) for a review).

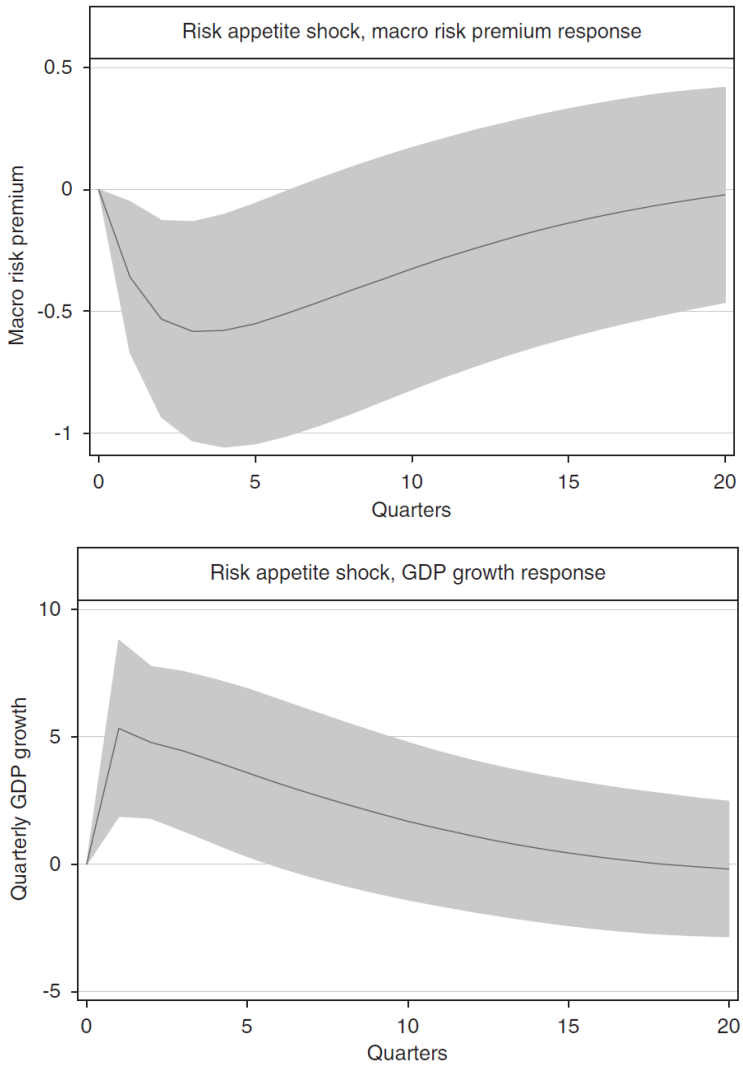
Both monetary policy and macroeconomic conditions appear to affect the risk appetite of financial intermediaries and their supply of credit. Adrian et al (2010b) study the links between the growth of financial intermediaries' balance sheets, the macroeconomic risk premium and output in the United States. The empirical behaviour of the macroeconomic risk premium tracks closely that of the term spread of interest rates and of the premium charged to more risky credits. They also develop a measure of intermediary risk appetite using changes in balance sheet quantities. In response to shocks to risk appetite, the macroeconomic risk premium and output

exhibit significant and persistent changes. Higher risk appetite is associated with a decline in the risk premium and a pick up in output (Figure 3.9).[124] Adrian and Duarte (2016) model how these interactions can make the financial system more vulnerable to negative shocks and lead to highly nonlinear dynamics that can adversely affect the real economy (see also Aikman et al (2016) for a review of the various possible links between financial vulnerabilities, monetary policy and macroeconomic developments).

Impulse responses to a risk appetite shock

Percent

Figure 3.9



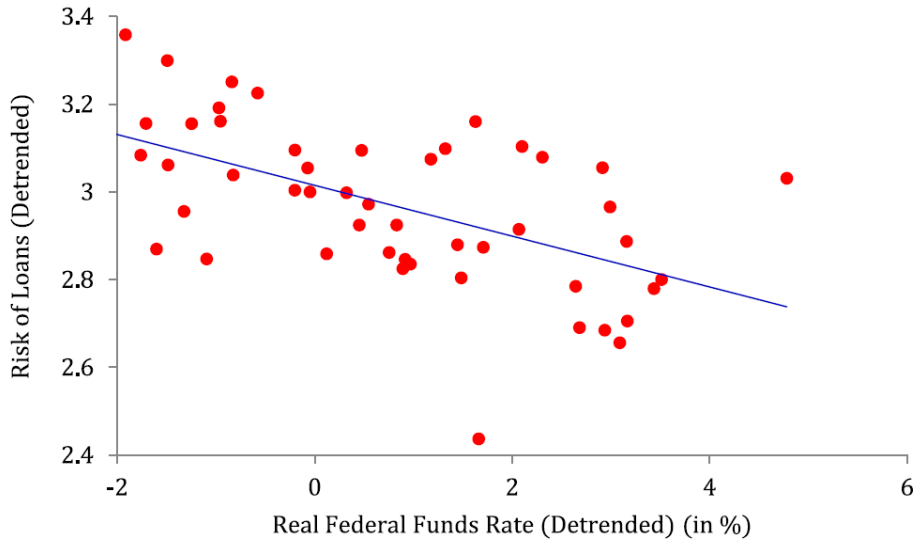

Note: Stronger risk appetite leads to an expansion of intermediaries' balance sheets and a compression of credit spreads. The response of the macroeconomic risk premium peaks at four quarters and then subsequently reverts slowly towards zero. However, the significance of the risk appetite shock on the macroeconomic premium is fairly persistent and only becomes insignificant after about six quarters.

Source: Adrian et al (2010b).

[124] See further Adrian et al (2016) on the relevance of leverage for macroeconomic modelling (and macrofinancial linkages). They show that a parsimonious model using detrended dealer leverage as a "price-of-risk" variable performs well in time series and cross-sectional tests for a wide variety of equity and bond portfolios (at least better than models that use intermediary net worth as a state variable) and in comparison to benchmark asset pricing models.

However, the relationship between the monetary policy stance and risk-taking is complex. De Nicolò et al (2010) model how monetary policy easing can induce greater risk-taking through a search for yield. At the same time, they show that there can be another effect at work if financial intermediaries operate with limited liability. In their model, at least in the short run when bank capital is fixed, high charter-value (well capitalised) banks increase risk-taking if the policy rate is low and low charter-value (poorly capitalised) banks do the opposite as they try to preserve their capital. On balance, the effects of monetary policy on risk-taking depend on intermediaries' degree of limited liability and financial health. Empirical evidence, while still partial, supports these complex interactions. For example, empirical evidence for the United States by De Nicolò et al (2010) broadly supports the prediction that a low policy rate is associated with greater risk-taking by banks as the riskiness of their loans is higher when interest rates are lower (Figure 3.10).[125]

Monetary conditions and bank risk-taking — Figure 3.10




Note: Simple OLS regression of a risk measure of bank lending and the real federal funds rate for all banks. The dependent variable is the risk of bank loans, which is based on an index ranging from 1 to 5. The measure is based on quarterly data over the period Q2 1997 to Q3 2009 and is taken from the Federal Reserve's Survey of Terms of Business Lending.

Source: Dell'Ariccia et al (2014).

[125] For the effects of monetary policy on risk-taking, including when interest rates are particularly low, see further Dell'Ariccia and Marquez (2013), Dell'Ariccia et al (2014), Jimenez et al (2014), Valencia (2014), Ioannidou et al (2015), and Borio and Hofmann (2017). Posen (2009), Bean et al (2010) and Bernanke (2010) argue otherwise. Adrian and Shin (2008, 2011a) and Adrian et al (2010a) analyse how the risk-taking channel works in the United States. Some other recent studies providing further microeconomic evidence for the presence of the risk-taking channel domestically and internationally include Maddaloni and Peydro (2011), Altunbas et al (2014), Bruno and Shin (2015, 2017), Morais et al (2015), Dell'Ariccia et al (2017), and Domanski, Shin and Sushko (2017). See also Rajan (2005) and Hanson and Stein (2015) for arguments and models linking low interest rates to search-for-yield motives for investors other than banks. For a review of studies of the effects of low interest rates on financial institutions' profitability and capitalization and risk-taking, see European Systemic Risk Board (2016).

## 3.7 Aggregate macrofinancial linkages

The previous sections documented that imperfections on the demand and supply sides of finance could be associated with pronounced fluctuations in the real economy. Complementary to this literature has been long standing research that provides important insights into the general patterns of aggregate macrofinancial linkages (see the overview of this literature in Box 3.3). Since it is hard to identify the direction of causality between changes in financial markets and fluctuations in real activity, and whether demand or supply channels are the main factors, many of these studies have taken a largely agnostic approach.

Box 3.3

### Business and financial cycles: an overview

Using various methodologies and measures to proxy cycles, a number of studies have examined the features of business and financial cycles and the aggregate linkages between such cycles. They have pointed out the procyclical nature of financial markets and provided the broad patterns describing the linkages between business and financial cycles. This Box reviews these studies for the three most important market segments: credit, equity and housing.[1]

*Credit market cycles and business cycles*

The study of credit cycles has a history that goes back to Mills (1867) at least. Most of the early work in this area employed qualitative approaches and considered the extreme versions of these cycles: booms and busts (or crunches) (see Keynes (1936), Galbraith (1954), Shiller (1989, 2000) and Sinai (1993); Niehans (1992) reviews very early work on credit cycles (Juglar (1862)). A number of studies also consider specific credit crunches in the United States and other countries (see Wojnilower (1980, 1985), Owens and Schreft (1995), Cantor and Wenninger (1993) and Helbling et al (2011)). Using US data going back to 1875, Bordo and Haubrich (2010) document that credit disruptions appear to exacerbate cyclical downturns. A number of studies also consider the important role played by credit in driving business cycles. Using VAR models, Meeks (2012) examines the role of credit shocks in explaining US business cycles and finds that such shocks play an important role during financial crises but a somewhat smaller role during "normal" business cycles.

Recent studies apply a variety of quantitative approaches to cross-country data to analyse episodes of credit booms and crunches. Mendoza and Terrones (2008), for example, use a "thresholds method" to identify credit booms in 48 countries over the period 1960–2006. They find that booms generally coincide with above-trend growth in output, consumption and investment during the build-up phase and below-trend growth of those variables in the unwinding phase. During the build-up phase, a surge in private capital inflows is accompanied by a deterioration of current account positions (see also Gourinchas et al (2001), Schularick and Taylor (2012), Ohnsorge and Yu (2016), and World Bank (2016)). Other researchers (such as Castro and Kubota (2013) and Dell'Ariccia et al (2016)) also study the determinants of credit booms' length.

*Cycles in asset (house and equity) prices and business cycles*

Booms and busts in asset prices have also been a major area of research. Borio and Lowe (2002), using an aggregate index of asset price (equities, and residential and commercial property), define booms as periods during which asset prices deviate from their trends by specified amounts. They also consider the interaction between developments in asset prices and credit. They report that there are substantial declines in house prices and residential investment during housing busts (after episodes of booms) in 16 advanced economies. This work builds on earlier contributions, including in Bank for International Settlements (1993), and Borio et al. (1994), and has since been deepened in a number of ways (see further Hofmann (2001) and Davis and Zhu (2004)). Similarly, Detken and Smets (2004) identify between 1970 and 2002 38 house price booms in 18 OECD countries on the basis of prices exceeding trend growth rates by at least 10% (see also Adalid and Detken (2007)). They emphasise the importance of joint fluctuations in house prices and credit over the boom-bust cycles in asset prices.

Others have focused on boom and bust episodes in house and equity prices. However, because they employed different methodologies and data sets, their findings have been difficult to compare. Bordo and Jeanne (2002) analysed episodes of booms and busts in house and equity prices for OECD countries and documented that more

than one in every two house price booms ended up with a bust, against one for every six equity price booms. Using OECD data for 18 countries from 1970 to 2009, Burnside et al (2016) found that the amplitude of typical house price booms and busts was 54% and 29%, with a median length of four and five years, respectively. They also report that booms are not always followed by busts.

A number of other studies have borrowed methods widely employed in the business cycle literature to study financial cycles. Following Harding and Pagan (2002), rigorous approaches to documenting financial cycles have been used. For example, Pagan and Sossounov (2003) identify "bear" and "bull" phases in equity markets using formal methods of business cycle dating for US monthly data over the 1835–1997 period. They report that while the duration of bear markets is about 15 months, it is around 25 months for bull markets. Bear markets are characterised by about a 30% decline in equity prices and bull markets by about a 40% increase.

Ohn et al (2004) examine the "duration dependence" exhibited by bull and bear markets in the United States and report that both phases show positive dependence. Using the same methodology, Edwards et al (2003) find that the cyclical properties of equity prices in EMEs change following periods of financial liberalisation. Kaminsky and Schmukler (2008) report that equity price cycles in EMEs tend to become more volatile after liberalisation. Drehmann et al (2012) show that the length and amplitude of financial cycles have increased markedly since the mid-1980s and that cyclical peaks are very closely associated with financial crises.

Other research focuses on the cyclical properties of house prices. Although cyclicality is common, the duration and amplitude of housing cycles vary widely across geographical areas and time (Cunningham and Kolet (2011) and Hall et al (2006)). This, in turn, reflects variations in demand and supply conditions, the characteristics of housing finance and the sources of linkage between housing and real activity. Igan and Loungani (2012) study the characteristics of house price cycles in advanced economies and find that long-run price dynamics are mostly driven by local fundamental factors, such as demographics and construction costs, although movements in such fundamentals – and credit conditions – can create short-run deviations from equilibrium paths.

Some studies consider the linkages between business and asset price cycles (Breitung and Eickmeier (2014), Cicarelli et al (2016) and Prieto et al (2016)). A central finding of these studies is that house price cycles tend to have an especially close relationship with business cycles. Based on evidence for 27 countries, Cecchetti (2008) finds that housing booms worsen growth prospects while equity booms have little impact on the expected mean and variance of macroeconomic performance (although they do aggravate adverse outcomes). Cecchetti and Li (2008) study the impact of booms in equity and house prices on extreme fluctuations in output and the price level. They find that equity and housing booms are both associated with significantly worse growth and inflation prospects over a three-year horizon. Leamer (2007) finds that there are strong linkages between various aspects of housing market and business cycles in the United States. Ha et al (2017) find evidence of global cycles specific to financial variables. They also find that shocks to house and equity prices have spillover effects on macroeconomic aggregates (see also Cotter et al (2017)).

*Synchronisation of financial cycles*

Some studies document the extent of cyclical synchronisation and lead-lag relationships in the financial markets of various countries. Goodhart and Hofmann (2008) analyse the degree of synchronisation between house prices and credit movements – where these two variables may comove because achange in housing wealth has collateral effects which affect both credit demand and supply or changes in credit supply affect house price fluctuations. They show that the effects of shocks to money and credit are stronger when house prices are booming. Borio and McGuire (2004) report that peaks in housing prices lag peaks in equity prices by up to two years, with the lag length negatively related to changes in short-term interest rates. Hirata et al (2012) analyse the synchronisation of house prices across countries and their interactions with other financial variables (see also Cesa-Bianchi (2013)). Using a dynamic factor model, Rey (2015) and Miranda-Agrippino and Rey (2015) find that a common factor drives a sizeable portion of variations in asset prices globally and capital flows. Cerutti et al (2017a), however, question the quantitative importance of global factors for capital flows.

① For additional references on the literature covering the linkages between business and financial cycles see Rebelo (2005), Claessens et al (2009, 2011, 2012a), Gomme et al (2011), Siregar and Lim (2011), Guarda and Jeanfils (2012), Hubrich et al (2013), Borio (2014), De Rezende (2014), Große Steffen (2015), Hubrich and Tetlow (2015), Kose and Terrones (2015), Hartmann et al (2015), Abbate (2016), Abildgren (2016), Jordà et al (2016, 2017), Bluwstein (2017) and Gandré (2017).

Until recently, this research programme did not present a comprehensive perspective on business and financial cycles. This was for at least two major reasons.

First, most studies consider only selected aspects of business and financial cycles. For example, many examined the implications of booms in asset prices or credit only rather than considering the full financial cycle. Second, research tended to focus on case studies or used small country samples. Although the literature on financial crises has employed broader samples, the identification of crises has often suffered from analytical drawbacks and the analysis has limited itself to a single phase of the cycle, the aftermath of a crisis.[126]

Some recent studies, however, document the major features of macrofinancial linkages using rich cross-country databases covering a long period of time. In this section, we present a summary of the findings of this work.[127] The section begins with an overview of the methodology and data sets used in these studies. This is followed by a discussion of the stylised facts that emerge from the data. The last sub-section considers the main properties of the linkages between business and financial cycles.

A number of salient facts emerge about the features of business and financial cycles and their interactions over different phases. First, financial cycles are often more pronounced than business cycles, with financial downturns deeper and more intense than recessions. Second, financial cycles can build on each other and become amplified. For example, credit downturns that overlap with house price busts tend to be longer and deeper than other credit downturns. Third, financial cycles appear to play an important role in shaping recessions and recoveries. In particular, recessions associated with financial disruptions, notably house price busts, are often longer and deeper than other recessions. Conversely, recoveries associated with rapid growth in credit and house prices tend to be stronger than other recoveries.

## A. Business and financial cycles: fundamentals

A number of methodologies have been developed to characterise business cycles. The findings reported in this section are based on the "classical" definition of a business cycle, which focuses on changes in levels of economic activity. The definition goes back to the pioneering work of Burns and Mitchell (1946) who laid the methodological foundations for the analysis of business cycles in the United States. Moreover, it constitutes the guiding principle of the Business Cycle Dating Committees of the National Bureau of Economic Research (NBER) and the Centre for Economic Policy Research (CEPR) in determining the turning points of US and European business cycles.[128]

[126] Claessens and Kose (2014) review a number of studies that focus specifically on periods of financial stress and crisis and the behaviour of real and financial variables during such events. Reinhart and Rogoff (2008, 2009a, 2009b, 2014) review the characteristics of various types of financial crisis for many countries over a long period. Boissay et al (2016) analyse the links between credit booms, (interbank) liquidity and banking crises (see also Allen et al (2011)).

[127] The notion of financial cycles was empirically documented in early studies for smaller samples of countries and periods of time, such as Borio et al (1994) and Borio and Lowe (2002), and refined in subsequent work, including Drehmann et al (2012), Aikman et al (2015) and Juselius and Drehmann (2015). This section draws on Claessens et al (2009, 2011, 2012a) which provide detailed empirical analyses of the interactions between business and financial cycles.

[128] An alternative methodology would be to consider how economic activity fluctuates around a trend and then to identify a "growth cycle" as a deviation from this trend (Stock and Watson (1999)). While several studies have use detrended series (and their second moments, such as volatility and correlation) to study the various aspects of cycles, it is well known that the results of these studies have depended on the choice of detrending methodology (Canova (1998)). The advantage of turning points identified by using the classical methodology is that they are robust to the inclusion of newly

The classical dating methodology distinguishes three phases of cycles: recessions, expansions and recoveries. It assumes that a recession begins just after the economy reaches a peak and ends as it reaches a trough. An expansion begins just after a trough and ends at the next peak. A complete business cycle has two phases, recession (from peak to trough) and expansion (from trough to peak). Together with these two phases, recoveries from recessions have been studied. The recovery phase is the early part of an expansion and is usually defined as the time it takes for output to return from its lowest point to the level it reached just before the decline began. An alternative definition considers the increase in output four quarters after the trough. Given the complementary nature of these two definitions of the recovery phase, both of them are used here.

Financial cycles are identified by employing the same methodology. However, different terms are used to describe them: the recovery phase is called an "upturn" and the contraction a "downturn". These two phases provide rather well defined time windows for considering the evolution of financial cycles. In what follows, we study the main features of business and financial cycles, considering, in particular, their duration, amplitude and synchronisation.[129]

### *Business cycles*

Recessions can be long, deep and costly. A typical recession lasts close to four quarters while a recovery last about five quarters (Figure 3.11).[130] The typical decline in output from peak to trough, the recession's amplitude, is about 3% for the full sample and the typical cumulative output loss amounts to about 5%. The amplitude of a recovery, defined as the increase in the first four quarters following the trough, is typically about 4%. Although most recessions (recoveries) are associated with moderate declines (increases) in output, there can be much larger changes in activity as well.

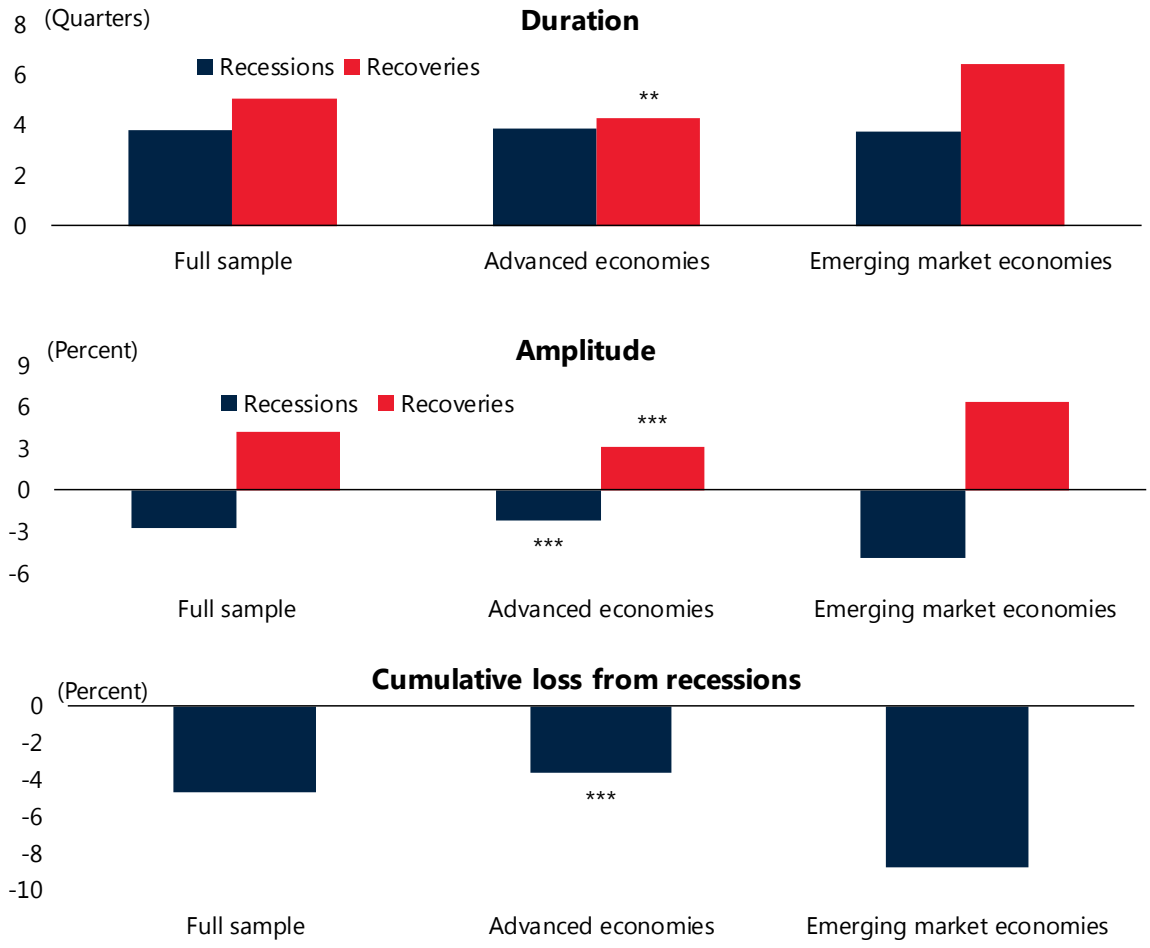
Business cycles in EMEs are more pronounced than those in advanced economies. In particular, the median decline in output during recessions is much larger in EMEs (4.9%) than in advanced economies (2.2%) and recoveries in EMEs are twice as strong as those in advanced countries. In terms of cumulative loss, recessions in EMEs are almost three times more costly than those in advanced economies. These findings suggest that macroeconomic developments, policy factors and institutional characteristics, including possibly the degree of financial frictions, potentially affect the evolution of business cycles in different countries.

available data. In other methodologies, the addition of new data can affect the estimated trend and thus the identification of a growth cycle. Fatas and Mihov (2013) analyse different approaches for the dating of recoveries using US data. See also Ng and Wright (2013) for a survey of business cycles facts and methodologies.

[129] The results reported in this section are based on a large database that comprises a total of 44 countries: 21 advanced OECD economies and 23 EMEs. For the former group, the data coverage ranges from Q1 1960 to Q4 2010 while for the latter it ranges from Q1 1978 to Q4 2010 (because quarterly data series are less consistently available prior to 1978). In order to study business cycles, GDP is used because that variable is the best available measure of economic activity. Financial cycles are studied considering three distinct but interdependent market segments: credit, housing and equity. See further Claessens et al (2012a).

[130] Claessens et al (2012a) identify 243 recessions and 245 recoveries. The number of recessions and recoveries differs slightly because of the timing of events. There are 804 complete financial cycles over the period Q1 1960 to Q4 2010. The sample features 253 downturns in credit, 183 in house prices and 443 in equity prices; and 220, 155 and 429 upturns in credit, house and equity prices, respectively. Since equity prices are more volatile than credit and house prices, they feature naturally more often in downturns and upturns than the other financial variables.

Recessions and recoveries: duration, amplitude and cumulative loss Figure 3.11




Note: All the statistics except for those relating to duration correspond to sample medians. For duration, the means are shown. The duration of a recession is the number of quarters that have elapsed between the peak and the trough. The duration of a recovery is the time taken to attain the level of output reached at the previous peak. The amplitude of a recession is the decline in output from peak to trough. The amplitude of a recovery is the one-year change in output after the trough. The cumulative loss combines information about the duration and the amplitude to measure the overall cost of a recession. ***, ** and * imply significance at the 1%, 5% and 10% levels, respectively. Significance refers to the difference between advanced economies and EMEs.

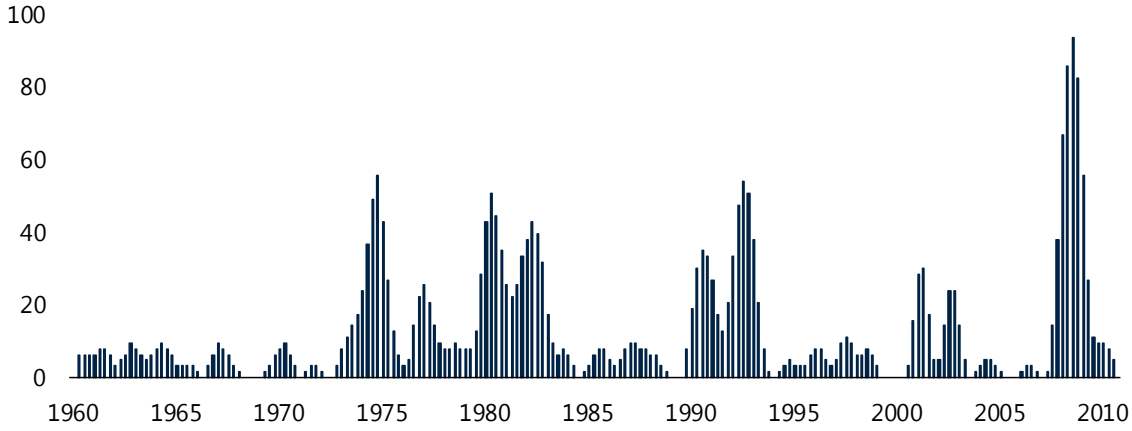
Source: Claessens et al (2012a).

Business cycles are highly synchronised across countries. For some observers, the global nature of the GFC, during which many economies experienced a recession at the same time, was surprising. However, this is not so unusual because recessions and recoveries are often synchronised across countries. Recessions in many advanced economies, for example, were concentrated in four periods over the past 40 years – the mid-1970s, the early 1980s, the early 1990s and 2008–09 – and often coincided with global shocks, such as increases in oil prices and interest rates (Figure 3.12). Such synchronised recessions tend to be deeper than other types of recession.

Synchronisation of recessions

Percent

Figure 3.12




Note: The share of countries experiencing a recession is presented. The figure includes completed as well as ongoing episodes. The sample contains quarterly data for 21 advanced economies over the period Q2 1960 to Q4 2010.

Source: Claessens et al (2012a).

*Financial cycles*

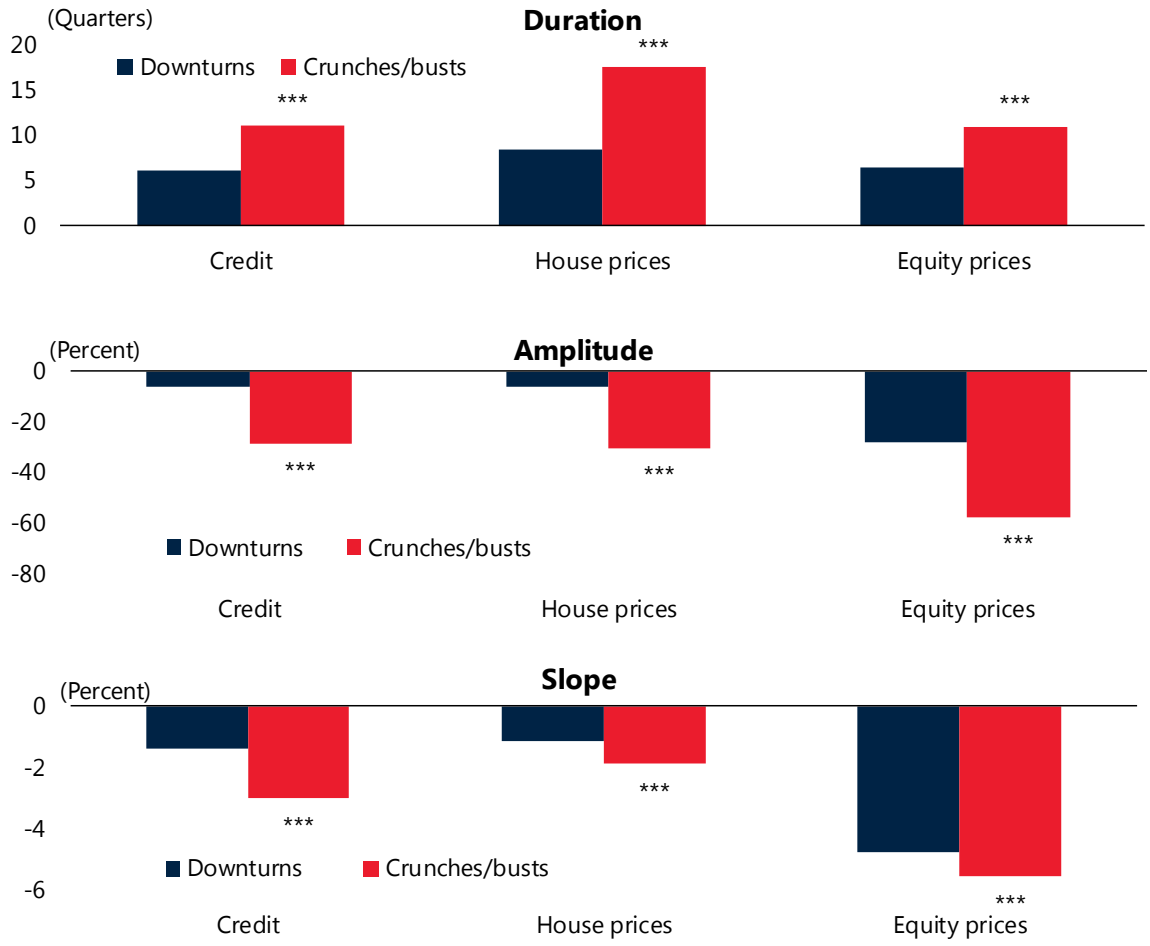
Financial cycles are often longer and more pronounced than business cycles, with financial downturns particularly deeper and longer than recessions. Downturns (upturns) of financial cycles tend to be longer than recessions (recoveries) (Figures 3.13 and 3.14). Episodes of house price downturns, in contrast, persist for about eight quarters and other financial downturns last around six quarters. A typical financial downturn corresponds to about a 6% decline in credit, 6%–7% fall in house prices and 30% decline in equity prices. Upturns are often longer than downturns, with the strength of upturns to differ across financial markets. Equity price upturns are the sharpest, some 26%. Financial cycles are also more intense than business cycles, ie financial variables adjust much more quickly than real ones, as shown by their slope coefficient. These findings are consistent with various studies documenting that asset prices are more volatile than economic fundamentals (see Shiller (1981, 2003) and Campbell (2003)).

The main features of financial downturns vary across EMEs and advanced economies. While not necessarily longer, financial downturns in EMEs are much sharper than in advanced countries. Credit contractions last about the same in both groups but are one-third deeper in EMEs. Equity downturns last as long in both groups but upturns are much shorter in EMEs. Comparisons between mean and medians show that the distributions of duration and amplitude of the phases of financial cycles are also more skewed to the right in EMEs than in advanced economies. These differences indicate that factors possibly related to the presence of financial frictions could affect financial cycles.

Financial cycles also tend to feed off of each other and become amplified. The likelihood of a credit downturn (or upturn) taking place goes up substantially if there is also a disruption (or boom) in house prices. There are also strong interactions between financial cycles. Credit downturns that overlap with house price busts tend to be longer and deeper than other credit downturns. Similarly, a typical credit upturn becomes 30% longer and twice as large when it coincides with a housing boom. This

suggests that feedback effects play a role as disruptions in one market aggravate the problems in another, probably because of collateral constraints and complementarities between credit and housing finance. Moreover, globally synchronised financial downturns are often longer and deeper, especially for credit and equity markets. During highly synchronised equity market downturns, for example, prices drop by about 30% compared with some 18% for other downturns.

Financial downturns: duration, amplitude and slope — Figure 3.13




Note: the amplitude and slope statistics correspond to sample medians. For duration, the means are shown. Duration is the number of quarters between peak and trough. Amplitude is based on the decline in each variable during the downturn. Slope is the amplitude divided by the duration. Busts (crunches) are the worst 25% of downturns calculated by the amplitude. ***, ** and * imply significance at the 1%, 5% and 10% levels, respectively. Significance refers to the difference between busts (crunches) and other financial downturns.

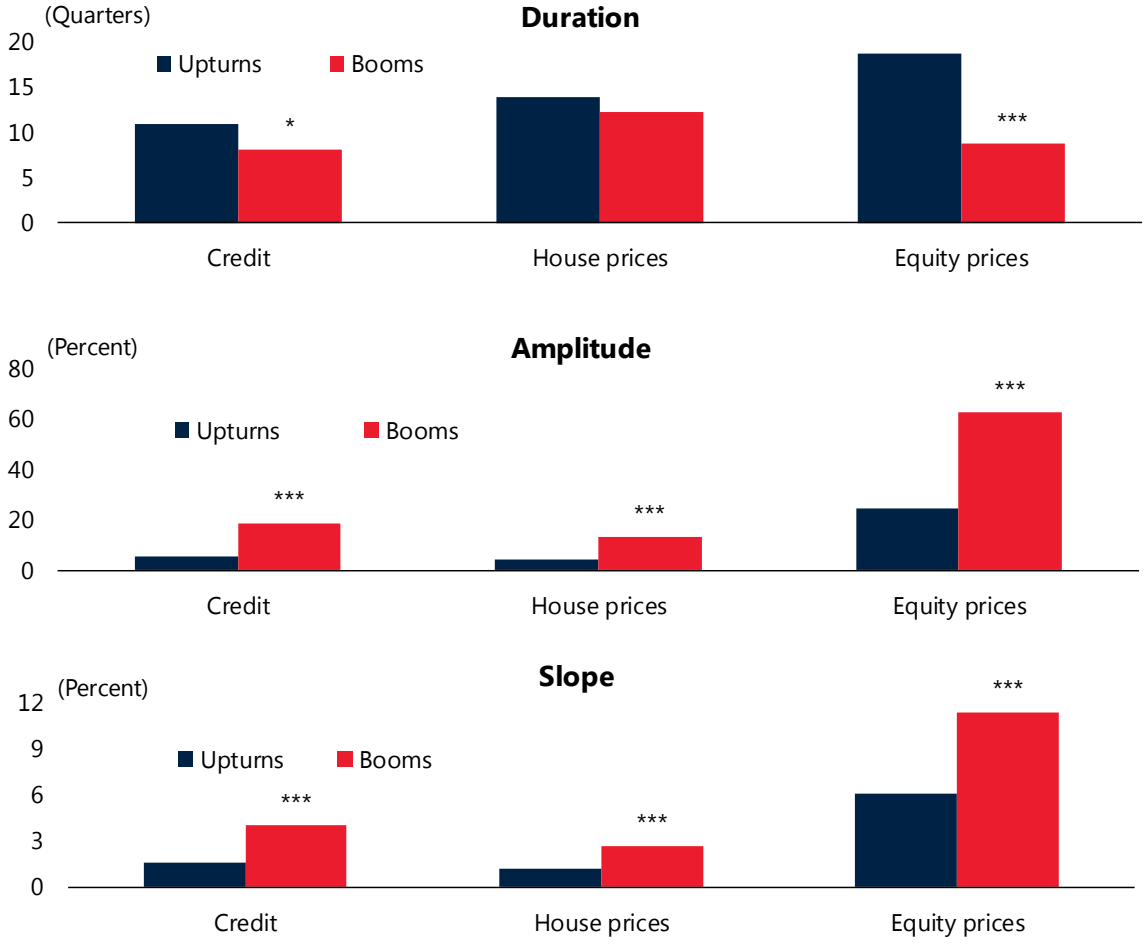
Source: Claessens et al (2012a).

Financial cycles also tend to feed off of each other and become amplified. The likelihood of a credit downturn (or upturn) taking place goes up substantially if there is also a disruption (or boom) in house prices. There are also strong interactions between financial cycles. Credit downturns that overlap with house price busts tend to be longer and deeper than other credit downturns. Similarly, a typical credit upturn becomes 30% longer and twice as large when it coincides with a housing boom. This suggests that feedback effects play a role as disruptions in one market aggravate the problems in another, probably because of collateral constraints and complementarities between credit and housing finance. Moreover, globally synchronised financial downturns are often longer and deeper, especially for credit

and equity markets. During highly synchronised equity market downturns, for example, prices drop by about 30% compared with some 18% for other downturns.

Financial upturns: duration, amplitude and slope

Figure 3.14




Note: The amplitude and slope correspond to sample medians. For duration, the means are shown. Duration is the time it takes to attain the level of the previous peak. Amplitude is the change in one year after the trough of each variable. Slope is the amplitude from the trough to the period where the financial variable reaches its last peak, divided by duration. Booms are the top 25% of upturns calculated by the amplitude. ***, ** and * imply significance at the 1%, 5%, and 10% levels, respectively. Significance refers to the difference between financial booms and other financial upturns.

Source: Claessens et al (2012a).

## B. Business and financial cycles: linkages

Recent research using cross-country data has revealed important links between business and financial cycles. Claessens et al (2012a) use a comprehensive database for a large sample of advanced economies and EMEs over a long period of time to provide a broad empirical characterisation of macrofinancial linkages. They report three main results. First, business cycles are more closely synchronised with credit and house price cycles than with equity price cycles. Second, financial cycles appear to play an important role in determining recessions and recoveries and shaping the features of business cycles more generally. In particular, recessions are more likely to coincide with financial disruptions while recoveries are more likely to be associated with booms. Third, recessions associated with some forms of financial disruption, notably house price busts, are often longer and deeper than other recessions.

Conversely, recoveries associated with rapid growth in credit and house prices tend to be stronger. These results collectively highlight the importance of macrofinancial linkages, especially those involving developments in credit and housing markets, for the real economy.

### *Synchronisation and likelihood of cycles*

Business cycles often move in tandem with financial cycles, especially with credit and house price cycles. One can study the degree of synchronisation between business and financial cycles by using the concordance statistic (Table 3.3).[131] Cycles in output and credit appear to be the most highly synchronised, with a median (mean) synchronisation of 0.81 (0.78). This means that cycles in output and credit are typically in the same phase about 80% of the time. The concordance statistic for cycles in output and house prices, 0.68 (0.64), is lower than that for output and credit but still slightly higher than that for output and equity prices, 0.58 (0.60). This reinforces the common finding that developments in credit and housing markets could be key in driving macrofinancial linkages.

Synchronisation of business and financial cycles

Concordance index — Table 3.3

| | All countries | Advanced economies | Emerging markets |
|---|---|---|---|
| **Output and credit cycles** | | | |
| Mean | 0.78 | 0.82** | 0.74 |
| Median | 0.81 | 0.83 | 0.76 |
| Standard deviation | 0.10 | 0.06 | 1.13 |
| **Output and house price cycles** | | | |
| Mean | 0.64 | 0.67** | 0.54 |
| Median | 0.68 | 0.70 | 0.50 |
| Standard deviation | 0.12 | 0.15 | 0.15 |
| **Output and equity price cycles** | | | |
| Mean | 0.59 | 0.57*** | 0.62 |
| Median | 0.58 | 0.57*** | 0.64 |
| Standard deviation | 0.06 | 0.08 | 0.05 |

Note: Each cell represents the concordance statistic for the corresponding two cycles. Concordance is calculated as the fraction of time that two cycles are in the same phase. *** and ** imply significance at the 1% and 5% levels, respectively. Significance refers to the difference between advanced economy and emerging markets (means and medians only).

There are also differences in concordance between advanced economies and EMEs. Advanced economies typically display a higher degree of synchronisation of output, credit and house prices than EMEs. This may reflect the more developed nature of advanced country financial markets with the result that fluctuations in credit, house prices and other financial variables are more important to the real economy. It may also indicate that EMEs are more often affected by global shocks operation through international capital flows, including through actions of their residents (see for example Forbes and Warnock (2012) and Caballero and Simsek (2016)).

The likelihood of recessions and recoveries varies with the presence of financial disruptions or booms. The unconditional probability of being in a recession or a

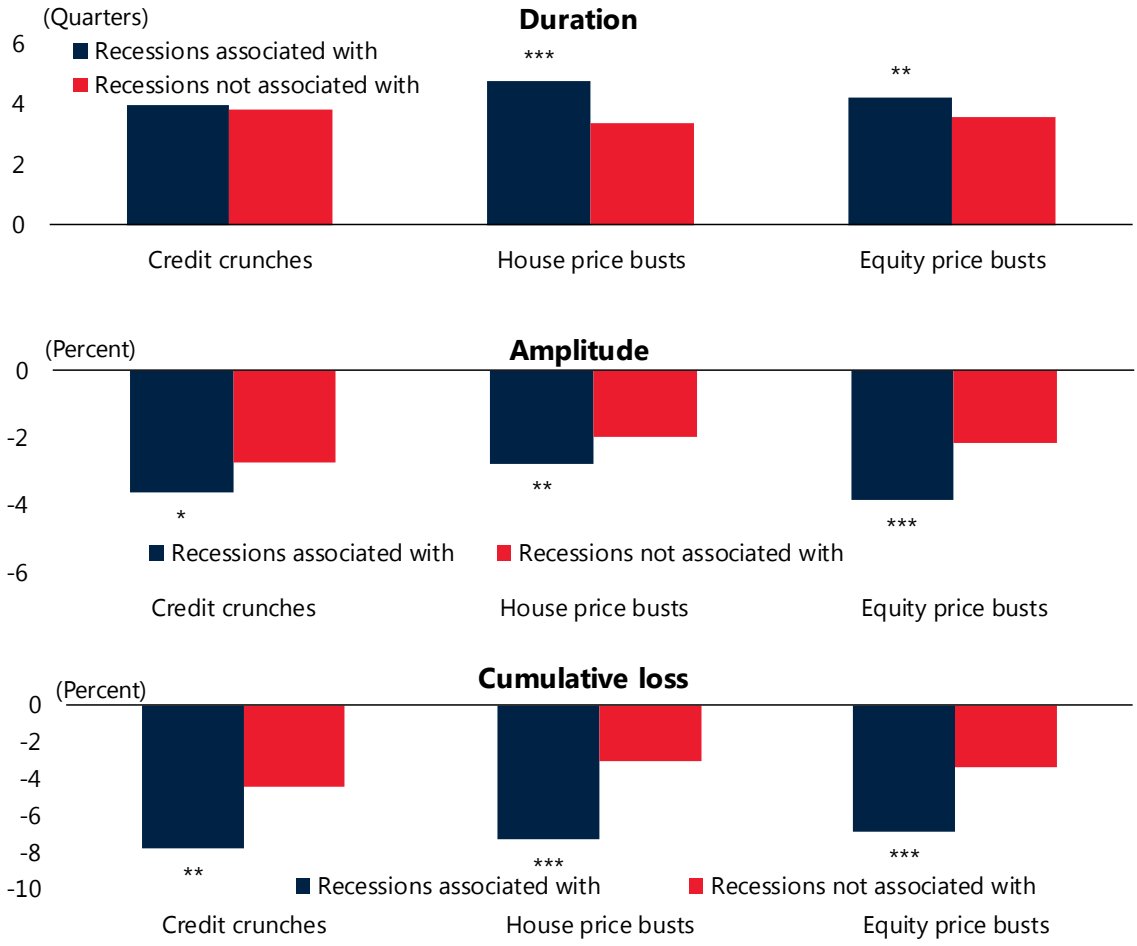
[131] The concordance statistic provides a measure of the fraction of time that the two series are in the same phase of their respective cycles. The series are perfectly procyclical (countercyclical) if the concordance index is equal to unity (zero).

recovery in any given quarter is about 19%. However, if there is a financial disruption episode in the same quarter, the probability of a recession increases substantially, to 35% to 38%. Similarly, if a credit (house price) boom is already underway, the probability of experiencing a recovery rises to roughly 57% (43%). Rapid growth in equity prices is, however, not associated with greater likelihood of a recovery in the real economy.

*Interactions between cycles*

Recessions accompanied by financial disruptions tend to be longer and deeper than other recessions. In particular, recessions associated with asset price busts are significantly longer than recessions without such disruptions (Figure 3.15). Recessions with severe asset price busts as well as credit crunches result in significantly larger

Recessions with financial disruptions: duration, amplitude and cumulative loss Figure 3.15




Note: The amplitude and cumulative loss statistics correspond to sample medians. Duration corresponds to the sample mean. Disruptions are the worst 25% of downturns as represented by the amplitude. ***, ** and * imply significance at the 1%, 5% and 10% levels, respectively. Significance refers to the difference between recessions with and without financial disruptions. For other definitions, see the notes to Figures 3.13 and 3.14.

Source: Claessens et al (2012a).

drops in output and, correspondingly, greater cumulative output losses relative to those without such episodes.[132]

A recession associated with one type of financial disruption is often accompanied by broader stress in other financial markets. For example, recessions accompanied by credit crunches result in a significant decline in credit as well as substantial drops in house and equity prices. One can also analyse recessions accompanied by combinations of credit crunches and asset busts. Although the number of such episodes is small, a recession associated with a credit crunch and an asset price bust often leads to a larger cumulative output loss than a recession with only a credit crunch or an asset price bust.

Just as recessions associated with financial disruptions are longer and deeper, recoveries associated with credit or house price booms are shorter and stronger. With respect to duration, recoveries coinciding with house price booms tend to be significantly shorter (Figure 3.16). Moreover, recoveries associated with credit and house price booms are often stronger and faster than those without such booms. By contrast, recoveries combined with booms in equity markets do not appear to be different from those without such episodes, confirming the somewhat limited role of equity markets in macrofinancial linkages.

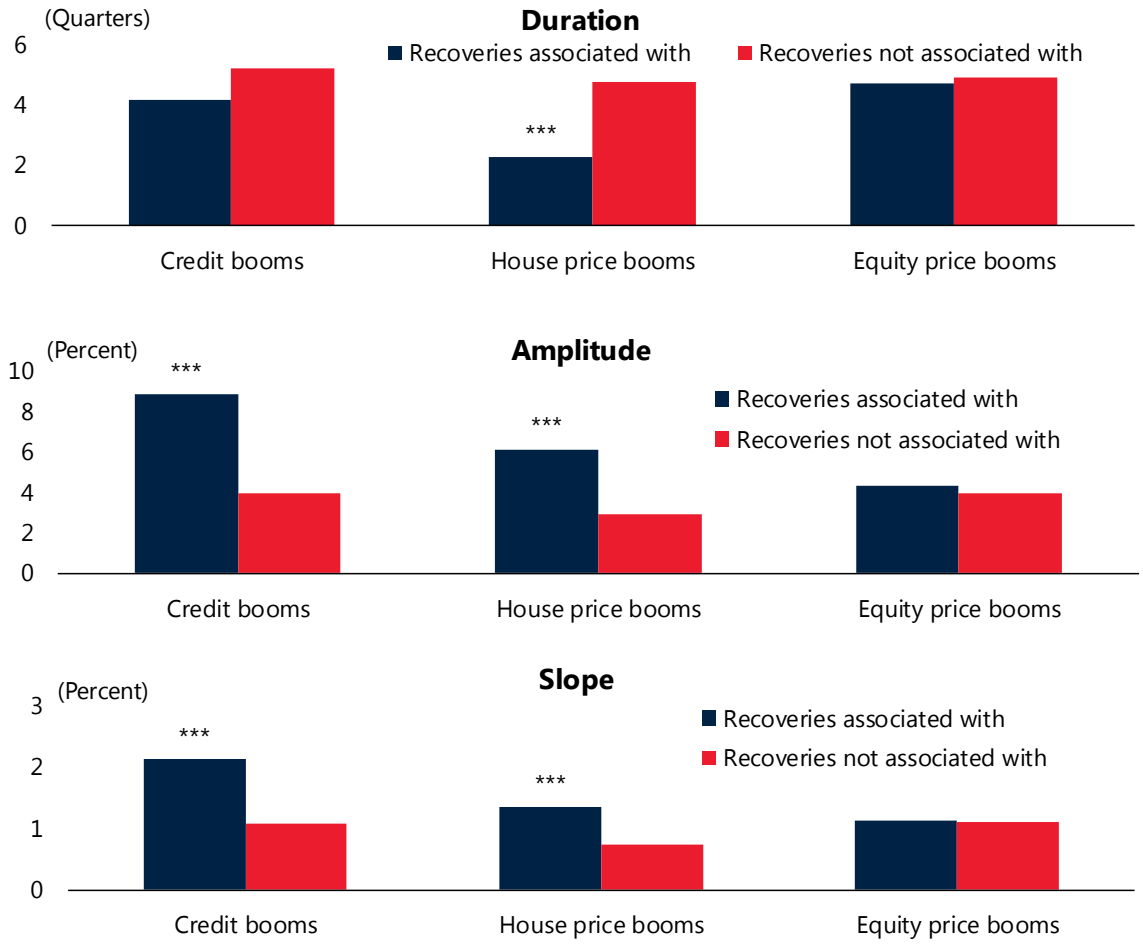
These stylised facts describing the aggregate linkages between business and financial cycles are also supported by the results of panel regressions incorporating a wide range of explanatory variables. In particular, changes in house prices tend to play a critical role in determining the duration and cost of recessions (Claessens et al (2012a)). The results are also consistent with the findings of recent empirical studies emphasising the importance of house price dynamics in shaping business cycles (Cecchetti (2008), Leamer (2007), IMF (2008), and Muellbauer (2007)).[133]

Why are recessions associated with house price busts more costly? First, housing represents a large share of wealth for most households and, consequently, price adjustments affect consumption and output more strongly (see Chapter 3 for a detailed discussion of this issue). By contrast, equity ownership is relatively less common and typically more highly concentrated among wealthy households who likely make much smaller adjustments to their consumption during the various phases of the financial cycle (and recessions and recoveries). Housing wealth has indeed been found to have a larger effect on consumption than equity wealth (Carroll et al (2011)). Second, equity prices are more volatile than house prices, implying that changes in house prices are more likely to be (perceived to be) permanent than those of equity prices (Cecchetti (2008) and Kishor (2007)). With more permanent wealth changes, households adjust their consumption more strongly when house prices increase (decline), leading to larger increases (declines) in output during recoveries (recessions) that are associated with house price booms (busts).

[132] For a deeper perspective, it is useful to consider additional measures of credit and asset prices. For example, some papers (Chari et al (2008) and Cohen-Cole et al (2008)) highlight the importance of going beyond aggregate measures (for example, by differentiating credit to corporations from credit to households) to study the dynamics of credit markets. Unfortunately, such disaggregated series are not available for a large number of countries over long periods.

[133] Analytical models also support this notion. Using the financial accelerator mechanism presented in Section 3.5, for example, some studies (Aoki et al (2004) and Iacoviello (2005)) use DSGE models to show specifically how endogenous developments in housing markets can magnify and transmit various types of shock to the real economy and find quantitatively large effects. Mian and Sufi (2010, 2014a) provide empirical evidence at the regional level for the real economy effects of mortgage credit expansion in the United States.

Recoveries with financial booms: duration, amplitude and slope Figure 3.16




Note: The amplitude and slope correspond to the sample medians. Duration corresponds to the sample means. Booms are the highest 25% of upturns by amplitude. ***, ** and * imply significance at the 1%, 5% and 10% levels, respectively. Significance refers to the difference between recoveries with and without booms. For other definitions, see the notes to Figures 3.13 and 3.14.

Source: Claessens et al (2012a).

## 3.8 Taking stock

The GFC was a painful reminder of the importance of macrofinancial linkages. These linkages centre on the two-way interactions between the real economy and the financial sector. Imperfections in financial markets can intensify these linkages and lead to gyrations in the financial sector and the real economy. Global dimensions of these linkages can result in spillovers across borders through both real and financial channels.

Research on macrofinancial linkages has a long tradition, but has become a central topic only over the past three decades. This chapter reviews this rich literature and presents a broad perspective on theoretical and empirical work. The survey considers the two channels – the demand and supply sides – through which financial imperfections can affect macroeconomic outcomes. The demand side channel, largely captured by financial accelerator-type mechanisms, describes how, through changes in the balance sheets of borrowers, financial markets can amplify macroeconomic fluctuations. The supply side channel emphasises the importance of changes in financial intermediaries' balance sheets for the availability of external financing and

liquidity, the role of financial markets in the determination of asset prices and the implications of those factors for the real economy.

The literature has made significant progress in understanding the demand side of macrofinancial linkages. Many models now feature amplification mechanisms operating through the demand side. These models show how a financial accelerator-type mechanism can lead to the propagation and amplification of small (real or financial) shocks across the real economy (through their impact on access to finance). A number of models that incorporate financial accelerator mechanisms show the importance of changes in asset prices and other financial shocks in driving movements in borrowers' net worth and access to finance, leading to fluctuations in aggregate activity.

These analytical findings are also supported by empirical studies. In particular, extensive evidence documents how the state of borrowers' balance sheets affects their access to external finance. Demand side imperfections in financial markets have been shown to lead to an amplification of shocks (monetary, real and financial) because changes in the net worth of borrowers affect their access to finance and, therefore, to consumption, investment and output. Empirical studies confirm that these imperfections tend to affect small firms and households particularly strongly, especially during periods of financial stress. Although most findings support the roles played by financial imperfections, there is nevertheless an ongoing debate about the quantitative importance of the financial accelerator.

The GFC has shifted attention to the critical role played by amplification channels operating through the supply side of finance. Earlier theoretical work on the bank lending channel analysed the possible general equilibrium effects arising from the special role of banks in financial intermediation. Empirical studies documented how the dependence of some firms on bank financing influences the transmission of monetary policy to the real economy. Since the GFC, there has been a broader recognition that the supply side of finance (beyond the specific role played by banks for some firms) can be a source of shocks, amplification and propagation.

This recognition has led to a number of studies on modelling the supply side of finance. Although the literature is still in its early stages, recent work has analysed the roles played by bank lending, bank capital and financial markets more generally – *inter alia* through their impact on asset prices, liquidity and leverage – in shaping macroeconomic outcomes. This work has brought out the critical role importance of the leverage channel in leading to more pronounced financial and business cycles. Related, given the importance of banks' credit and liquidity provisioning roles, studies have provided insights into how to consider and adapt banks' internal organisation, and their regulation and supervision in general equilibrium settings.

Recent empirical studies confirm that shocks associated with the supply side of finance can affect the evolution of external financing and asset prices, with the potential for feedback loops between real and financial markets. New tests of the bank lending channel based on variables, like the size of banks, types of loan, and certain other specific features of the financial system, show its importance as a channel of monetary transmission. Other work shows that the potency of the bank capital channel varies over business and financial cycles (especially during credit crunches). Recent work also examines the procyclical nature of financial system leverage, asset prices and liquidity, providing evidence relating to their impact on real aggregates, especially in times of financial stress.

In addition, a number of empirical studies on aggregate macrofinancial linkages document the importance of developments in financial markets for the real economy. In particular, cycles in various financial market segments (equity, housing and credit) appear to play an important role in shaping recessions and recoveries. Recessions associated with financial disruptions are often longer and deeper than other recessions while, conversely, recoveries associated with rapid growth in credit and house prices tend to be relatively stronger.

## 4. What is next?

Our survey suggests that the profession has made substantial progress in advancing its understanding of the linkages between asset prices and macroeconomic outcomes. For example, the standard models have been useful for studying the fundamental determinants of these linkages. There is also a wealth of empirical evidence supporting some of the channels posited by these models. However, there are still many qualitative and quantitative differences between the predictions of the models and data. In addition, empirical evidence points to a range of puzzles that require exploration. Hence, the topic of macrofinancial linkages promises to remain an exciting area of research, given the many open questions and significant policy interest. We briefly discuss three promising areas for future research.

**Data issues.** There are large data gaps. The lack of adequate time series data on important financial and macroeconomic variables has been a severe limitation for researchers. For example, comprehensive cross-country databases on public debt, fiscal space, and business and financial cycles are only of recent construction (see Kose et al (2017a) and World Bank (2015b, 2017b) for a discussion of the literature on fiscal space). Although the prices of many traded assets are widely available (including for equities and bonds), gaps remain with respect to higher frequency and longer-dated series relating to the housing market and aggregate credit. Comprehensive cross-country databases pertaining to business and financial cycles have only recently been constructed.

Researchers would also benefit from better access to granular data on external financing and credit, and on the balance sheets of firms, banks and other financial intermediaries. Such data are essential to the exploration of the links between the financial sector and the real economy and to the assessment of the systemic risks that can arise from these linkages (see the papers collected in Brunnermeier and Krishnamurthy (2014) on the general data needs required for research on macrofinancial linkages).

Data deficiencies are especially significant at the international level. There is a dearth of information at the aggregate and granular levels about bilateral exposures – between two countries as well as between two financial institutions, the cross-border activities of banks, institutional investors, hedge funds and other market participants (see further Cerutti et al (2014), Borio (2013), Tarashev et al (2016) and Heath and Bese Goksu (2017)). Moreover, existing data sources are often not comparable because they are compiled under different regimes. While some recent data collection efforts have been underway, such as those under the G20 Data Gap Initiative (FSB-IMF (2016)), progress in this area has been slow, including on obtaining data on the world's largest financial institutions, the so-called global systemically important financial institutions (G-SIFIs).

**New generation of models.** Chapter 2 documented a number of puzzles in the context of asset prices. Some of these puzzles may simply have stemmed historically from a lack of data to properly test for the predictions of models. However, many puzzles likely reflect the inability of underlying theoretical models to account for certain features that potentially lead to macrofinancial linkages. The literature has been cognizant of the various factors that could drive these puzzles (such as financial market imperfections). However, it has not always been able to relate the puzzles to specific analytical deficiencies or convincingly demonstrate the role played by particular channels. It is therefore critical to develop models that can better account for the heterogeneous behaviour of agents, financial imperfections, differences in financial and institutional structures across countries, and global linkages and spillovers (see further Blanchard (2017a)). Such models also need to take into account demand- and supply-driven linkages between asset price movements and macroeconomic aggregates. We discuss below potential research avenues that would take into account financial imperfections associated with demand and supply side channels.

It is also necessary to develop a better understanding of the roles played by quantities in driving linkages between asset prices and activity. Most models feature mechanisms that work through prices, yet quantities appear to matter as well for the behaviour and volatility of macroeconomic outcomes. For example, the interactions between house prices and lending appear to affect how house prices relate to macroeconomic outcomes. The impact of interest rates on activity also varies depending on the state of household and corporate balance sheets. In addition, exchange rates appear to depend not only on interest rate differentials but also on (changes in) balance sheets, order flows and valuation effects.

**Demand side channels.** Although research on the demand side channels is much richer than that on the supply side, many questions remain open. DSGE models, including those with financial market imperfections and financial accelerator-type amplification mechanisms, have been widely used by policy institutions. Yet, when calibrated with reasonable parameters and tested with realistic shocks, the quantitative importance of the financial accelerator in explaining real activity appears to be limited. Models still face difficulties in accounting for heterogeneity among agents and for the asymmetries and non-linearities that arise from macrofinancial linkages, especially when adverse shocks hit borrowers' net worth and curtail their access to external financing. Little attention has been devoted to the role of the debt service ratio as leading indicators of household consumption (Juselius and Drehmann (2015) and Drehmann et al (2017)).[134]

Some fundamental aspects associated with the demand side channels are still being debated. For example, questions surrounding the quantitative importance of financial market imperfections for small firms should be answered, as some argue that there is little difference between small and large firms. While many empirical studies find that the effects of financial conditions vary by type of economic agent, including households, firms, financial intermediaries and sovereign entities, many of those do not present rigorous tests for specific financial imperfections. To illustrate, the GFC has highlighted the role of house prices in affecting consumption and

[134] Several surveys discuss advances in the modelling of heterogeneous agents, news shocks, financial crises, bubbles and systemic risk (Heathcote et al (2009), Lorenzoni (2011, 2014), and Brunnermeier and Oehmke (2013)). Another strand of the literature uses *ad hoc* borrowing constraints to model financial imperfections in environments with a continuum of households (Huggett (1993), Aiyagari (1994), Krusell and Smith (1998)), which is particularly useful in studying distributional issues. Moll (2014) studies an environment in which financial frictions lead to misallocation of resources.

broader macroeconomic outcomes, but the exact channels by which this takes place are not yet well established. Consequently, the implications of empirical findings for regulation, institutional reform or other policy design issues require additional work.

**Supply side channels.** Since the GFC, few question the relevance of supply side factors for macroeconomic outcomes. That said, the theoretical literature still falls short of providing realistic models. While some models show how supply side dynamics can lead to macrofinancial linkages, they are still rudimentary in their treatment of the financial system. They tend to focus on banks rather than on the financial sector as a whole. And even when banks are included, their treatment is highly stylised. For example, many models simply assume the presence of banks, but do attempt to justify their existence, eg whether banks arise to overcome information asymmetries or because they are "special" in other ways.

Models often assume that banks are homogenous while in practice large banks operate very differently from small ones. There is often no distinction between liquidity and solvency risks, and the interaction between such risks is not always explicitly modelled. Moreover, the banks' choice of assets, including which sectors they lend to, is often imposed a priori rather than being endogenously determined. Models typically ignore many parts of the financial system (other than banking) and are unable to account for gross positions or intra-financial system transactions (such as interbank claims or transactions between banks and capital markets).[135]

A more realistic representation of the supply side of finance requires richer models that account for the heterogeneity of banks and capture the behaviour of other financial intermediaries. It also means modelling how banks, non-bank financial institutions and markets are linked to each other (such as through shadow banking activities) as well as how such institutions and markets are linked to the international financial system. Furthermore, more sophisticated approaches to modelling of the intricate linkages between financial imperfections, labour markets and real activity are sorely needed. Any advances in this area would require, among others, overcoming the general "linear" structure of DSGE models, which has proved to be a hindrance to the analysis of financial turmoil given that "non-linear" effects, such as liquidity shortages, fire sales and deleveraging, are prevalent.

More empirical work is also needed on the roles of various asset markets, including credit, housing and equity markets. Empirical studies need to provide a better understanding of the potential role of supply side channels through the operations of bank, non-bank financial institutions and financial markets. The roles played by institutional and other factors (such as benchmark-based compensation contracts, competition among financial institutions and the states of general liquidity and capitalisation) in driving the leverage cycle of banks and other financial institutions are in great part a mystery. The roles of collateral and margin constraints during boom and fire sale periods need deeper analysis. Interbank markets, especially during periods of financial turmoil, are surprisingly little analysed. Research also needs to focus on identifying the best measures (price, quantity or a combination of both) that characterise the linkages between supply side financial market imperfections and macroeconomic outcomes. This could also help answer some basic

[135] See Acemoglu et al (2015) and Boissay et al (2016) for analysis focusing on effects of networks and links among financial institutions, including through the interbank market. See Freixas et al (2011) for analysis on monetary and prudential policies in the interbank markets. See Dou et al (2017) for a review of the role of macrofinancial interactions in dynamics models used at central banks.

questions, such as which quantitative variables are better in predicting fluctuations in macrofinancial linkages and systemic risk.

**Global implications of financial imperfections.** The rapid spread of disruptions from US financial markets to other countries during the GFC has led to a number of questions about the cross-border transmission of real and financial shocks. Understanding the reasons for the collapse of global trade and financial flows during the height of the crisis and the implications of this for the real sector is likely to be a significant area of research. More work on the international spillovers of financial shocks, the roles played by multinational financial intermediaries and the synchronisation of business and financial cycles is also needed. On the theory front, open economy models could do a better job in assessing the cross-border implications of financial imperfections, considering the influence of both demand and supply side channels.

**Policy challenges**. As noted in the introduction, the GFC has generated an intense debate in the economics profession about the state of research on the importance of financial market imperfections in explaining macroeconomic fluctuations. Some argue that the crisis showed that the profession had not paid sufficient attention to these linkages. Others claim that these linkages had been recognised for a long time and that substantial progress had been made in understanding them. Our survey shows that the profession has indeed produced valuable research spanning a wide spectrum of issues. However, challenges remain, notably with respect to how the findings may best translate into policy. More research is required in order to arrive at a solid understanding of the issues and help guide policy decisions.[136]

Policy challenges stemming from the GFC require a much better integration of "core" research with empirical findings and the operational aspects of policy design. Since the GFC, many new regulations have been adopted (FSB (2017)). Questions remain, however, about what may be the "optimal" design of the financial system (Claessens (2016)). And related to this is the preferred design of the regulatory infrastructure, an issue that is not often formally addressed when adopting new regulations (see Claessens and Kodres (2017) for a review). One set of questions, for example, relates to the best configuration of capital adequacy and liquidity requirements for commercial banks.[137] Other questions focus on how to best monitor and, perhaps, regulate the shadow banking system (see Claessens et al (2015) for a collection of papers on the subject).

The interactions between monetary policy and financial imperfections also require work. For example, the conduct monetary policy in the presence of financial frictions and the zero lower bound demands further analysis (eg Brunnermeier and Sannikov (2016) and Rogoff (2017)). A better assessment of the role played by

[136] Bernanke (2010), Blanchard et al (2010, 2013), Caballero (2010), Kocherlakota (2010), Woodford (2010a), Turner (2012), Claessens et al (2014a), Kose and Terrones (2015), Blanchard and Summers (2017), Mankiw and Reis (2017), and several papers in the Fall 2010 issue of the *Journal of Economic Perspectives* look at how the GFC may have influenced research, including the literature on the intersection between macroeconomics and finance. Blanchard et al (2012, 2016) and Akerlof et al (2014) discuss how economic policies have been reassessed by economists since the GFC. Gopinath (2017) provides a review of the recent macroeconomic policy-related work in international economics.

[137] See, for example, Dewatripont and Tirole (2012), Stein (2012), Goodhart et al (2013), Admati and Hellwig (2014), Fender and Lewrick (2016), Kara and Ozsoy (2016), Elenev et al (2017), and Kashyap et al (2017).

monetary policy during a liquidity trap and the implications of UMPs are of strong policy interest (eg Korinek and Simsek (2016) and Del Negro et al (2017)). Related is the need for a better understanding of the role of financial factors in determining the real interest rate, including in the context of a possible global secular stagnation scenario. Some work on this has pointed at debt overhang in driving low interest rates, including for open economies.[138] While recent research has advanced our understanding of the basic issues, more work is warranted.

A broad area of further research involves the design of macroprudential policies (see Claessens (2015) and Adrian (2017b) for analytical reviews and IMF-FSB-BIS (2016) for a review of policies). Following initial work at the BIS (see Galati and Moessner (2013)), there is now a widespread recognition of the importance of imperfections, externalities and specific market features as motivating factors for macroprudential policy.[139] While progress is being made, the conceptual frameworks underpinning proposals for specific policies still require much more work, particularly given the non-linearities involved (see Mendoza (2016)).

Furthermore, the empirical work to date has often used aggregate data, which does not always allow for specific policy recommendations incorporating all relevant trade-offs, notably the costs of macroprudential policies and the possibility of regulatory adaption and arbitrage. For example, empirical studies on how specific macroprudential policy tools, such as borrowing limits on housing finance or countercyclical capital buffers, may affect banks' overall risk-taking have been limited and their results are still preliminary (see Acharya et al (2017) and Auer and Ongena (2017) for early work). More research could help in guiding the design of macroprudential policies.

There is also a vigorous debate on the effectiveness of macroprudential policies and other regulatory measures to cope with large fluctuations in asset and credit markets, and whether monetary policy is perhaps also needed, as reflected in the contrasting views on the costs and benefits of "leaning against the wind" (compare Svensson (2016, 2017) and Adrian and Liang (2016)). More research on the linkages between monetary policy and asset price dynamics, and related financial systemic risks, is thus definitely needed. The global dimension of financial cycles is also an area that is subject to debate, with varying views of the quantitative importance of the global financial cycle (Rey (2015), Cerutti et al (2017b) and Ha et al (2017)). Related, more work on the global consequences of monetary policies is needed to help guide the design of such policies, including for small open economies, which often use a combination of exchange rate, foreign exchange reserves, macroprudential and capital flow management policies.[140] Future research also needs to focus on the interaction between financial policies and fiscal policy.

[138] See Eggertsson and Krugman (2012) and Eggertsson et al (2016); see also Borio (2017) on the possible role of monetary policy in affecting the real interest rate.

[139] See the early contributions by Crockett (2000), Borio (2003) and Knight (2006) (see also Clement (2010)). Subsequently, the BIS and other related entities have conducted much research on various aspects of macroprudential policy. The Committee on the Global Financial System (CGFS), for example, reported on operational aspects in 2010, 2011 and 2012 (CGFS (2010, 2012) and CBGG (2011)). An influential, post-GFC take was Brunnermeier et al (2009a). Recent work on macroprudential policy includes Bianchi et al (2012, 2016), Farhi and Werning (2016) and Bianchi and Mendoza (forthcoming).

[140] See Jeanne (2014, 2016), Leeper and Nason (2015), Pereira da Silva (2016) and Agénor et al (2017).

# References


Abbate, A., 2016, "Essays on Macro Financial Linkages," Doctoral dissertation, European University Institute, Florence.

Abel, A. B., 1983, "Optimal Investment under Uncertainty," American Economic Review, Vol. 73, No. 1, pp. 228–33.

Abel, A. B., and O. J. Blanchard, 1986, "The Present Value of Profits and Cyclical Movements in Investment," Econometrica, Vol. 54, No. 2, pp. 249–73.

Abel, A. B., and J. Eberly, 2011, "How Q and Cash Flow Affect Investment without Frictions: An Analytic Explanation," Review of Economic Studies, Vol. 78, No. 4, pp. 1179–200.

Abhyankar, A., L. Sarno, and G. Valente, 2005, "Exchange Rates and Fundamentals: Evidence on the Economic Value of Predictability," Journal of International Economics, Vol. 66, No. 2, pp. 325–48.

Abildgren, K., 2016, "A Century of Macro-Financial Linkages," Journal of Financial Economic Policy, Vol. 8, No. 4, pp. 458–71.

Acemoglu, D., A. Ozdaglar, and A. Tahbaz-Salehi, 2015, "Systemic Risk and Stability in Financial Networks," American Economic Review, Vol. 105, No. 2, pp. 564–608.

Acharya, V. V., K. Bergant, M. Crosignani, T. Eisert, and F. McCann, 2017, "The Anatomy of the Transmission of Macroprudential Policies: Evidence from Ireland," Paper presented at the 16th International Conference on Credit Risk Evaluation, Interest Rates, Growth, and Regulation, September 28–29, Venice.

Acharya, V. V., D. Gale, and T. Yorulmazer, 2011a, "Rollover Risk and Market Freezes," Journal of Finance, Vol. 66, No. 4, pp. 1177–209.

Acharya, V. V., H. S. Shin, and T. Yorulmazer, 2011b, "Crisis Resolution and Bank Liquidity," Review of Financial Studies, Vol. 24, No. 6, pp. 2166–205.

Adalid, R., and C. Detken, 2007, "Liquidity Shocks and Asset Price Boom/Bust Cycles," ECB Working Paper 732, European Central Bank, Frankfurt am Main.

Adler, M., and B. Dumas, 1983, "International Portfolio Choice and Corporation Finance: A Synthesis," Journal of Finance, Vol. 38, No. 3, pp. 925–84.

Admati, A., and M. Hellwig, 2014, The Bankers' New Clothes: What's Wrong with Banking and What to Do about It, Princeton: Princeton University Press.

Adrian, T., 2017a, "The Term Structure of Interest Rates and Macro-Financial Dynamics," Speech at the Bank of Canada Conference on Advances in Fixed Income and Macro-Finance Research, Vancouver, August 17.

Adrian, T., 2017b, "Macroprudential Policy and Financial Vulnerabilities," Speech at the European Systemic Risk Board Annual Conference, September 22, Frankfurt am Main.

Adrian, T., and A. B. Ashcraft, 2016, "Shadow Banking: A Review of the Literature," in Banking Crises: Perspectives from The New Palgrave Dictionary, G. Jones (ed), pp. 282–315, London: Palgrave Macmillan.

Adrian, T., P. Colla, and H. S. Shin, 2012, "Which Financial Frictions? Parsing the Evidence from the Financial Crisis of 2007-09," in NBER Macroeconomics Annual

2012, Vol. 27, D. Acemoglu, J. Parker, and M. Woodford (eds), pp. 159–214, Chicago: University of Chicago Press.

Adrian, T., and F. Duarte, 2016, "Financial Vulnerability and Monetary Policy," Federal Reserve Bank of New York Staff Report 804, Federal Reserve Bank of New York, New York.

Adrian, T., A. Esterella, and H. S. Shin, 2010a, "Monetary Cycles, Financial Cycles, and the Business Cycles," Federal Reserve Bank of New York, Staff Report 421, Federal Reserve Bank of New York, New York.

Adrian, T., E. Etula, and H. S. Shin, 2015, "Risk Appetite and Exchange Rate," Federal Reserve Bank of New York Staff Report 750, Federal Reserve Bank of New York, New York.

Adrian, T., and N. Liang, 2016, "Monetary Policy, Financial Conditions, and Financial Stability," International Journal of Central Banking, forthcoming.

Adrian, T., E. Moench, and H. S. Shin, 2010b, "Macro Risk Premium and Intermediary Balance Sheet Quantities," IMF Economic Review, Vol. 58, No. 1, pp. 179–207.

Adrian, T., E. Moench, and H. S. Shin, 2016, "Dynamic Leverage Asset Pricing," CEPR Discussion Paper 11466, Centre for Economic Policy Research, London.

Adrian, T., and H. S. Shin, 2008, "Liquidity, Monetary Policy, and Financial Cycles," Current Issues in Economics and Finance, Vol. 14, No. 1, Federal Reserve Bank of New York, New York.

Adrian, T., and H. S. Shin, 2010a, "Liquidity and Leverage," Journal of Financial Intermediation, Vol. 19, No. 3, pp. 418–37.

Adrian, T., and H. S. Shin, 2010b, "The Changing Nature of Financial Intermediation and the Financial Crisis of 2007-2009," Annual Review of Economics, Vol. 2, No. 1, pp. 603–18.

Adrian, T., and H. S. Shin, 2011a, "Financial Intermediaries and Monetary Economics," in Handbook of Monetary Economics, Vol. 3, B. M. Friedman and M. Woodford (eds), pp. 601–50, Amsterdam: North-Holland.

Adrian, T., and H. S. Shin, 2011b, "Financial Intermediary Balance Sheet Management," Annual Review of Financial Economics, Vol. 3, pp. 289–307.

Adrian, T., and H. S. Shin, 2014, "Procyclical Leverage and Value-at-Risk," Review of Financial Studies, Vol. 27, No. 2, pp. 373–403.

Agénor, P.-R., E. Kharroubi, L. Gambacorta, G. Lombardo, and L. Pereira da Silva, 2017, "The International Dimensions of Macroprudential Policies," BIS Working Paper 643, Bank for International Settlements, Basel.

Aghion, P., G.-M. Angeletos, A. Banerjee, and K. Manova, 2010, "Volatility and Growth: Credit Constraints and the Composition of Investment," Journal of Monetary Economics, Vol. 57, No. 3, pp. 246–65.

Aghion, P., P. Bacchetta, and A. Banerjee, 2000, "A Simple Model of Monetary Policy and Currency Crises," European Economic Review, Vol. 44, No. 4–6, pp. 728–38.

Aghion, P., P. Bacchetta, and A. Banerjee, 2004, "Financial Development and the Instability of Open Economies," Journal of Monetary Economics, Vol. 51, No. 6, pp. 1077–106.

Aghion, P., and R. Holden, 2011, "Incomplete Contracts and the Theory of the Firm: What Have We Learned Over the Past 25 Years?" Journal of Economic Perspectives, Vol. 25, No. 2, pp. 181–97.

Aguiar, M., 2005, "Investment, Devaluation, and Foreign Currency Exposure: The Case of Mexico," Journal of Development Economics, Vol. 78, No. 1, pp. 95–113.

Aikman, D., A. G. Haldane, and B. D. Nelson, 2015, "Curbing the Credit Cycle," Economic Journal, Vol. 125, No. 585, pp. 1072–109.

Aikman, D., A. Lehnert, N. Liang, and M. Modugno, 2016, "Financial Vulnerabilities, Macroeconomic Dynamics, and Monetary Policy," Finance and Economics Discussion Series 2016-055, Board of Governors of the Federal Reserve System, Washington, DC.

Aiyagari, S. R., 1994, "Uninsured Idiosyncratic Risk and Aggregate Saving," Quarterly Journal of Economics, Vol. 109, No. 3, pp. 659–84.

Aizenman, J., M. D. Chinn, and H. Ito, 2011, "Surfing the Waves of Globalization: Asia and Financial Globalization in the Context of the Trilemma," Journal of the Japanese and International Economies, Vol. 25, No. 3, pp. 290–320.

Ajello, A., 2016, "Financial Intermediation, Investment Dynamics, and Business Cycle Fluctuations," American Economic Review, Vol. 106, No. 8, pp. 2256–303.

Akerlof, G. A., 1970, "The Market for Lemons: Quality Uncertainty and the Market Mechanism," Quarterly Journal of Economics, Vol. 84, No. 3, pp. 488–500.

Akerlof, G. A., O. Blanchard, D. Romer, and J. E. Stiglitz, 2014, What Have We Learned? Macroeconomic Policy after the Crisis, Cambridge: MIT Press.

Akerlof, G. A., and R. J. Shiller, 2009, Animal Spirits: How Human Psychology Drives the Economy and Why it Matters for Global Capitalism, Princeton: Princeton University Press.

Akerlof, G. A., and R. J. Shiller, 2015, Phishing for Phools: The Economics of Manipulation and Deception, Princeton: Princeton University Press.

Akram, F., D. Rime, and L. Sarno, 2008, "Arbitrage in the Foreign Exchange Market: Turning on the Microscope," Journal of International Economics, Vol. 76, pp. 237–53.

Albuquerque, R., M. Eichenbaum, V. X. Luo, and S. Rebelo, 2016, "Valuation Risk and Asset Pricing," Journal of Finance, Vol. 71, No. 6, pp. 2861–904.

Allen, F., 1993, "Stock Markets and Resource Allocation," in Capital Markets and Financial Intermediation, C. Mayer and X. Vives (eds), pp. 81–108, New York: Cambridge University Press.

Allen, F., and D. Gale, 1998, "Optimal Financial Crises," Journal of Finance, Vol. 53, No. 4, pp. 1245–84.

Allen, F., E. Carletti, J. P. Krahnen, and M. Tyrell (eds), 2011, Liquidity and Crises, New York: Oxford University Press.

Allen, F., and D. Gale, 2000, Comparing Financial Systems, Cambridge: MIT Press.

Almeida, H., and M. Campello, 2010, "Financial Frictions and the Substitution between Internal and External Funds," Journal of Financial and Quantitative Analysis, Vol. 45, No. 3, pp. 589–622.

Almeida, H., M. Campello, B. Laranjeira, and S. Weisbenner, 2012, "Corporate Debt Maturity and the Real Effects of the 2007 Credit Crisis," Critical Finance Review, Vol. 1, pp. 3–58.

Almeida, H., M. Campello, and C. Liu, 2006, "The Financial Accelerator: Evidence from International Housing Markets," Review of Finance, Vol. 10, No. 3, pp. 321–52.

Alquist, R., and M. Chinn, 2008, "Conventional and Unconventional Approaches to Exchange Rate Modeling and Assessment," International Journal of Finance & Economics, Vol. 13, No. 1, pp. 2–13.

Altissimo, F., E. Georgiou, T. Sastre, M. T. Valderrama, G. Sterne, M. Stocker, M. Weth, K. Whelan, and A. Willman, 2005, "Wealth and Asset Price Effects on Economic Activity," ECB Occasional Paper 29, European Central Bank, Frankfurt am Main.

Altunbas, Y., L. Gambacorta, and D. Marques-Ibanez, 2010, "Bank Risk and Monetary Policy," Journal of Financial Stability, Vol. 6, No. 3, pp. 121–9.

Altunbas, Y., L. Gambacorta, and D. Marques-Ibanez, 2014, "Does Monetary Policy Affect Bank Risk?" International Journal of Central Banking, Vol. 10, No. 1, pp. 95–135.

Alvarez, F., A. Atkeson, and P. J. Kehoe, 2009, "Time-Varying Risk, Interest Rates, and Exchange Rates in General Equilibrium," Review of Economic Studies, Vol. 76, No. 3, pp. 851–78.

Alves da Silva, M., D. Baerlocher, and H. Veras de Paiva Fonseca, 2015, "Fiscal Shocks, the Real Exchange Rate and the Trade Balance: Some Evidence for Emerging Economies," B.E. Journal of Macroeconomics, Vol. 15, No. 2, pp. 727–68.

Amato, J. D., and E. M. Remolona, 2013, "The Credit Spread Puzzle," BIS Quarterly Review, December, pp. 51–63, Bank for International Settlements, Basel.

Amiti, M., O. Itskhoki, and J. Konings, 2014, "Importers, Exporters, and Exchange Rate Disconnect," American Economic Review, Vol. 104, No. 7, pp. 1942–78.

Amiti, M., and D. E. Weinstein, 2011, "Exports and Financial Shocks," Quarterly Journal of Economics, Vol. 126, No. 4, pp. 1841–77.

Ando, A. and F. Modigliani, 1963, "The 'Life Cycle' Hypothesis of Saving: Aggregate Implications and Tests," American Economic Review, Vol. 53, No. 1, pp. 55–84.

Andrés, J., J. E. Boscá, and J. Ferri, 2010, "Labor Market Search, Housing Prices and Borrowing Constraints," International Economics Institute Working Paper 1001, University of Valencia, Valencia.

Ang, A., M. Piazzesi, and M. Wei, 2006, "What does the Yield Curve Tell Us about GDP Growth?" Journal of Econometrics, Vol. 131, No. 1–2, pp. 359–403.

Angeloni, I., A. K. Kashyap, B. Mojon, and D. Terlizzese, 2003, "The Output Composition Puzzle: A Difference in the Monetary Transmission Mechanism in the Euro Area and the United States," Journal of Money, Credit and Banking, Vol. 35, No. 6, pp. 1265–306.

Antony, J., and P. Broer, 2010, "Linkages between the Financial and the Real Sector of the Economy: A Literature Survey," CPB Document 216, CPB Netherlands Bureau for Economic Policy Analysis, Hague.

Aoki, K., G. Benigno, and N. Kiyotaki, 2010, "Adjusting to Capital Account Liberalization," CEPR Discussion Paper 8087, Centre for Economic Policy Research, London.

Aoki, K., J. Proudman, and G. Vlieghe, 2004, "House Prices, Consumption, and Monetary Policy: A Financial Accelerator Approach," Journal of Financial Intermediation, Vol. 13, No. 4, pp. 414–35.

Araujo, L., and R. Minetti, 2007, "Financial Intermediaries as Markets for Firm Assets," Economic Journal, Vol. 117, No. 523, pp. 1380–402.

Araujo, L., and R. Minetti, 2011, "On the Essentiality of Banks," International Economic Review, Vol. 52, No. 3, pp. 679–91.

Arteta, C., M. A. Kose, F. Ohnsorge, and M. Stocker, 2015, "The Coming U.S. Interest Rate Tightening Cycle: Smooth Sailing or Stormy Waters?" World Bank Policy Research Note 15/02, World Bank, Washington, DC.

Arteta, C., M. A. Kose, M. Stocker, and T. Taskin, 2016, "Negative Interest Rate Policies: Sources and Implications," World Bank Policy Research Working Paper 7791, World Bank, Washington, DC.

Aruoba, S. B., 2011, "Money, Search, and Business Cycles," International Economic Review, Vol. 52, No. 3, pp. 935–59.

Ashcraft, A. B., 2005, "Are Banks Really Special? New Evidence from the FDIC-Induced Failure of Healthy Banks," American Economic Review, Vol. 95, pp. 1712–30.

Ashcraft, A. B., 2006, "New Evidence on the Lending Channel," Journal of Money, Credit and Banking, Vol. 38, pp. 751–75.

Ashworth, P., and E. P. Davis, 2001, "Some Evidence on Financial Factors in the Determination of Aggregate Business Investment for the G7 Countries," Discussion Paper 187, National Institute of Economic and Social Research, London.

Aspachs-Bracons, O., and P. Rabanal, 2010, "The Drivers of Housing Cycles in Spain," SERIEs, Vol. 1, No. 1–2, pp. 101–30.

Atta-Mensah, J., and A. Dib, 2008, "Bank Lending, Credit Shocks, and the Transmission of Canadian Monetary Policy," International Review of Economics & Finance, Vol. 17, No. 1, pp. 159–76.

Attanasio, O., A. Leicester, and M. Wakefield, 2011, "Do House Prices Drive Consumption Growth? The Coincident Cycles of House Prices and Consumption in the UK," Journal of the European Economic Association, Vol. 9, No. 3, pp. 399–435.

Auer, R., and S. Ongena, 2017, "The Countercyclical Capital Buffer and the Composition of Bank Lending," BIS Working Paper 593, Bank for International Settlements, Basel.

Avdjiev, S., W. Du, C. Koch, and H. S. Shin, 2017, "The Dollar, Bank Leverage and the Deviation from Covered Interest Parity," BIS Working Paper 592, Bank for International Settlements, Basel.

Aylward, A., and J. Glen, 2000, "Some International Evidence of Stock Prices as Leading Indicators of Economic Activity," Applied Financial Economics, Vol. 10, pp. 1–14.

Azariadis, C., and B. Smith, 1998, "Financial Intermediation and Regime Switching in Business Cycles," American Economic Review, Vol. 88, No. 3, pp. 516–36.

Baba, N., and F. Packer, 2009, "From Turmoil to Crisis: Dislocations in the FX Swap Market before and after the Failure of Lehman Brothers," Journal of International Money and Finance, Vol. 28, No. 8, pp. 1350–74.

Baba, N., F. Packer, and T. Nagano, 2008, "The Spillover of Money Market Turbulence to FX Swap and Cross-Currency Swap Markets," BIS Quarterly Review, March, pp. 73–86, Bank for International Settlements, Basel.

Bacchetta, P., and R. Caminal, 2000, "Do Capital Market Imperfections Exacerbate Output Fluctuations?" European Economic Review, Vol. 44, No. 3, pp. 449–68.

Bacchetta, P., and E. Van Wincoop, 2004, "A Scapegoat Model of Exchange-Rate Fluctuations," American Economic Review, Vol. 94, No. 2, pp. 114–8.

Bacchetta, P., and E. Van Wincoop, 2006, "Can Information Heterogeneity Explain the Exchange Rate Determination Puzzle?" American Economic Review, Vol. 96, No. 3, pp. 552–76.

Bacchetta, P., and E. Van Wincoop, 2013, "On the Unstable Relationship between Exchange Rates and Macroeconomic Fundamentals," Journal of International Economics, Vol. 91, No. 1, pp. 18–26.

Bacchetta, P., and E. Van Wincoop, 2016, "The Great Recession: A Self-Fulfilling Global Panic," American Economic Journal: Macroeconomics, Vol. 8, No. 4, pp. 177–98.

Bacchetta, P., E. Van Wincoop, and T. Beutler, 2010, "Can Parameter Instability Explain the Meese-Rogoff Puzzle?" NBER International Seminar on Macroeconomics 2009, L. Reichlin and K. D. West (eds), pp. 125–73, Chicago: University of Chicago Press.

Bachelier, L., 1900, Theorie de la Speculation, Paris: Gauthier-Villars.

Backus, D. K., P. J. Kehoe, and F. E. Kydland, 1994, "Relative Price Movements in Dynamic General Equilibrium Models of International Trade," in The Handbook of International Macroeconomics, F. van der Ploeg (ed), pp. 62–96, Cambridge: Blackwell Publishers.

Backus, D. K., and G. W. Smith, 1993, "Consumption and Real Exchange Rates in Dynamic Economies with Non-Traded Goods," Journal of International Economics, Vol. 35, pp. 297–316.

Baele, L., G. Bekaert, and K. Inghelbrecht, 2010, "The Determinants of Stock and Bond Return Comovements," Review of Financial Studies, Vol. 23, No. 6, pp. 2374–428.

Bahmani-Oskooee, M., and A. Ratha, 2004, "The J-Curve: A Literature Review," Applied Economics, Vol. 36, pp. 1377–98.

Baker, S. R., and N. Bloom, 2013, "Does Uncertainty Reduce Growth? Using Disasters as Natural Experiments," NBER Working Paper 19475, National Bureau of Economic Research, Cambridge.

Baker, M., and J. Wurgler, 2013, "Behavioral Corporate Finance: An Updated Survey," in Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 357–424, Amsterdam: North-Holland.

Balassa, B., 1964, "The Purchasing Power Parity Doctrine: A Reappraisal," Journal of Political Economy, Vol. 72, pp. 584–96.

Balassa, B., 1978, "The Monetary Approach to the Exchange Rate: Some Evidence," IMF Staff Papers, Vol. 25, pp. 503–28.

Bank for International Settlements, 1993, 63rd Annual Report, Basel: Bank for International Settlements.

Bank for International Settlements, 1995, "Financial Structure and the Monetary Policy Transmission Mechanism," BIS Paper 0, Bank for International Settlements, Basel.

Barberis, N., 2013, "Thirty Years of Prospect Theory in Economics: A Review and Assessment," Journal of Economic Perspectives, Vol. 27, pp. 173–96.

Barberis, N., M. Huang, and T. Santos, 2001, "Prospect Theory and Asset Prices," Quarterly Journal of Economics, Vol. 116, No. 1, pp. 1–53.

Barberis, N., A. Shleifer, and R. Vishny, 1998, "A Model of Investor Sentiment," Journal of Financial Economics, Vol. 49, No. 3, pp. 307–43.

Barberis, N., and R. Thaler, 2003, "A Survey of Behavioral Finance," in Handbook of the Economics of Finance, Vol. 1, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 1053–128, Amsterdam: North-Holland.

Barlevy, G., 2003, "Credit Market Frictions and the Allocation of Resources over the Business Cycle," Journal of Monetary Economics, Vol. 50, No. 8, pp. 1795–818.

Barlevy, G., 2014, "A Leverage-Based Model of Speculative Bubbles," Journal of Economic Theory, Vol. 153, pp. 459–505.

Barrell, R., and E. P. Davis, 2005, "Equity Prices and the Real Economy–A Vector-Error-Correction Approach," Economics and Finance Working Paper 05–13, Brunel University, Uxbridge.

Barrell, R., and E. P. Davis, 2007a, "Financial Liberalisation, Consumption and Wealth Effects in Seven OECD Countries," Scottish Journal of Political Economy, Vol. 54, No 2, pp. 254–67.

Barrell, R., and E. P. Davis, 2007b, "Shocks and Shock Absorbers: The International Propagation of Equity Market Shocks and the Design of Appropriate Policy Responses," in The External Dimension of the Euro Area: Assessing the Linkages, F. di Mauro and R. Anderton (eds), pp. 146–72, New York: Cambridge University Press.

Barro, R. J., 2006, "On the Welfare Costs of Consumption Uncertainty," NBER Working Paper 12763, National Bureau of Economic Research, Cambridge.

Barsky, R. B., and J. B. De Long, 1993, "Why does the Stock Market Fluctuate?" Quarterly Journal of Economics, Vol. 108, No. 2, pp. 291–311.

Basel Committee on Banking Supervision, 2011, "The Transmission Channels between the Financial and Real Sectors: A Critical Survey of the Literature," BCBS Working Paper 18, Bank for International Settlements, Basel.

Basel Committee on Banking Supervision, 2012, "The Policy Implications of Transmission Channels between the Financial System and the Real Economy," BCBS Working Paper 20, Bank for International Settlements, Basel.

Basel Committee on Banking Supervision, 2016, "Literature Review on Integration of Regulatory Capital and Liquidity Instruments," BCBS Working Paper 30, Bank for International Settlements, Basel.

Bassett, W. F., M. B. Chosak, J. C. Driscoll, and E. Zakrajšek, 2014, "Changes in Bank Lending Standards and the Macroeconomy," Journal of Monetary Economics, Vol. 62, pp. 23–40.

Bauer, M. D., and G. D. Rudebusch, 2014, "The Signaling Channel for Federal Reserve Bond Purchases," International Journal of Central Banking, Vol. 10, No. 3, pp. 233–89.

Baumeister, C., and L. Benati, 2013, "Unconventional Monetary Policy and the Great Recession: Estimating the Macroeconomic Effects of a Spread Compression at the Zero Lower Bound," International Journal of Central Banking, Vol. 9, No. 2, pp. 165-212.

Baxter, M., and M. J. Crucini, 1995, "Business Cycles and the Asset Structure of Foreign Trade," International Economic Review, Vol. 36, No. 4, pp. 821–54.

Baxter, M., and U. J. Jermann, 1997, "The International Diversification Puzzle is Worse Than You Think," American Economic Review, Vol. 87, No. 1, pp. 170–80.

Baxter, M., and A. C. Stockman, 1989, "Business Cycles and the Exchange-Rate Regime: Some International Evidence," Journal of Monetary Economics, Vol. 23, No. 3, pp. 377–400.

Bayoumi, T., and H. Edison, 2003, "Is Wealth Increasingly Driving Consumption?" DNB Staff Report 101, De Nederlandsche Bank, Amsterdam.

Bayoumi, T., and O. Melander, 2008, "Credit Matters: Empirical Evidence on U.S. Macro-Financial Linkages," IMF Working Paper 08/169, International Monetary Fund, Washington, DC.

Bean, C., M. Paustian, A. Penalver, and T. Taylor, 2010, "Monetary Policy After the Fall," Proceedings of Economic Policy Symposium, Macroeconomic Challenges: The Decade Ahead, Federal Reserve Bank of Kansas City, August 26–28, Jackson Hole, pp. 267–328.

Becker, B., and V. Ivashina, 2014, "Cyclicality of Credit Supply: Firm Level Evidence," Journal of Monetary Economics, Vol. 62, pp. 76–93.

Begenau, J., 2016, "Capital Requirements, Risk Choice, and Liquidity Provision in a Business Cycle Model," Stanford GSB Working Paper 3554, Stanford University, Stanford.

Begenau, J., and T. Landvoigt, 2017, "Financial Regulation in a Quantitative Model of the Modern Banking System," Stanford GSB Working Paper 3558, Stanford University, Stanford.

Beine, M., and B. Candelon, 2011, "Liberalisation and Stock Market Co-Movement between Emerging Economies," Quantitative Finance, Vol. 11, No. 2, pp. 299–312.

Bekaert, G., and C. R. Harvey, 2000, "Capital Flows and the Behavior of Emerging Market Equity Returns," in Capital Inflows to Emerging Markets, S. Edwards (ed), pp. 159–94, Chicago: University of Chicago Press.

Bekaert, G., C. R. Harvey, A. Kiguel, and X. Wang, 2016, "Globalization and Asset Returns," Annual Review of Financial Economics, Vol. 8, pp. 221–88.

Bems, R., R. C. Johnson, and K.-M. Yi, 2013, "The Great Trade Collapse," Annual Review of Economics, Vol. 5, No. 1, pp. 375–400.

Benigno, G., 2004, "Real Exchange Rate Persistence and Monetary Policy Rules," Journal of Monetary Economics, Vol. 51, No. 3, pp. 473–502.

Benigno, G., 2009, "Comment on 'Expectations, Monetary Policy, and the Misalignment of Traded Goods Prices'," in NBER International Seminar on Macroeconomics 2007, R. Clarida and F. Giavazzi (eds), pp. 158–68, Chicago: University of Chicago Press.

Benmelech, E., R. R. Meisenzahl, and R. Ramcharan, 2017, "The Real Effects of Liquidity during the Financial Crisis: Evidence from Automobiles," Quarterly Journal of Economics, Vol. 132, No. 1, pp. 317–65.

Benninga, S., 2008, Financial Modeling, 3rd edition, Cambridge: MIT Press.

Bentolila, S., and G. Bertola, 1990, "Firing Costs and Labour Demand: How Bad is Eurosclerosis?" Review of Economic Studies, Vol. 57, No. 3, pp. 381–402.

Berger, A. N., and C. H.S. Bouwman, 2013, "How does Capital Affect Bank Performance during Financial Crises?" Journal of Financial Economics, Vol. 109, No. 1, pp. 146–76.

Berger, A. N., and G. F. Udell, 1994, "Did Risk-Based Capital Allocate Bank Credit and Cause a 'Credit Crunch' in the United States?" Journal of Money, Credit and Banking, Vol. 26, No. 3, pp. 585–628.

Bernanke, B. S., 1983a, "The Determinants of Investment: Another Look," American Economic Review, Vol. 73, No. 2, pp. 71–5.

Bernanke, B. S., 1983b, "Nonmonetary Effects of the Financial Crisis in Propagation of the Great Depression," American Economic Review, Vol. 73, No. 3, pp. 257–76.

Bernanke, B. S., 1990, "On the Predictive Power of Interest Rates and Interest Rate Spreads," New England Economic Review, pp. 51–68, November, Federal Reserve Bank of Boston, Boston.

Bernanke, B. S., 1992, "The Bank Credit Crunch," Proceedings 369, 28th Annual Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, May 6, Chicago.

Bernanke, B. S., 1993, "Credit in the Macroeconomy," Quarterly Review, Spring, pp. 50–70, Federal Reserve Bank of New York, New York.

Bernanke, B. S., 1995, "The Macroeconomics of the Great Depression: A Comparative Approach," Journal of Money, Credit and Banking, Vol. 27, No. 1, pp. 1–28.

Bernanke, B. S., 2007, "The Financial Accelerator and the Credit Channel," Speech at the Credit Channel of Monetary Policy in the Twenty-first Century Conference, Federal Reserve Bank of Atlanta, June 15, Atlanta.

Bernanke, B. S., 2010, "On the Implications of the Financial Crisis for Economics," Speech at the Conference Co-sponsored by the Center for Economic Policy Studies and the Bendheim Center for Finance, Princeton University, September 24, Princeton.

Bernanke, B. S., 2013, The Federal Reserve and the Financial Crisis, Princeton: Princeton University Press.

Bernanke, B. S., and A. Blinder, 1988, "Credit, Money, and Aggregate Demand," American Economic Review, Vol. 78, No. 2, pp. 435–9.

Bernanke, B., and M. Gertler, 1989, "Agency Costs, Net Worth, and Business Fluctuations," American Economic Review, Vol. 79, No. 1, pp. 14–31.

Bernanke, B., and M. Gertler, 1990, "Financial Fragility and Economic Performance," Quarterly Journal of Economics, Vol. 105, No. 1, pp. 87–114.

Bernanke, B. S., and M. Gertler, 1995, "Inside the Black Box: The Credit Channel of Monetary Policy Transmission," Journal of Economic Perspectives, Vol. 9, No. 4, pp. 27–48.

Bernanke, B., and M. Gertler, 2000, "Monetary Policy and Asset Price Volatility," NBER Working Paper 7559, National Bureau of Economic Research, Cambridge.

Bernanke, B., M. Gertler, and S. Gilchrist, 1996, "The Financial Accelerator and the Flight to Quality," Review of Economics and Statistics, Vol. 78, No. 1, pp. 1–15.

Bernanke, B., M. Gertler, and S. Gilchrist, 1999, "The Financial Accelerator in a Quantitative Business Cycle Framework," in Handbook of Macroeconomics, Vol. 1, J. B. Taylor and M. Woodford (eds), pp. 1341-93, Amsterdam: North-Holland.

Bernanke, B. S., and C. S. Lown, 1991, "The Credit Crunch," Brookings Papers on Economic Activity, Vol. 1991, No. 2, pp. 205–39.

Bernanke, B. S., and F. S. Mishkin, 1997, "Inflation Targeting: A New Framework for Monetary Policy?" Journal of Economic Perspectives, Vol. 11, No. 2, pp. 97–116.

Bernanke, B. S., V. R. Reinhart, and B. P. Sack, 2004, "Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment," Brookings Papers on Economic Activity, Vol. 2004, No. 2, pp. 1–78.

Berriel, T. C., and S. Bhattarai, 2013, "Hedging against the Government: A Solution to the Home Asset Bias Puzzle," American Economic Journal: Macroeconomics, Vol. 5, No. 1, pp. 102–34.

Berrospide, J. M., and R. M. Edge, 2010, "The Effects of Bank Capital on Lending: What do We Know, and What does It Mean?" International Journal of Central Banking, Vol. 6, No. 4, pp. 5–54.

Besanko, D., and A. Thakor, 1987, "Collateral and Rationing: Sorting Equilibria in Monopolistic and Competitive Credit Markets," International Economic Review, Vol. 28, No. 3, pp. 671–89.

Bester, H., 1987, "The Role of Collateral in Credit Markets with Imperfect Information," European Economic Review, Vol. 31, No. 4, pp. 887–99.

Bianchi, J., 2011, "Overborrowing and Systemic Externalities in the Business Cycle," American Economic Review, Vol. 101, No. 7, pp. 3400–26.

Bianchi, J., E. Boz, and E. G. Mendoza, 2012, "Macroprudential Policy in a Fisherian Model of Financial Innovation," IMF Economic Review, Vol. 60, No. 2, pp. 223–69.

Bianchi, J., C. Liu, and E. G. Mendoza, 2016, "Fundamentals News, Global Liquidity and Macroprudential Policy," Journal of International Economics, Vol. 99, No. S1, pp. S2-15.

Bianchi, J., and E. G. Mendoza, forthcoming, "Optimal Time-Consistent Macroprudential Policy," Journal of Political Economy.

Bikhchandani, S., and S. Sharma, 2000, "Herd Behavior in Financial Markets - A Review," IMF Working Paper 00/48, International Monetary Fund, Washington, DC.

Black, F., 1974, "International Capital Market Equilibrium with Investment Barriers," Journal of Financial Economics, Vol. 1, pp. 337–52.

Black, F., and M. Scholes, 1973, "The Pricing of Options and Corporate Liabilities," Journal of Political Economy, Vol. 81, No. 3, pp. 637–54.

Blanchard, O., 1990, "Money and Output: A Survey," in Handbook of Monetary Economics, Vol. 2, B. M. Friedman and F. H. Hahn (eds), pp. 779–835, Amsterdam: North-Holland.

Blanchard, O., 2000, "What do We Know about Macroeconomics That Fisher and Wicksell did not?" Quarterly Journal of Economics, Vol. 115, No. 4, pp. 1375-409.

Blanchard, O., 2009, "The State of Macro," Annual Review of Economics, Vol. 1, No. 1, pp. 209–28.

Blanchard, O., 2017a, "Distortions in Macroeconomics," Paper submitted to NBER Macroeconomics Annual, June 18, Peterson Institute for International Economics, Washington, DC.

Blanchard, O., 2017b, "On the Need for (At Least) Five Classes of Macro Models," Peterson Institute for International Economics, Washington, DC.

Blanchard, O., G. Dell'Ariccia, and P. Mauro, 2010, "Rethinking Macroeconomic Policy," Journal of Money, Credit and Banking, Vol. 42, No. S1, pp. 199–215.

Blanchard, O., G. Dell'Ariccia, and P. Mauro, 2013, "Rethinking Macro Policy II: Getting Granular," IMF Staff Discussion Note 13/03, International Monetary Fund, Washington, DC.

Blanchard, O., F. Giavazzi, and F. Sa, 2005, "International Investors, the U.S. Current Account, and the Dollar," Brookings Papers on Economic Activity, Vol. 2005, No. 1, pp. 1–65.

Blanchard, O. J., F. Lopez-de-Silanes, and A. Shleifer, 1994, "What do Firms Do with Cash Windfalls?" Journal of Financial Economics, Vol. 36, No. 3, pp. 337–60.

Blanchard, O., and G. M. Milesi-Ferretti, 2012, "(Why) Should Current Account Balances Be Reduced?" IMF Economic Review, Vol. 60, No. 1, pp. 139–50.

Blanchard, O., R. Rajan, K. Rogoff, and L. Summers (eds), 2016, Progress and Confusion: The State of Macroeconomic Policy, Cambridge: MIT Press.

Blanchard, O., C. Rhee, and L. H. Summers, 1993, "The Stock Market, Profit and Investment," Quarterly Journal of Economics, Vol. 108, No. 1, pp. 115–36.

Blanchard, O., D. Romer, M. Spence, and J. Stiglitz, 2012, In the Wake of the Crisis: Leading Economists Reassess Economic Policy, Cambridge: MIT Press.

Blanchard, O., and L. Summers, 2017, "Rethinking Stabilization Policy: Back to the Future," Paper presented at the Rethinking Macroeconomic Policy Conference, Peterson Institute for International Economics, October 12–13, Washington, DC.

Blanchard, O. J., and M. W. Watson, 1982, "Bubbles, Rational Expectations and Financial Markets," in Crises in the Economic and Financial Structure, P. Wachtel (ed), pp. 295–316, Lexington: D.C. Heath and Company.

Blinder, A. S., 2013, After the Music Stopped: The Financial Crisis, the Response, and the Work Ahead, New York: Penguin Press.

Blinder, A. S., and L. J. Maccini, 1991, "The Resurgence of Inventory Research: What Have We Learned?" Journal of Economic Surveys, Vol. 5, No. 4, pp. 291–328.

Bloom, N., 2009, "The Impact of Uncertainty Shocks," Econometrica, Vol. 77, No. 3, pp. 623–85.

Bloom, N., 2014, "Fluctuations in Uncertainty," Journal of Economic Perspectives, Vol. 28, No. 2, pp. 153–76.

Bloom, N., M. Floetotto, N. Jaimovich, I. Saporta-Eksten, and S. J. Terry, 2012, "Really Uncertain Business Cycles," NBER Working Paper 18245, National Bureau of Economic Research, Cambridge.

Bluedorn, J. C., J. Decressin, M. E. Terrones, 2016, "Do Asset Price Drops Foreshadow Recessions?" International Journal of Forecasting, Vol. 32, No. 2, pp. 518–26.

Bluwstein, K., 2017, "Asymmetric Macro-Financial Spillovers," Sveriges Riksbank Working Paper 337, Sveriges Riksbank, Stockholm.

Boissay, F., F. Collard, and F. Smets, 2016, "Booms and Banking Crises," Journal of Political Economy, Vol. 124, No. 2, pp. 489–538.

Boivin, J., M. T. Kiley, and F. S. Mishkin, 2011, "How Has the Monetary Transmission Mechanism Evolved Over Time?" in Handbook of Monetary Economics, Vol. 3, B. M. Friedman and M. Woodford (eds), pp. 369–422, Amsterdam: North-Holland.

Bolton, P., H. Chen, and N. Wang, 2013, "Market Timing, Investment, and Risk Management," Journal of Financial Economics, Vol. 109, No. 1, pp. 40–62.

Bonser-Neal, C., and T. R. Morley, 1997, "Does the Yield Spread Predict Real Economic Activity? A Multicountry Analysis," Federal Reserve Bank of Kansas City Economic Review, Vol. 82, No. 3, pp. 37–53.

Bordo, M. D., E. U. Choudhri, G. Fazio, and R. MacDonald, 2017, "The Real Exchange Rate in the Long Run: Balassa-Samuelson Effects Reconsidered," Journal of International Money and Finance, Vol. 75, pp. 69–92.

Bordo, M. D., and J. G. Haubrich, 2004, "The Yield Curve, Recessions and the Credibility of the Monetary Regime: Long Run Evidence 1975–1997," NBER Working Paper 10431, National Bureau of Economic Research, Cambridge.

Bordo, M. D., and J. G. Haubrich, 2010, "Credit Crises, Money and Contractions: A Historical View," Journal of Monetary Economics, Vol. 57, No. 1, pp. 1–18.

Bordo, M. D., and O. Jeanne, 2002, "Monetary Policy and Asset Prices: Does 'Benign Neglect' Make Sense?" International Finance, Vol. 5, No. 2, pp. 139–64.

Borio, C. E. V., 1997, "Monetary Policy Operating Procedures in Industrial Countries," BIS Working Paper 40, Bank for International Settlements, Basel.

Borio, C., 2000, "Market Liquidity and Stress: Selected Issues and Policy Implications," BIS Quarterly Review, November, pp. 38–48, Bank for International Settlements, Basel.

Borio, C., 2003, "Towards a Macroprudential Framework for Financial Supervision and Regulation?" CESifo Economic Studies, Vol. 49, No. 2, pp. 181–215.

Borio, C., 2004, "Market Distress and Vanishing Liquidity: Anatomy and Policy Options," BIS Working Paper 158, Bank for International Settlements, Basel.

Borio, C., 2013, "The Great Financial Crisis: Setting Priorities for New Statistics," Journal of Banking Regulation, Vol. 14, No. 3–4, pp. 306–17.

Borio, C., 2014, "The Financial Cycle and Macroeconomics: What Have We Learnt?" Journal of Banking & Finance, Vol. 45, pp. 182–98.

Borio, C., 2017, "Through the Looking Glass," OMFIF City Lecture, September 22, London.

Borio, C., and P. Disyatat, 2011, "Global Imbalances and the Financial Crisis: Link or No Link?" BIS Working Paper 346, Bank for International Settlements, Basel.

Borio, C., and M. Drehmann, 2009, "Assessing the Risk of Banking Crises – Revisited," BIS Quarterly Review, March, pp. 29–46, Bank for International Settlements, Basel.

Borio, C., C. Furfine, and P. Lowe, 2001, "Procyclicality of the Financial System and Financial Stability: Issues and Policy Options," in BIS Paper 1, Marrying Macro- and Micro-Prudential Dimensions of Financial Stability, pp. 1–57, Bank for International Settlements, Basel.

Borio, C., and B. Hofmann, 2017, "Is Monetary Policy Less Effective When Interest Rates are Persistently Low?" BIS Working Paper 628, Bank for International Settlements, Basel.

Borio, C. E. V., N. Kennedy, and S. D. Prowse, 1994, "Exploring Aggregate Asset Price Fluctuations across Countries: Measurement, Determinants and Monetary Policy Implications," BIS Economic Paper 40, Bank for International Settlements, Basel.

Borio, C., and P. Lowe, 2002, "Asset Prices, Financial and Monetary Stability: Exploring the Nexus," BIS Working Paper 114, Bank for International Settlements, Basel.

Borio, C., and P. Lowe, 2004, "Securing Sustainable Price Stability: Should Credit Come Back from the Wilderness?" BIS Working Paper 157, Bank for International Settlements, Basel.

Borio, C., R. McCauley, P. McGuire, and V. Sushko, 2016, "Covered Interest Parity Lost: Understanding the Cross-Currency Basis," BIS Quarterly Review, September, pp. 45–64, Bank for International Settlements, Basel.

Borio, C., and P. McGuire, 2004, "Twin Peaks in Equity and Housing Prices?" BIS Quarterly Review, March, pp. 79–93, Bank for International Settlements, Basel.

Borio, C., and A. Zabai, 2016, "Unconventional Monetary Policies: A Re-Appraisal," BIS Working Paper 570, Bank for International Settlements, Basel.

Borio, C., and H. Zhu, 2012, "Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?" Journal of Financial Stability, Vol. 8, No. 4, pp. 236–51.

Bouakez, H., and A. Eyquem, 2015, "Government Spending, Monetary Policy, and the Real Exchange Rate," Journal of International Money and Finance, Vol. 56, pp. 178–201.

Boulier, B. L., and H. O. Stekler, 2000, "The Term Spread as a Monthly Cyclical Indicator," Economics Letters, Vol. 66, pp. 79–83.

Bouwman, C. H. S., 2014, "Liquidity: How Banks Create It and How It Should Be Regulated," in The Oxford Handbook of Banking, 2nd edition, A. N. Berger, P. Moyneux, and J. O. S. Wilson (eds), pp. 184–218, New York: Oxford University Press.

Brainard, W., and J. Tobin, 1968, "Pitfalls in Financial Model-Building," American Economic Review, Vol. 58, No. 2, pp. 99–122.

Branson, W. H., and D. W. Henderson, 1985, "The Specification and Influence of Assets Markets," in Handbook of International Economics, Vol. 2, R. W. Jones and P. B. Kenen (eds), pp. 749–805, Amsterdam: North-Holland.

Brealey, R. A., S. C. Myers, and F. Allen, 2016, Principles of Corporate Finance, 12th edition, New York: McGraw-Hill.

Breedon, F., D. Rime, and P. Vitale, 2016, "Carry Trades, Order Flow, and the Forward Bias Puzzle," Journal of Money, Credit and Banking, Vol. 48, No. 6, pp. 1113–34.

Breitung, J., and S. Eickmeier, 2014, "Analyzing Business and Financial Cycles Using Multi-Level Factor Models," CAMA Working Paper 43/2014, Australian National University, Canberra.

Bruche, M., and J. Suarez, 2010, "Deposit Insurance and Money Market Freezes," Journal of Monetary Economics, Vol. 57, No. 1, pp. 45–61.

Brunner, K., and A. H. Meltzer, 1963, "Predicting Velocity: Implications for Theory and Policy," Journal of Finance, Vol. 18, pp. 319–54.

Brunner, K., and A. H. Meltzer, 1988, "Money and Credit in the Monetary Transmission Process," American Economic Review, Vol. 78, No. 2, pp. 446–51.

Brunnermeier, M. K., 2001, Asset Pricing Under Asymmetric Information: Bubbles, Crashes, Technical Analysis and Herding, New York: Oxford University Press.

Brunnermeier, M., A. Crockett, C. Goodhart, A. D. Persaud, and H. S. Shin, 2009a, The Fundamental Principles of Financial Regulation, Geneva Report on the World Economy, No. 11, Geneva: International Center for Monetary and Banking Studies.

Brunnermeier, M. K., T. M. Eisenbach, and Y. Sannikov, 2013, "Macroeconomics with Financial Frictions: A Survey," in Advances in Economics and Econometrics, Tenth World Congress of the Econometric Society, Vol. 2, D. Acemoglu, M. Arellano, and E. Dekel (eds), pp. 4–94, New York: Cambridge University Press.

Brunnermeier, M., and A. Krishnamurthy (eds), 2014, Risk Topography: Systemic Risk and Macro Modeling, Chicago: University of Chicago Press.

Brunnermeier, M. K., S. Nagel, and L. H. Pedersen, 2009b, "Carry Trades and Currency Crashes," in NBER Macroeconomics Annual 2008, Vol. 23, D. Acemoglu, K. Rogoff, and M. Woodford (eds), pp. 313–47, Chicago: University of Chicago Press.

Brunnermeier, M. K., and M. Oehmke, 2013, "Bubbles, Financial Crises, and Systemic Risk," in Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 1221–88, Amsterdam: North-Holland.

Brunnermeier, M. K., and L. H. Pedersen, 2009, "Market Liquidity and Funding Liquidity," Review of Financial Studies, Vol. 22, No. 6, pp. 2201–38.

Brunnermeier, M. K., and Y. Sannikov, 2014, "A Macroeconomic Model with a Financial Sector," American Economic Review, Vol. 104, No. 2, pp. 379–421.

Brunnermeier, M. K., and Y. Sannikov, 2015, "International Credit Flows and Pecuniary Externalities," American Economic Journal: Macroeconomics, Vol. 7, No. 1, pp. 297–338.

Brunnermeier, M. K., and Y. Sannikov, 2016, "The I Theory of Money," NBER Working Paper 22533, National Bureau of Economic Research, Cambridge.

Bruno, V., and H. S. Shin, 2015, "Capital Flows and the Risk-Taking Channel of Monetary Policy," Journal of Monetary Economics, Vol. 71, pp. 119–32.

Bruno, V., and H. S. Shin, 2017, "Global Dollar Credit and Carry Trades: A Firm-Level Analysis," Review of Financial Studies, Vol. 30, No 3, pp. 703–49.

Buera, F. J., and B. Moll, 2015, "Aggregate Implications of a Credit Crunch: The Importance of Heterogeneity," American Economic Journal: Macroeconomics, Vol. 7, No. 3, pp. 1–42.

Buiter, W. H., 2010, "Housing Wealth Isn't Wealth," Economics: The Open-Access, Open-Assessment E-Journal, Vol. 4, Article 2010–22.

Bulow, J., and K. Rogoff, 1989, "A Constant Recontracting Model of Sovereign Debt," Journal of Political Economy, Vol. 97, No. 1, pp. 155–78.

Burns, A. F., and W. C. Mitchell, 1946, Measuring Business Cycles, New York: National Bureau of Economic Research.

Burnside, C., M. S. Eichenbaum, I. Kieshchelski, and S. Rebelo, 2011a, "Do Peso Problems Explain the Returns to the Carry Trade?" Review of Financial Studies, Vol. 24, No. 3, pp. 853–91.

Burnside, C., M. S. Eichenbaum, and S. Rebelo, 2011b, "Carry Trade and Momentum in Currency Markets," Annual Review of Financial Economics, Vol. 3, pp. 511–35.

Burnside, C., M. Eichenbaum, and S. Rebelo, 2016, "Understanding Booms and Busts in Housing Markets," Journal of Political Economy, Vol. 124, No, 4, pp. 1088–147.

Burstein, A., M. S. Eichenbaum, and S. Rebelo, 2005, "Large Devaluations and the Real Exchange Rate," Journal of Political Economy, Vol. 113, No. 4, pp. 742–84.

Burstein, A., M. S. Eichenbaum, and S. Rebelo, 2007, "Modeling Exchange Rate Passthrough After Large Devaluations," Journal of Monetary Economics, Vol. 54, No. 2, pp. 246–68.

Burstein, A., and G. Gopinath, 2014, "International Prices and Exchange Rates," in Handbook of International Economics, Vol. 4, G. Gopinath, E. Helpman, and K. Rogoff (eds), pp. 391–451. Amsterdam: North-Holland.

Butzen, P., C. Fuss, and P. Vermeulen, 2003, "The Impact of Uncertainty on Investment Plans: A Survey Data Approach," in Firms' Investment and Finance Decisions: Theory and Empirical Methodology, P. Butzen and C. Fuss (eds), pp. 227–45, Cheltenham: Edward Elgar Publishing.

Ca' Zorzi, M., M. Kolasa, and M. Rubaszek, 2017, "Exchange Rate Forecasting with DSGE Models," Journal of International Economics, Vol. 107, pp. 127–46.

Caballero, R. J., 1999, "Aggregate Investment," in Handbook of Macroeconomics, Vol. 1, J. B. Taylor, and M. Woodford (eds), pp. 813–62, Amsterdam: North-Holland.

Caballero, R. J., 2010, "Macroeconomics after the Crisis: Time to Deal with the Pretense-of-Knowledge Syndrome," Journal of Economic Perspectives, Vol. 24, No. 4, pp. 85–102.

Caballero, R. J., and V. Corbo, 1989, "The Effect of Real Exchange Rate Uncertainty on Exports: Empirical Evidence," World Bank Economic Review, Vol. 3, No. 2, pp. 263–78.

Caballero, R. J., E. Farhi, and P. O. Gourinchas, 2008a, "Financial Crash, Commodity Prices and Global Imbalances," Brookings Papers on Economic Activity, Vol. 2008, No. 1, pp. 1–55.

Caballero, R. J., T. Hoshi, and A. K. Kashyap, 2008b, "Zombie Lending and Depressed Restructuring in Japan," American Economic Review, Vol. 98, No. 5, pp. 1943–77.

Caballero, R. J., and A. Krishnamurthy, 1998, "Emerging Market Crises: An Asset Markets Perspective," NBER Working Paper 6843, National Bureau of Economic Research, Cambridge.

Caballero, R. J., and A. Krishnamurthy, 2001, "International and Domestic Collateral Constraints in a Model of Emerging Market Crises," Journal of Monetary Economics, Vol. 48, No. 3, pp. 513–48.

Caballero, R. J., and A. Simsek, 2016, "A Model of Fickle Capital Flows and Retrenchment," NBER Working Paper 22751, National Bureau of Economic Research, Cambridge.

Calomiris, C. W., 1993, "Corporate-Finance Benefits from Universal Banking: Germany and the United States, 1870–1917," Proceedings 424, 29th Annual Conference on Risk Structure and Competition, Federal Reserve Bank of Chicago, May 7, Chicago.

Calomiris, C. W., C. P. Himmelberg, and P. Wachtel, 1995, "Commercial Paper, Corporate Finance, and the Business Cycle: A Microeconomic Perspective," Carnegie-Rochester Conference Series on Public Policy, Vol. 42, No. 1, pp. 203–50.

Calomiris, C. W., and C. Kahn, 1991, "The Role of Demandable Debt in Structuring Optimal Banking Arrangements," American Economic Review, Vol. 81, pp. 497–513.

Calomiris, C. W., S. D. Longhofer, and W. Miles, 2013, "The Housing Wealth Effect: The Crucial Roles of Demographics, Wealth Distribution and Wealth Shares," Critical Finance Review, Vol. 2, No. 1, pp. 49–99.

Calomiris, C. W., and J. R. Mason, 2004, "How to Restructure Failed Banking Systems: Lessons from the United States in the 1930s and Japan in the 1990s," in Governance, Regulation, and Privatization in the Asia-Pacific Region, NBER East Asia Seminar on Economics, Vol. 12, T. Ito and A. O. Krueger (eds), pp. 375–423, Chicago: University of Chicago Press.

Calvo, G., 2005, Emerging Capital Markets in Turmoil, Cambridge: MIT Press.

Cameron, R., 1961, France and the Economic Development of Europe, 1800–1914: Conquests of Peace and Seeds of War, Princeton: Princeton University Press.

Cameron, R., 1967, Banking in the Early Stages of Industrialization: A Study in Comparative Economic History, New York: Oxford University Press.

Campa, J., and L. Goldberg, 1999, "Investment, Pass-Through, and Exchange Rates: A Cross-Country Comparison," International Economic Review, Vol. 40, No. 2, pp. 287–31.

Campa, J., and L. Goldberg, 2005, "Exchange Rate Pass-Through into Import Prices," Review of Economics and Statistics, Vol. 87, pp. 679–90.

Campbell, J. R., C. L. Evans, J. D. M. Fisher, and A. Justiniano, 2012, "Macroeconomic Effects of Federal Reserve Forward Guidance," Brookings Papers on Economic Activity, Spring, pp. 1–80.

Campbell, J. R., and Z. Hercowitz, 2009. "Liquidity Constraints of the Middle Class," Federal Reserve Bank of Chicago Working Paper 09–20, Federal Reserve Bank of Chicago, Chicago.

Campbell, J. Y., 1986, "A Defense of Traditional Hypotheses about the Term Structure of Interest Rates," Journal of Finance, Vol. 41, No. 1, pp. 183–93.

Campbell, J. Y., 2003, "Consumption-Based Asset Pricing," in Handbook of the Economics of Finance, Vol. 1, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 803–87, Amsterdam: North-Holland.

Campbell, J. Y., 2014, "Empirical Asset Pricing: Eugene Fama, Lars Peter Hansen, and Robert Shiller," Scandinavian Journal of Economics, Vol. 116, No. 3, 593–634.

Campbell, J. Y., and J. F. Cocco, 2007, "How do House Prices Affect Consumption? Evidence from Micro Data," Journal of Monetary Economics, Vol. 54, No. 3, pp. 591-621.

Campbell, J. Y., and J. H. Cochrane, 1999, "Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior," Journal of Political Economy, Vol. 107, No. 2, pp. 205–51.

Campbell, J. Y., S. Giglio, and C. Polk, 2013, "Hard Times," Review of Asset Pricing Studies, Vol. 3, No. 1, pp. 95–132.

Campbell, J. Y., S. W. Giglio, C. Polk, and R. Turley, 2015, "An Intertemporal CAPM with Stochastic Volatility," CEPR Discussion Paper 10681, Centre for Economic Policy Research, London.

Campbell, J. Y., A. W. Lo, and A. C. MacKinlay, 1996, The Econometrics of Financial Markets, Princeton: Princeton University Press.

Campbell, J. Y., and N. G. Mankiw, 1989, "Consumption, Income and Interest Rates: Reinterpreting the Time Series Evidence," in NBER Macroeconomics Annual 1989, Vol. 4, O. J. Blanchard and S. Fischer (eds), pp. 185–246, Cambridge: MIT Press.

Campbell, J. Y., and N. G. Mankiw, 1990, "Permanent Income, Current Income, and Consumption," Journal of Business & Economic Statistics, Vol. 8, No. 3, pp. 265–79.

Campbell, J. Y., C. Pflueger, and L. M. Viceira, 2014, "Monetary Policy Drivers of Bond and Equity Risks," NBER Working Paper 20070, National Bureau of Economic Research, Cambridge.

Campbell, J. Y., and R. J. Shiller, 1987, "Cointegration and Tests of Present Value Models," Journal of Political Economy, Vol. 95, No. 5, pp. 1062–88.

Campbell, J. Y., and R. J. Shiller, 1988a, "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors," Review of Financial Studies, Vol. 1, No. 3, pp. 195–228.

Campbell, J. Y., and R. J. Shiller, 1988b, "Stock Prices, Earnings, and Expected Dividends," Journal of Finance, Vol. 43, No. 3, pp. 661–76.

Campbell, J. Y., A. Sunderam, and L. M. Viceira, 2017, "Inflation Bets or Deflation Hedges? The Changing Risks of Nominal Bonds," Critical Finance Review, Vol. 6, pp. 263–301.

Campello, M., J. R. Graham, and C. Harvey, 2010, "The Real Effects of Financial Constraints: Evidence from a Financial Crisis," Journal of Financial Economics, Vol. 97, No. 3, pp. 470–87.

Canova, F., 1998, "Detrending and Business Cycle Facts," Journal of Monetary Economics, Vol. 41, No. 3, pp. 475–512.

Cantor, R., 1990, "A Panel Study of the Effects of Leverage on Investment and Employment," Research Paper 9011, Federal Reserve Bank of New York, New York.

Cantor R., and J. Wenninger, 1993, "Perspective on the Credit Slowdown," Quarterly Review, Vol. 18, No. 1, pp. 3–36, Federal Reserve Bank of New York, New York.

Caprio, G. Jr., 2011, "Macro-Financial Linkages in IMF Research," IEO Background Paper 11/07, International Monetary Fund, Washington, DC.

Cardarelli, R., T. Monacelli, A. Rebucci, and L. Sala, 2008, "Housing Finance, Housing Shocks, and the Business Cycles: Evidence from OECD Countries," Paper prepared for the 5th Workshop of the Latin American Finance Network, Inter-American Development Bank, November 19, Rio de Janeiro.

Carlstrom, C. T., and T. S. Fuerst, 1997, "Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis," American Economic Review, Vol. 87, No. 5, pp. 893–910.

Carlstrom, C. T., T. S. Fuerst, and M. Paustian, 2009, "Inflation Persistence, Monetary Policy, and the Great Moderation," Journal of Money, Credit and Banking, Vol. 41, No. 4, pp. 767–86.

Carpenter, R. E., S. M. Fazzari, and B. C. Petersen, 1994, "Inventory Investment, Internal Finance Fluctuations, and the Business Cycle," Brookings Papers on Economic Activity, Vol. 1994, No. 2, pp. 75–138.

Carroll, C. D., 1997, "Buffer Stock Saving and the Life Cycle/Permanent Income Hypothesis," Quarterly Journal of Economics, Vol. 112, pp. 1–55.

Carroll, C. D., 2001, "A Theory of the Consumption Function, With and Without Liquidity Constraints," Journal of Economic Perspectives, Vol. 15, No. 3, pp. 23–45.

Carroll, C. D., M. Otsuka, and J. Slacalek, 2011, "How Large Are Housing and Financial Wealth Effects? A New Approach," Journal of Money, Credit and Banking, Vol. 43, No. 1, pp. 55–79.

Casas, C., F. Díez, G. Gopinath and P.-O. Gourinchas, 2017, "Dollar Pricing Redux," BIS Working Paper 653, Bank for International Settlements, Basel.

Case, K. E., J. M. Quigley, and R. J. Shiller, 2005, "Comparing Wealth Effects: The Stock Market versus the Housing Market," Advances on Macroeconomics, Vol. 5, No. 1, Article 1.

Case, K. E., J. M. Quigley, and R. J. Shiller, 2013, "Wealth Effects Revisited 1975–2012," Critical Finance Review, Vol. 2, No. 1, pp. 101–28.

Castro, V., and M. Kubota, 2013, "Duration Dependence and Change-Points in the Likelihood of Credit Booms Ending," World Bank Policy Research Working Paper 6475, World Bank, Washington, DC.

Catte, P., N. Girouard, R. W. R. Price, and C. André, 2004, "Housing Markets, Wealth and the Business Cycle," OECD Economics Department Working Paper 394, Organisation for Economic Co-operation and Development, Paris.

Cavallo, M., and F. Ghironi, 2002, "Net Foreign Assets and the Exchange Rate: Redux Revived," Journal of Monetary Economics, Vol. 49, No. 5, pp. 1057–97.

Cecchetti, S. G., 1995, "Distinguishing Theories of the Monetary Transmission Mechanism," Review, Vol. 77, No. 3, pp. 83–97, Federal Reserve Bank of St. Louis, St. Louis.

Cecchetti, S. G., 2008, "Measuring the Macroeconomic Risks Posed by Asset Price Booms," in Asset Prices and Monetary Policy, J. Y. Campbell (ed), pp. 9–43, Chicago: University of Chicago Press.

Cecchetti, S. G., H. Genberg, J. Lipsky, and S. Wadhwani, 2000, Asset Prices and Central Bank Policy, Geneva Report on the World Economy, No. 2, Geneva: International Center for Monetary and Banking Studies.

Cecchetti, S. G., and L. Li, 2008, "Do Capital Adequacy Requirements Matter for Monetary Policy?" Economic Inquiry, Vol. 46, No. 4, pp. 643–59.

Cenedese, G., R. Payne, L. Sarno, and G. Valente, 2016, "What do Stock Markets Tell Us about Exchange Rates?" Review of Finance, Vol. 20, No. 3, pp. 1045–80.

Cenedese, G., L. Sarno, and I. Tsiakas, 2014, "Foreign Exchange Risk and the Predictability of Carry Trade Returns," Journal of Banking & Finance, Vol. 42, pp. 302-13.

Cerra, V., and S. C. Saxena, 2010, "The Monetary Model Strikes Back: Evidence from the World," Journal of International Economics, Vol. 81, pp. 184–96.

Cerutti, E., S. Claessens, and P. McGuire, 2014, "Systemic Risks in Global Banking: What Available Data can Tell Us and What More Data are Needed?" in Risk Topography: Systemic Risk and Macro Modeling, M. Brunnermeier and A. Krishnamurthy (eds), pp. 235–60, Chicago: University of Chicago Press.

Cerutti, E., S. Claessens, and D. Puy, 2015, "Push Factors and Capital Flows to Emerging Markets: Why Knowing Your Lender Matters More Than Fundamentals," IMF Working Paper 15/127, International Monetary Fund, Washington, DC.

Cerutti, E., S. Claessens, and L. Ratnovski, 2017a, "Global Liquidity and Cross-Border Bank Flows," Economic Policy, Vol. 32, No. 89, pp. 81–125.

Cerutti, E., S. Claessens, and A. Rose, 2017b, "How Important is the Global Financial Cycle? Evidence from Capital Flows," BIS Working Paper 661, Bank for International Settlements, Basel.

Cesa-Bianchi, A., 2013, "Housing Cycles and Macroeconomic Fluctuations: A Global Perspective," Journal of International Money and Finance, Vol. 37, pp. 215–38.

Cesa-Bianchi, A., L. F. Cespedes, and A. Rebucci, 2015, "Global Liquidity, House Prices, and the Macroeconomy: Evidence from Advanced and Emerging Economies," Journal of Money, Credit and Banking, Vol. 47, No. S1, pp. 301–35.

Cesa-Bianchi, A., A. Ferrero, and A. Rebucci, forthcoming, "International Credit Supply Shocks," in NBER International Seminar on Macroeconomics 2017, J. Frankel and H. Rey (eds), Elsevier.

Céspedes, L. F., R. Chang, and A. Velasco, 2004, "Balance Sheets and Exchange Rate Policy," American Economic Review, Vol. 94, No. 4, pp. 1183–93.

CBGG, 2011, "Central Bank Governance and Financial Stability," Report prepared by a study group chaired by S. Ingves, May, Bank for International Settlements, Basel.

CGFS, 2010, "Macroprudential Instruments and Frameworks: A Stocktaking of Issues and Experiences," CGFS Paper 38, Committee on the Global Financial System, Basel.

CGFS, 2012, "Operationalising the Selection and Application of Macroprudential Instruments," CGFS Paper 48, Committee on the Global Financial System, Basel.

Chaney, T., D. Sraer, and D. Thesmar, 2012, "The Collateral Channel: How Real Estate Shocks Affect Corporate Investment," American Economic Review, Vol. 102, No. 6, pp. 2381–409.

Chari, V. V., L. J. Christiano, and P. J. Kehoe, 2008, "Facts and Myths about the Financial Crisis of 2008," Federal Reserve Bank of Minneapolis Working Paper 666, Federal Reserve Bank of Minneapolis, Minneapolis.

Chari, A., and P. B. Henry, 2004, "Risk Sharing and Asset Prices: Evidence from a Natural Experiment," Journal of Finance, Vol. 59, No. 3, pp. 1295–324.

Chari, V. V., and P. J. Kehoe, 2006, "Modern Macroeconomics in Practice: How Theory is Shaping Policy," Journal of Economic Perspectives, Vol. 20, No. 4, pp. 3–28.

Chari, V. V., P. J. Kehoe, and E. R. McGrattan, 2007, "Comparing Alternative Representations and Alternative Methodologies in Business Cycle Accounting," Federal Reserve Bank of Minneapolis Staff Report 384, Federal Reserve Bank of Minneapolis, Minneapolis.

Chatterjee, S., 2006, "The Long-Run Effects of the Bankruptcy Reform Bill," Research Rap Special Report, October, Federal Reserve Bank of Philadelphia, Philadelphia.

Chen, H., S. Joslin, and N. Tran, 2012, "Rare Disasters and Risk Sharing with Heterogeneous Beliefs," Review of Financial Studies, Vol. 25, No. 7, pp. 2189–224.

Chen, N., and L. Juvenal, 2016, "Quality, Trade, and Exchange Rate Pass-Through," Journal of International Economics, Vol. 100, pp. 61–80.

Chen, N.-K., 2001, "Bank Net Worth, Asset Prices and Economic Activity," Journal of Monetary Economics, Vol. 48, No. 2, pp. 415–36.

Chen, Y., K. Rogoff, and B. Rossi, 2010, "Can Exchange Rates Forecast Commodity Prices?" Quarterly Journal of Economics, Vol. 125, No. 3, pp. 1145–94.

Chen, Y., and K. Tsang, 2013, "What Does the Yield Curve Tell Us about Exchange Rate Predictability?" Review of Economics and Statistics, Vol. 95, No. 1, pp. 185–205.

Cheung, Y.-W., M. D. Chinn, and A. Garcia Pascual, 2005, "What do We Know about Recent Exchange Rate Models? In-Sample Fit and Out of Sample Performance Evaluated," in Exchange Rate Modelling: Where do We Stand? P. DeGrauwe (ed), pp. 239–76, Cambridge: MIT Press.

Cheung, Y.-W., M. D. Chinn, A. Garcia Pascual, and Y. Zhang, 2017, "Exchange Rate Prediction Redux: New Models, New Data, New Currencies," NBER Working Paper 23267, National Bureau of Economic Research, Cambridge.

Chinn, M. D, 2006, "The (Partial) Rehabilitation of Interest Rate Parity: Longer Horizons, Alternative Expectations, and Emerging Markets," Journal of International Money and Finance, Vol. 25, pp. 7–21.

Chinn, M. D, 2010, "Supply Capacity, Vertical Specialization and Trade Costs: The Implications for Aggregate U.S. Trade Flow Equations," CAGE Working Paper 14, University of Warwick, Coventry.

Chinn, M. D., 2012, "Macro Approaches to Foreign Exchange Determination," in Handbook of Exchange Rates, J. James, I. W. Marsh, and L. Sarno (eds), pp. 45–71, Hoboken: Wiley.

Chinn, M. D., and L. D. Johnston, 1999, "The Impact of Productivity Differentials on Real Exchange Rates: Beyond the Balassa-Samuelson Framework," Department of Economics Working Paper 442, University of California, Santa Cruz, Santa Cruz.

Chinn, M., and K. Kucko, 2015, "The Predictive Power of the Yield Curve across Countries and Time," International Finance, Vol. 18, No. 2, pp. 129–56.

Chinn, M. D., and G. Meredith, 2004, "Monetary Policy and Long Horizon Uncovered Interest Parity," IMF Staff Papers, Vol. 51, No. 3, pp. 409–30.

Chinn, M. D., and M. J. Moore, 2011, "Order Flow and the Monetary Model of Exchange Rates: Evidence from a Novel Data Set," Journal of Money, Credit and Banking, Vol. 43, No. 8, pp. 1599–624.

Chinn, M. D., and S.-J. Wei, 2013, "A Faith-Based Initiative Meets the Evidence: Does a Flexible Exchange Rate Regime Really Facilitate Current Account Adjustment?" Review of Economics and Statistics, Vol. 95, No. 1, pp. 168–84.

Chirinko, R. S., 1993, "Business Fixed Investment Spending: A Critical Survey of Modeling Strategies, Empirical Results, and Policy Implications," Research Working Paper 93–01, Federal Reserve Bank of Kansas City, Kansas City.

Chirinko, R. S., 1997, "Finance Constraints, Liquidity, and Investment Spending: Theoretical Restrictions and International Evidence," Journal of the Japanese and International Economics, Vol. 11, No. 2, pp. 185–207.

Choi, W. G., and D. Cook, 2012, "Fire Sales and the Financial Accelerator," Journal of Monetary Economics, Vol. 59, No. 4, pp. 336–51.

Chong, Y., O. Jordà, and A. M. Taylor, 2012, "The Harrod-Balassa-Samuelson Hypothesis: Real Exchange Rates and their Long-Run Equilibrium," International Economic Review, Vol. 53, No. 2, pp. 609–34.

Chor, D., and K. Manova, 2012, "Off the Cliff and Back? Credit Conditions and International Trade during the Global Financial Crisis," Journal of International Economics, Vol. 87, pp. 117–33.

Choudhri, E. U., and D. S. Hakura, 2015, "The Exchange Rate Pass-Through to Import and Export Prices: The Role of Nominal Rigidities and Currency Choice," Journal of International Money and Finance, Vol. 51, pp. 1–25.

Chowdhury, A. R., 1993, "Does Exchange Rate Volatility Depress Trade Flows? Evidence from Error-Correction Models," Review of Economics and Statistics, Vol. 75, No. 4, pp. 700–6.

Christiano, L. J., and J. M. Davis, 2006, "Two Flaws in Business Cycle Dating," Federal Reserve Bank of Cleveland Working Paper 06–12, Federal Reserve Bank of Cleveland, Cleveland.

Christiano, L. J., M. Eichenbaum, and C. L. Evans, 1999, "Monetary Policy Shocks: What Have We Learned, and To What End?" in Handbook of Macroeconomics, Vol. 1, J. B. Taylor and M. Woodford (eds), pp. 65–148, Amsterdam: North-Holland.

Christiano, L. J., M. Eichenbaum, and C. L. Evans, 2005, "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," Journal of Political Economy, Vol. 113, No. 1, pp. 1–45.

Christiano, L., and D. Ikeda, 2013, "Government Policy, Credit Markets and Economic Activity" in The Origins, History, and Future of the Federal Reserve, M. D. Bordo and W. Roberts (eds), pp. 226–331, New York: Cambridge University Press.

Christiano, L., R. Motto, and M. Rostagno, 2003, "The Great Depression and the Friedman-Schwartz Hypothesis," Journal of Money, Credit and Banking, Vol. 35, No. 6, pp. 1119–97.

Christiano, L., R. Motto, and M. Rostagno, 2008, "Two Reasons Why Money and Credit may be Useful in Monetary Policy," in The Role of Money: Money and Monetary Policy in the Twenty-First Century, A. Beyer and L. Reichlin (eds), pp. 56–82, Frankfurt am Main: European Central Bank.

Christiano, L. J., M. Trabandt, and K. Walentin, 2011a, "Introducing Financial Frictions and Unemployment into a Small Open Economy Model," Journal of Economic Dynamics and Control, Vol. 35, No. 12, pp. 1999–2041.

Christiano, L. J., M. Trabandt, and K. Walentin, 2011b, "DSGE Models for Monetary Policy Analysis," in Handbook of Monetary Economics, Vol. 3, B. M. Friedman and M. Woodford (eds), pp. 285–367, Amsterdam: North-Holland.

Christiansen, C., and A. Ranaldo, 2007, "Realized Bond-Stock Correlation: Macroeconomic Announcement Effects," Journal of Futures Markets, Vol. 27, pp. 439-69.

Christinsen, I., and A. Dib, 2008, "The Financial Accelerator in an Estimated New Keynesian Model," Review of Economic Dynamics, Vol. 11, pp. 155–78.

Chung, H. T., M. T. Kiley, and J.-P. Laforte, 2010, "Documentation of the Estimated Dynamic, Optimization-Based (EDO) Model of the U.S. Economy: 2010 Version," Finance and Economics Discussion Series 2010–29, Board of Governors of the Federal Reserve System, Washington, DC.

Ciccarelli, M., E. Ortega, and M. T. Valderrama, 2016, "Commonalities and Cross-Country Spillovers in Macroeconomic-Financial Linkages," B.E. Journal of Macroeconomics, Vol. 16, No. 1, pp. 231–75.

Claessens, S., 2015, "An Overview of Macroprudential Policy Tools," Annual Review of Financial Economics, Vol. 7, pp. 397–422.

Claessens, S., 2016, "Regulation and Structural Change in Financial Systems," Proceedings of ECB Forum on Central Banking, The Future of the International Monetary and Financial Architecture, European Central Bank, June 27–29, Sintra, pp. 188–221.

Claessens, S., D. Evanoff, G. Kaufman, and L. Laeven (eds), 2015, Shadow Banking within and across National Borders, World Scientific Studies in International Economics, Vol 40, Hackensack: World Scientific Publishing.

Claessens, S., S. Evenett, and B. Hoekman, 2010, Rebalancing the Global Economy: A Primer for Policymaking, Vox e-book.

Claessens, S., and L. Kodres, 2017, "The Regulatory Responses to the Global Financial Crisis: Some Uncomfortable Questions," in Policy Shock: Recalibrating Risk and Regulation after Oil Spills, Nuclear Accidents and Financial Meltdowns Crises, E. J. Balleisen, L. S. Bennear, K. D. Krawiec, and J. Wiener, pp. 435–84, New York: Cambridge University Press.

Claessens, S., and M. A. Kose, 2014, "Financial Crises: Explanations, Types, and Implications," in Financial Crises: Causes, Consequences, and Policy Responses, S. Claessens, M. A. Kose, L. Laeven, and F. Valencia (eds), pp. 3–59, Washington, DC: International Monetary Fund.

Claessens, S., M. A. Kose, L. Laeven, and F. Valencia (eds), 2014a, Financial Crises: Causes, Consequences, and Policy Responses, Washington, DC: International Monetary Fund.

Claessens, S., M. A. Kose, and M. E. Terrones, 2009, "What Happens During Recessions, Crunches, and Busts?" Economic Policy, Vol. 60, pp. 653–700.

Claessens, S., M. A. Kose, and M. E. Terrones, 2011, "Financial Cycles: What? How? When?" in NBER International Seminar on Macroeconomics 2010, R. Clarida and F. Giavazzi (eds), pp. 303–43. Chicago: University of Chicago Press.

Claessens, S., M. A. Kose, and M. E. Terrones, 2012a, "How do Business and Financial Cycles Interact?" Journal of International Economics, Vol. 87, No. 1, pp. 178–90.

Claessens, S., Z. Pozsar, L. Ratnovski, and M. Singh, 2012b, "Shadow Banking: Economics and Policy," IMF Staff Discussion Note 12/12, International Monetary Fund, Washington, DC.

Claessens, S., K. Ueda, and Y. Yafeh, 2014b, "Institutions and Financial Frictions: Estimating with Structural Restrictions on Firm Value and Investment," Journal of Development Economics, Vol. 110, pp. 107–22.

Clarida, R., J. Davis, and N. Pedersen, 2009, "Currency Carry Trade Regimes: Beyond the Fama Regression," Journal of International Money and Finance, Vol. 28, No. 8, pp. 1375–89.

Clarida, R., J. Galí, and M. Gertler, 1999, "The Science of Monetary Policy: A New Keynesian Perspective," Journal of Economic Literature, Vol. 37, No. 4, pp. 1661–707.

Clement, P., 2010, "The Term 'Macroprudential:' Origins and Evolution," BIS Quarterly Review, March, pp. 59–67, Bank for International Settlements, Basel.

Coase, R., 1937, "The Nature of the Firm," Economica, Vol. 4, No. 16, pp. 386–405.

Cochrane, J. H., 2000, "Money as Stock: Price Level Determination with no Money Demand," NBER Working Paper 7498, National Bureau of Economic Research, Cambridge.

Cochrane, J. H., 2005, Asset Pricing, revised edition, Princeton: Princeton University Press.

Cochrane, J. H., 2006, "Financial Markets and the Real Economy," in International Library of Critical Writings in Financial Economics, Vol. 18, J. H. Cochrane (ed), pp. 11-9, London: Edward Elgar.

Cochrane, J. H., 2008, "The Dog That Did Not Bark: A Defense of Return Predictability," Review of Financial Studies, Vol. 21, No. 4, pp. 1533–75.

Cochrane, J. H., 2011a, "How did Paul Krugman Get It So Wrong?" Economic Affairs, Vol. 31, No 2, pp. 36–40.

Cochrane, J. H., 2011b, "Presidential Address: Discount Rates," Journal of Finance, Vol. 66, pp. 1047–108.

Cochrane, J. H., 2017, "Macro-Finance," Review of Finance, Vol. 21, No. 3, pp. 945–85.

Coenen, G., C. Erceg, C. Freedman, D. Furceri, M. Kumhof, R. Lalonde, D. Laxton, J. Linde, A. Mourougane, D. Muir, S. Mursula, J. Roberts, W. Roeger, C. de Resende, S. Snudden, and M. Trabandt, 2012, "Effects of Fiscal Stimulus in Structural Models," American Economic Journal: Macroeconomics, Vol. 4, No. 1, pp. 22–68.

Coeurdacier, N., and S. Guibaud, 2011, "International Portfolio Diversification Is Better Than You Think," Journal of International Money and Finance, Vol. 30, No. 2, pp. 289-308.

Coeurdacier, N., R. Kollmann, and P. Martin, 2010, "International Portfolios, Capital Accumulation and Foreign Assets Dynamics," Journal of International Economics, Vol. 80, No. 1, pp. 100–12.

Coeurdacier, N., and H. Rey, 2013, "Home Bias in Open Economy Financial Macroeconomics," Journal of Economic Literature, Vol. 51, No. 1, pp. 63–115.

Coffey, N., W. B. Hrung, and A. Sarkar, 2009, "Capital Constraints, Counterparty Risks, and Deviations from Covered Interest Rate Parity," Federal Reserve Bank of New York Staff Report 393, Federal Reserve Bank of New York, New York.

Cohen, B. H., D. Domanski, I. Fender, and H. S. Shin, 2017, "Global Liquidity: A Selective Review," Annual Review of Economics, Vol. 9, pp. 587–612.

Cohen-Cole, E., B. Duygan-Bump, J. Fillat, and J. Montoriol-Garriga, 2008, "Looking behind the Aggregates: A Reply to '"Facts and Myths about the Financial Crisis of 2008'," Quantitative Analysis Unit Working Paper QAU08-5, Federal Reserve Bank of Boston, Boston.

Cole, H. L., and L. E. Ohanian, 2004, "New Deal Policies and the Persistence of the Great Depression: A General Equilibrium Analysis," Journal of Political Economy, Vol. 112, No. 4, pp. 779–816.

Constantinides, G. M., M. Harris, and R. M. Stulz (eds), 2003, Handbook of the Economics of Finance, Vol. 1, Amsterdam: North-Holland.

Constantinides, G. M., M. Harris, and R. M. Stulz (eds), 2013, Handbook of the Economics of Finance, Vol. 2, Amsterdam: North-Holland.

Cook, D., 2004, "Experience and Growth," Economics Letters, Vol. 85, No. 1, pp. 53–6.

Cooley, T. F., and G. D. Hansen, 1995, "Money and the Business Cycle," in Frontiers of Business Cycle Research, T. F. Cooley (ed), pp. 175–216, Princeton: Princeton University Press.

Cordella, T., and P. Gupta, 2015, "What Makes a Currency Procyclical? An Empirical Investigation," Journal of International Money and Finance, Vol. 55, pp. 240–59.

Cordoba, J., and M. Ripoll, 2004a, "Collateral Constraints in a Monetary Economy," Journal of the European Economic Association, Vol. 2, No. 6, pp. 1172–205.

Cordoba, J., and M. Ripoll, 2004b, "Credit Cycles Redux," International Economic Review, Vol. 45, No. 4, pp. 1011–46.

Coric, B., 2011, "The Financial Accelerator Effect: Concept and Challenges," Financial Theory and Practice, Vol. 35, No. 2, pp. 171–96.

Cornett, M. M., J. J. McNutt, P. E. Strahan, and H. Tehranian, 2011, "Liquidity Risk Management and Credit Supply in the Financial Crisis," Journal of Financial Economics, Vol. 101, No. 2, pp. 297–312.

Corsetti, G., 2008, "New Open Economy Macroeconomics," in The New Palgrave Dictionary of Economics, 2nd edition, S. N. Durlauf and L. E. Blume (eds), Palgrave Macmillan.

Corsetti, G., L. Dedola, and S. Leduc, 2011, "Optimal Monetary Policy in Open Economies," in Handbook of Monetary Economics, Vol. 3, B. M. Friedman and M. Woodford (eds), pp. 861–933, Amsterdam: North-Holland.

Corsetti, G., and P. Pesenti, 2001, "Welfare and Macroeconomic Interdependence," Quarterly Journal of Economics, Vol. 116, No. 2, pp. 421–45.

Cotter, J., M. Hallam, and K. Yilmaz, 2017, "Macro-Financial Spillovers," mimeo, September 25.

Covas, F., and W. J. den Haan, 2011, "The Cyclical Behavior of Debt and Equity Finance," American Economic Review, Vol. 101, No. 2, pp. 877–99.

Covitz, D., N. Liang, and G. Suarez, 2013, "The Evolution of a Financial Crisis: Collapse of the Asset-Backed Commercial Paper Market," Journal of Finance, Vol. 68, No. 3, pp. 815–48.

Crockett, A., 2000, "Marrying the Micro- and Macro- Prudential Dimensions of Financial Stability," Remarks before the 11th International Conference of Banking Supervisors, September 20–21, Basel.

Croushore, D., and K. Marsten, 2016, "Reassessing the Relative Power of the Yield Spread in Forecasting Recessions," Journal of Applied Econometrics, Vol. 31, No. 6, pp. 1183–91.

Crowe, C., S. Johnson, J. Ostry, and J. Zettelmeyer, 2010, Macrofinancial Linkages: Trends, Crises, and Policies, Washington, DC: International Monetary Fund.

Cummins, J. G., K. A. Hassett, and S. D. Oliner, 2006, "Investment Behavior, Observable Expectations, and Internal Funds," American Economic Review, Vol. 96, No. 3, pp. 796-810.

Cunningham, R., and I. Kolet, 2011, "Housing Market Cycles and Duration Dependence in the United States and Canada," Applied Economics, Vol. 43, No. 5, pp. 569–86.

Curcuru, S., C. Thomas, and F. Warnock, 2013, "On Returns Differentials," Journal of International Money and Finance, Vol. 36, pp. 1–25.

Cúrdia, V., and M. Woodford, 2016, "Credit Frictions and Optimal Monetary Policy," Journal of Monetary Economics, Vol. 84, pp. 30–65.

Cuthbertson, K., and D. Gasparro, 1995, "Fixed Investment Decisions in UK manufacturing: The Importance of Tobin's Q, Output and Debt," European Economic Review, Vol. 39, pp. 919–41.

Dai, Q., and K. J. Singleton, 2003, "Fixed-Income Pricing," in Handbook of the Economics of Finance, Vol. 1, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 1207–46, Amsterdam: North-Holland.

Danielsson, J., H. S. Shin, and J.-P. Zigrand, 2011, "Balance Sheet Capacity and Endogenous Risk," FMG Discussion Paper 665, Financial Markets Group, London School of Economics and Political Science, London.

Darby, J., A. H. Hallett, J. Ireland, and L. Piscitelli, 1999, "The Impact of Exchange Rate Uncertainty on the Level of Investment," Economic Journal, Vol. 109, pp. C55–67.

David, A., and P. Veronesi, 2013, "What Ties Return Volatilities to Price Valuations and Fundamentals?" Journal of Political Economy, Vol. 121, No. 4, pp. 682–746.

Dávila, E., and A. Korinek, 2017, "Pecuniary Externalities in Economies with Financial Frictions," Review of Economic Studies, forthcoming.

Davis, E. P., 2010a, "New International Evidence on Asset-Price Effects on Investment, and a Survey for Consumption," OECD Journal: Economic Studies, Vol. 2010, No. 1.

Davis, E. P., 2010b, "Asset Prices and Real Economic Activity," OECD Economics Department Working Paper 764, Organisation for Economic Co-operation and Development, Paris.

Davis, E. P., and M. Stone, 2004, "Corporate Financial Structure and Financial Stability," Journal of Financial Stability, Vol. 1, pp. 65–91.

Davis, E. P., and H. Zhu, 2004, "Bank Lending and Commercial Property Cycles: Some Cross-Country Evidence," BIS Working Paper 150, Bank for International Settlements, Basel.

Davis, M. A., and J. Heathcote, 2005, "Housing and the Business Cycle," International Economic Review, Vol. 46, No. 3, pp. 751–84.

Davis, M. A., and J. Heathcote, 2007, "The Price and Quantity of Residential Land in the United States," Journal of Monetary Economics, Vol. 54, No. 8, pp. 2595–620.

Davis, M. A., and M. G. Palumbo, 2001, "A Primer on the Economics and Time Series Econometrics of Wealth Effects," Finance and Economics Discussion Series 2001–09, Board of Governors of the Federal Reserve System, Washington, DC.

Davis, M. A., and S. Van Nieuwerburgh, 2015, "Housing, Finance, and the Macroeconomy," in Handbook of Regional and Urban Economics, Vol. 4, G. Duranton, J. V. Henderson, and W. C. Strange (eds), pp. 753–811. Amsterdam: North-Holland.

Deaton, A., 1992, Understanding Consumption, Oxford: Clarendon Press.

De Bondt, G., A. Maddaloni, J. L. Peydró, and S. Scopel, 2010, "The Bank Lending Survey Matters: Empirical Evidence for Credit and Output Growth," ECB Working Paper 1160, European Central Bank, Frankfurt am Main.

De Bondt, W. F. M., and R. Thaler, 1985, "Does the Stock Market Overreact?" Journal of Finance, Vol. 40, No. 3, pp. 793–805.

Dedola, L., and G. Lombardo, 2012, "Financial Fictions, Financial Integration and the International Propagation of Shocks," Economic Policy, Vol. 27, No. 70, pp. 319–59.

De Fiore, F., and O. Tristani, 2011, "Credit and the Natural Rate of Interest," Journal of Money, Credit and Banking, Vol. 43, No. 2–3, pp. 407–40.

De Graeve, F., 2008, "The External Finance Premium and the Macroeconomy: US Post-WWII Evidence," Journal of Economic Dynamics and Control, Vol. 32, No. 11, pp. 3415–40.

De Nicolò, G., G. Dell'Ariccia, L. Laeven, and F. Valencia, 2010, "Monetary Policy and Bank Risk Taking," IMF Staff Position Note 10/09, International Monetary Fund, Washington, DC.

De Rezende, R. B., 2014, "Essays on Macro-Financial Linkages," Doctoral dissertation, Stockholm School of Economics, Stockholm.

Del Negro, M., G. Eggertsson, A. Ferrero, and N. Kiyotaki, 2017, "The Great Escape? A Quantitative Evaluation of the Fed's Liquidity Facilities," American Economic Review, Vol. 107, No. 3, pp. 824–57.

Dell'Ariccia, G., D. Igan, L. Laeven, and H. Tong, 2016, "Credit Booms and Macrofinancial Stability," Economic Policy, Vol. 2016, No. 86, pp. 299–333.

Dell'Ariccia, G., L. Laeven, and R. Marquez, 2014, "Real Interest Rates, Leverage, and Bank Risk-Taking," Journal of Economic Theory, Vol. 149, pp. 65–99.

Dell'Ariccia, G., L. Laeven, and G. A. Suarez, 2017, "Bank Leverage and Monetary Policy's Risk-Taking Channel: Evidence from the United States," Journal of Finance, Vol. 70, No. 2, pp. 613–54.

Dell'Ariccia, G., and R. Marquez, 2006, "Lending Booms and Lending Standards," Journal of Finance, Vol. 61, No. 5, pp. 2511–46.

Dell'Ariccia, G., and R. Marquez, 2013, "Interest Rates and the Bank Risk-Taking Channel," Annual Review of Financial Economics, Vol. 5, pp. 123–41.

Della Corte, P., T. Ramadorai, and L. Sarno, 2016a, "Volatility Risk Premia and Exchange Rate Prediction," Journal of Financial Economics, Vol. 120, No. 1, pp. 21–40.

Della Corte, P., S. J. Riddiough, and L. Sarno, 2016b, "Currency Premia and Global Imbalanced," Review of Financial Studies, Vol. 29, No. 8, pp. 2161–93.

Della Corte, P., L. Sarno, and G. Sestieri, 2012, "The Predictive Information Content of External Imbalances for Exchange Rate Returns: How Much Is It Worth?" Review of Economics and Statistics, Vol. 94, No. 1, pp. 100–15.

Dellas, H., and M. Hess, 2005, "Financial Development and Stock Returns: A Cross Country Analysis," Journal of International Money and Finance, Vol. 24, No. 6, pp. 891-912.

den Haan, W. J., G. Ramey, and J. Watson, 2003, "Liquidity Flows and Fragility of Business Enterprises," Journal of Monetary Economics, Vol. 50, No. 6, pp. 1215–41.

den Haan, W. J., S. W. Sumner, and G. Yamashiro, 2007, "Bank Loan Portfolios and the Monetary Transmission Mechanism," Journal of Monetary Economics, Vol. 54, No. 3, pp. 904–24.

Detken, C., and F. Smets, 2004, "Asset Price Booms and Monetary Policy," in Macroeconomic Policies in the World Economy, H. Siebert (ed), pp. 189–227, New York: Springer.

Devereux, M. B., P. R. Lane, and J. Xu, 2006, "Exchange Rates and Monetary Policy in Emerging Market Economies," Economic Journal, Vol. 116, No. 511, pp. 478–506.

Devereux, M. B., and A. Sutherland, 2009, "A Portfolio Model of Capital Flows to Emerging Markets," Journal of Development Economics, Vol. 89, No. 2, pp. 181–93.

Devereux, M. B., and A. Sutherland, 2010, "Country Portfolio Dynamics," Journal of Economic Dynamics and Control, Vol. 34, No. 7, pp. 1325–42.

Devereux, M. B., and J. Yetman, 2010, "Leverage Constraints and the International Transmission of Shocks," Journal of Money, Credit and Banking, Vol. 42, No. S1, pp. 71–105.

Dewatripont, M., and J. Tirole, 1994, "A Theory of Debt and Equity: Diversity of Securities and Manager-Shareholder Congruence," Quarterly Journal of Economics, Vol. 109, No. 4, pp. 1027–54.

Dewatripont, M., and J. Tirole, 2012, "Macroeconomic Shocks and Banking Regulation," Journal of Money, Credit and Banking, Vol. 44, No. S2, pp. 237–54.

Diamond, D. W., and P. H. Dybvig, 1983, "Bank Runs, Deposit Insurance, and Liquidity," Journal of Political Economy, Vol. 91, No. 3, pp. 401–19.

Diamond, D. W., and R. G. Rajan, 2001, "Banks, Short-Term Debt and Financial Crises: Theory, Policy Implications and Applications," Carnegie-Rochester Conference Series, Vol. 54, pp. 37–71.

Diamond, D. W., and R. G. Rajan, 2005, "Liquidity Shortages and Banking Crises," Journal of Finance, Vol. 60, No. 2, pp. 615–47.

Diamond, D. W., and R. G. Rajan, 2011, "Fear of Fire Sales, Illiquidity Seeking, and the Credit Freezes," Quarterly Journal of Economics, Vol. 126, No. 2, pp. 557–91.

Diebold, F. X., M. Piazzesi, and G. D. Rudebusch, 2005, "Modeling Bond Yields in Finance and Macroeconomics," American Economic Review, Vol. 95, No. 2, pp. 415-20.

Diebold, F. X., G. D. Rudebusch, and S. B. Aruoba, 2006, "The Macroeconomy and the Yield Curve: A Dynamic Latent Factor Approach," Journal of Econometrics, Vol. 131, No. 1–2, pp. 309–38.

Diebold, F. X. and K. Yilmaz, 2009, "Measuring Financial Asset Return and Volatility Spillovers, with Application to Global Equity Markets," Economic Journal, Vol. 119, No. 534, pp. 158–71.

Diebold, F. X., and K. Yilmaz, 2015, Financial and Macroeconomic Connectedness: A Network Approach to Measurement and Monitoring, New York: Oxford University Press.

di Mauro, F., F. Fornari, and D. Mannucci, 2011, "Stock Market Firm-Level Information and Real Economic Activity," ECB Working Paper 1366, European Central Bank, Frankfurt am Main.

Disyatat, P., 2011, "The Bank Lending Channel Revisited," Journal of Money, Credit and Banking, Vol. 43, No. 4, pp. 711–34.

Dixit, A. K., and R. S. Pindyck, 1994, Investment under Uncertainty, Princeton: Princeton University Press.

Djeutem, E., 2014, "Model Uncertainty and the Forward Premium Puzzle," Journal of International Money and Finance, Vol. 46, pp. 16–40.

Domanski, D., H. S. Shin, and V. Sushko, 2017, "The Hunt for Duration: Not Waving but Drowning?" IMF Economic Review, Vol. 65, No. 1, pp 113–53.

Dominguez, K. M., and L. L. Tesar, 2006 "Exchange Rate Exposure," Journal of International Economics, Vol. 68, No. 1, pp. 188–218.

Dorich, J., M. Johnston, R. Mendes, S. Murchison, and Y. Zhang, 2013, "ToTEM II: An Updated Version of the Bank of Canada's Quarterly Projection Model," Bank of Canada Technical Report 100, Bank of Canada, Ottawa.

Dornbusch, R., 1976, "The Theory of Flexible Exchange Rate Regimes and Macroeconomic Policy," Scandinavian Journal of Economics, Vol. 78, No. 2, pp. 255-75.

Dornbusch, R., 1981, "Exchange Rate Rules and Macroeconomic Stability," in Exchange Rate Rules: The Theory, Performance and Prospects of the Crawling Peg, J. Williamson (ed), pp. 55–67, New York: St. Martin's Press.

Dornbusch, R., Y. C. Park, and S. Claessens, 2000, "Contagion: Understanding How It Spreads," World Bank Research Observer, Vol. 15, No. 2, pp. 177–97.

Dou, W. W., A. W. Lo, A. Muley, and H. Uhlig, 2017, "Macroeconomic Models for Monetary Policy: A Critical Review from a Finance Perspective," Paper presented at the CEPR MMCN Conference 2017, Institute for Monetary and Financial Stability, June 19–20, Frankfurt am Main.

Dow, J., G. Gorton, and A. Krishnamurthy, 2005, "Equilibrium Asset Prices and Investment under Imperfect Corporate Control," American Economic Review, Vol. 95, No. 3, pp. 659–81.

Drehmann, M., C. Borio, and K. Tsatsaronis, 2012, "Characterising the Financial Cycle: Don't Lose Sight of the Medium Term!" BIS Working Paper 380, Bank for International Settlements, Basel.

Drehmann, M., and M. Juselius, 2012, "Do Debt Service Costs Affect Macroeconomic and Financial Stability?" BIS Quarterly Review, September, pp. 21–35, Bank for International Settlements, Basel.

Drehmann, M., M. Juselius, and A. Korinek, 2017, "Accounting for Debt Service: The Painful Legacy of Credit Booms," BIS Working Paper 645, Bank for International Settlements, Basel.

Du, W., and J. Schreger, 2016, "Local Currency Sovereign Risk," Journal of Finance, Vol. 71, No. 3, pp. 1027–70.

Du, W., A. Tepper, and A. Verdelhan, 2017, "Deviations from Covered Interest Rate Parity," NBER Working Paper 23170, National Bureau of Economic Research, Cambridge.

Duffee, G. R., 2013, "Bond Pricing and the Macroeconomy," in Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 907–67, Amsterdam: North-Holland.

Duffie, D., 2001, Dynamic Asset Pricing Theory, 3rd edition, Princeton: Princeton University Press.

Duffie, D., 2010, "Presidential Address: Asset Price Dynamics with Slow-Moving Capital," Journal of Finance, Vol. 65, No. 4, pp. 1237–67.

Dumas, B., 1994, "Partial vs General Equilibrium Models of the International Capital Market," in The Handbook of International Macroeconomics, F. van der Ploeg (ed), Cambridge: Blackwell Publishers.

Eaton, J., S. Kortum and B. Neiman, 2016, "Obstfeld and Rogoff's International Macro Puzzles: A Quantitative Assessment," Journal of Economic Dynamics and Control, Vol. 72, pp. 5–23.

Eberly, J., S. Rebelo, and N. Vincent, 2008, "Investment and Value: A Neoclassical Benchmark," NBER Working Paper 13866, National Bureau of Economic Research, Cambridge.

Eckstein, O., and A. Sinai, 1986, "The Mechanisms of the Business Cycle in the Postwar Era," in The American Business Cycle: Continuity and Change, R. J. Gordon (ed), pp. 39–122, Chicago: University of Chicago Press.

Edge, R., M. Kiley, and J. P. Laforte, 2008, "Natural Rate Measures in an Estimated DSGE Model of the U.S. Economy," Journal of Economic Dynamics and Control, Vol. 32, pp. 2512–35.

Edwards, S., J. G. Biscarri, and F. Perez de Gracia, 2003, "Stock Market Cycles, Financial Liberalization and Volatility," Journal of International Money and Finance, Vol. 22, No. 7, pp. 925–55.

Eggertsson, G. B., 2012, "Was the New Deal Contractionary?" American Economic Review, Vol. 102, No. 1, pp. 524–55.

Eggertsson, G. B., and P. Krugman, 2012, "Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach," Quarterly Journal of Economics, Vol. 127, No. 3, pp. 1469–513.

Eggertsson, G. B., N. Mehrotra, S. Singh, and L. Summers, 2016, "A Contagious Malady? Open Economy Dimensions of Secular Stagnation," IMF Economic Review, Vol. 64, No. 4, pp. 581–634.

Eggertsson, G. B., and M. Woodford, 2003, "The Zero Bound on Interest Rates and Optimal Monetary Policy," Brookings Papers on Economic Activity, Vol. 2003, No. 1, pp. 139–211.

Eggertsson, G. B., and M. Woodford, 2004, "Policy Options in a Liquidity Trap," American Economic Review, Vol. 94, No. 2, pp. 76–79.

Ehrmann, M., and M. Fratzscher, 2005, "Exchange Rates and Fundamentals: New Evidence from Real Time Data," Journal of International Money and Finance, Vol. 24, pp. 317–41.

Ehrmann, M., M. Fratzscher, and R. Rigobon, 2011, "Stocks, Bonds, Money Markets and Exchange Rates: Measuring International Financial Transmission," Journal of Applied Econometrics, Vol. 26, No. 6, pp. 948–74.

Ehrmann, M., L. Gambacorte, J. Martinez-Pages, P. Sevestre, and A. Worms, 2003, "The Effects of Monetary Policy in the Euro Area," Oxford Review of Economic Policy, Vol. 19, No. 1, pp. 58–72.

Eichenbaum, M., and C. L. Evans, 1995, "Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rates," Quarterly Journal of Economics, Vol. 110, No. 4, pp. 975–1009.

Eichenbaum, M., B. K. Johannsen, and S. Rebelo, 2017, "Monetary Policy and the Predictability of Nominal Exchange Rates," NBER Working Paper 23158, National Bureau of Economic Research, Cambridge.

Eisfeldt, A. L., and A. A. Rampini, 2006, "Capital Reallocation and Liquidity," Journal of Monetary Economics, Vol. 53, No. 3, pp. 369–99.

Elenev, V., T. Landvoigt, and S. Van Nieuwerburgh, 2017, "A Macroeconomic Model with Financially Constrained Producers and Intermediaries," CEPR Discussion Paper 12282, Centre for Economic Policy Research, London.

Elliott, G., and T. Ito, 1999, "Heterogeneous Expectations and Tests of Efficiency in the Yen/Dollar Forward Exchange Rate Market," Journal of Monetary Economics, Vol. 43. No. 2, pp. 435–56.

Elmendorf, D. W., 1996, "The Effect of Interest-Rate Changes on Household Saving and Consumption: A Survey," Finance and Economics Discussion Series 96–27, Board of Governors of the Federal Reserve System, Washington, DC.

Engel, C. M., 1986, "On the Correlation of Exchange Rates and Interest Rates," Journal of International Money and Finance, Vol. 5, No. 1, pp. 125–8.

Engel, C. M., 1994, "Tests of CAPM on an International Portfolio of Bonds and Stocks," in The Internationalization of Equity Markets, J. A. Frankel (ed), pp. 149–83, Chicago: University of Chicago Press.

Engel, C., 2010, "Exchange Rate Policies," in BIS Paper 52, The International Financial Crisis and Policy Challenges in Asia and the Pacific: Proceedings of the Wrap-Up Conference of the Asian Research Programme, Shanghai, 6–8 August 2009, pp. 229-250, Bank for International Settlements, Basel.

Engel, C., 2011, "Currency Misalignment and Optimal Monetary Policy: A Reexamination," American Economic Review, Vol. 101, No. 6, pp. 2796–822.

Engel, C., 2014, "Exchange Rates and Interest Parity," in Handbook of International Economics, Vol. 4, G. Gopinath, E. Helpman, and K. Rogoff (eds), pp. 453–552. Amsterdam: North-Holland.

Engel, C., 2016, "Exchange Rates, Interest Rates, and the Risk Premium," American Economic Review, Vol. 106, No. 2, pp. 436–74.

Engel, C., 2017, "The Role of Exchange Rates in International Price Adjustment," Macroeconomic Review, Vol. 16, No. 1, pp. 85–91, Monetary Authority of Singapore, Singapore.

Engel, C., N. C. Mark, and K. D. West, 2008, "Exchange Rate Models Are Not as Bad as You Think," in NBER Macroeconomics Annual 2007, D. Acemoglu, K. Rogoff, and M. Woodford (eds), pp. 381–441, Chicago: University of Chicago Press.

Engel, C., and A. Matsumoto, 2009, "International Risk Sharing: Through Equity Diversification or Exchange Rate Hedging?" IMF Working Paper 09/138, International Monetary Fund, Washington, DC.

Engel, C., and K. D. West, 2005, "Exchange Rates and Fundamentals," Journal of Political Economy, Vol. 113, No. 3, pp. 485–517.

Engel, C., and K. D. West, 2006, "Taylor Rules and the Deutschemark-Dollar Real Exchange Rate," Journal of Money, Credit and Banking, Vol. 38, pp. 1175–194.

Engel, C., and K. D. West, 2010, "Global Interest Rates, Currency Returns, and the Real Value of the Dollar," American Economic Review, Vol. 100, No. 2, pp. 562–67.

Engel, C., K. D. West, and M. Zhu, 2010, "Global Interest Rates, Monetary Policy, and Currency Returns," mimeo, May 21, University of Wisconsin, Madison.

Engel, C., and F. Zhu, 2017, "Exchange Rate Puzzles: Evidence from Rigidly Fixed Nominal Exchange Rate Systems," mimeo, University of Wisconsin, Madison.

Engle, R. F., and R. Susmel, 1993, "Common Volatility in International Equity Markets," Journal of Business and Economic Statistics, Vol. 11, No. 2, pp. 167–76.

Epstein, L. G., and S. E. Zin, 1989, "Substitution, Risk Aversion, and the Temporal Behavior of Consumption and Asset Returns: A Theoretical Framework," Econometrica, Vol. 57, No. 4, pp. 937–69.

Erickson, T., and T. M. Whited, 2000, "Measurement Error and the Relationship between Investment and Q," Journal of Political Economy, Vol. 108, No. 5, pp. 1027-57.

Errunza, V., and E. Losq, 1985, "International Asset Pricing under Mild Segmentation: Theory and Test," Journal of Finance, Vol. 40, No. 1, pp. 105–24.

Estrella, A., 2005, "Why Does the Yield Curve Predict Output and Inflation?" Economic Journal, Vol. 115, pp. 722–44.

Estrella, A., and G. A. Hardouvelis, 1991, "The Term Structure as a Predictor of Real Economic Activity," Journal of Finance, Vol. 46, No. 2, pp. 555–76.

Estrella, A., and F. S. Mishkin, 1997, "The Predictive Power of the Term Structure of Interest Rates in Europe and the United States: Implications for the European Central Bank," European Economic Review, Vol. 41, No. 7, pp. 1375–401.

Estrella, A., and F. S. Mishkin, 1998, "Predicting U.S. Recessions: Financial Variables As Leading Indicators," Review of Economics and Statistics, Vol. 80, No. 1, pp. 45–61.

Estrella, A., and M. R. Trubin, 2006, "The Yield Curve as a Leading Indicator: Some Practical Issues," Current Issues in Economics and Finance, Vol. 12, No. 5, Federal Reserve Bank of New York, New York.

Eun, C. S., and S. Janakiramanan, 1986, "A Model of International Asset Pricing with a Constraint on the Foreign Equity Ownership," Journal of Finance, Vol. 41, No. 4, pp. 897–914.

European Systemic Risk Board, 2016, "Macroprudential Policy Issues Arising from Low Interest Rates and Structural Changes in the EU Financial System," Joint Task Force Report, November, European Systemic Risk Board, Frankfurt am Main.

Evans, C. L., and D. A. Marshall, 2007, "Economic Determinants of the Nominal Treasury Yield Curve," Journal of Monetary Economics, Vol. 54, No. 7, pp. 1986–2003.

Evans, M. D. D., 2010, "Order Flows and the Exchange Rate Disconnect Puzzle," Journal of International Economics, Vol. 80, No. 1, pp. 58–71.

Evans, M. D. D., 2011, Exchange-Rate Dynamics, Princeton: Princeton University Press.

Faia, E., and T. Monacelli, 2007, "Optimal Interest Rate Rules, Asset Prices, and Credit Frictions," Journal of Economic Dynamics and Control, Vol. 31, No. 10, pp. 3228–54.

Fama, E. F., 1963, "Mandelbrot and the Stable Paretian Hypothesis," Journal of Business, Vol. 36, No. 4, pp. 420–9.

Fama, E. F., 1965, "The Behavior of Stock-Market Prices," Journal of Business, Vol. 38, No. 1, pp. 34–105.

Fama, E. F., 1970, "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance, Vol. 25, No. 2, pp. 383–417.

Fama, E. F., 1984, "Forward and Spot Exchange Rates," Journal of Monetary Economics, Vol. 14, No. 3, pp. 319–38.

Fama, E. F., 1991, "Efficient Capital Markets: II," Journal of Finance, Vol. 46, No. 5, pp. 1575–617.

Farhi, E., S. P. Fraiberger, X. Gabaix, R. Ranciere, and A. Verdelhan, 2009, "Crash Risk in Currency Markets," NBER Working Paper 15062, National Bureau of Economic Research, Cambridge.

Farhi, E., and X. Gabaix, 2016, "Rare Disasters and Exchange Rates," Quarterly Journal of Economics, Vol. 131, No. 1, pp. 1–52.

Farhi, E., and J. Tirole, 2012, "Collective Moral Hazard, Maturity Mismatch, and Systemic Bailouts," American Economic Review, Vol. 102, No. 1, pp. 60–93.

Farhi, E., and I. Werning, 2016, "A Theory of Macroprudential Policies in the Presence of Nominal Rigidities," Econometrica, Vol. 84, No. 5, pp. 1645–704.

Farmer, R. E. A, 1984, "A New Theory of Aggregate Supply," American Economic Review, Vol. 74, No. 5, pp. 920–30.

Farmer, R. E. A., 2012, "Qualitative Easing: How It Works and Why It Matters," NBER Working Paper 18421, National Bureau of Economic Research, Cambridge.

Farmer, R. E. A., 2016, Prosperity for All: How to Prevent Financial Crises, New York: Oxford University Press.

Farmer, R. E. A., and K. Platonov, 2016, "Animal Spirits in a Monetary Model," NBER Working Paper 22136, National Bureau of Economic Research, Cambridge.

Farmer, R., and P. Zabczyk, 2016, "The Theory of Unconventional Monetary Policy," NBER Working Paper 22135, National Bureau of Economic Research, Cambridge.

Fatas, A., and I. Mihov, 2013, "Recoveries," CEPR Discussion Paper 9551, Centre for Economic Policy Research, London.

Fazzari, S. M., R. G. Hubbard, and B. C. Petersen, 1988, "Financing Constraints and Corporate Investment," Brookings Papers on Economic Activity, Vol. 1988, No. 1, pp. 141–206.

Fender, I., and U. Lewrick, 2016, "Adding It All Up: The Macroeconomic Impact of Basel III and Outstanding Reform Issues", BIS Working Paper 591, Bank for International Settlements, Basel.

Ferraris, L., and R. Minetti, 2013, "Foreign Banks and the Dual Effect of Financial Liberalization," Journal of Money, Credit and Banking, Vol. 45, No. 7, pp. 1301–33.

Ferraro, D., K. Rogoff, and B. Rossi, 2015, "Can Oil Prices Forecast Exchange Rates? An Empirical Analysis of the Relationship between Commodity Prices and Exchange Rates," Journal of International Money and Finance, Vol. 54, pp. 116–41.

Fisher, I., 1933, "The Debt-Deflation Theory of Great Depressions," Econometrica, Vol. 1, No. 4, pp. 337–57.

Fitzgerald, D., 2003, "Terms-of-Trade Effects, Interdependence and Cross-Country Differences in Price Levels," mimeo, Harvard University.

Flavin, M. A., 1981, "The Adjustment of Consumption to Changing Expectations about Future Income," Journal of Political Economy, Vol. 89, No. 5, pp. 974–1009.

Fleming, M. J., 1962, "Domestic Financial Policies under Fixed and under Floating Exchange Rates," IMF Staff Papers, Vol. 9, No. 3, pp. 369–80.

Flood, R. P., and A. K. Rose, 1995, "Fixing Exchange Rates: A Virtual Quest for Fundamentals," Journal of Monetary Economics, Vol. 36, No. 1, pp. 3–37.

Flood, R. P., and A. K. Rose, 2002, "Uncovered Interest Parity in Crisis," IMF Staff Papers, Vol. 49, No. 2, pp. 252–66.

Flood, R. P., and M. P. Taylor, 1996, "Exchange Rate Economics: What's Wrong with the Conventional Macro Approach?" in The Microstructure of Foreign Exchange Markets, J. A. Frankel, G. Galli, and A. Giovannini (eds), pp. 261–302, Chicago: University of Chicago Press.

Forbes, K., 2012, "The 'Big C': Identifying Contagion," NBER Working Paper 18465, National Bureau of Economic Research, Cambridge.

Forbes, K., and M. D. Chinn, 2004, "A Decomposition of Global Linkages in Financial Markets Over Time," Review of Economics and Statistics, Vol. 86, No. 3, pp. 705–22.

Forbes, K., I. Hjortsoe, and T. Nenova, 2017, "Shocks versus Structure: Explaining Differences in Exchange Rate Pass-Through across Countries and Time," External MPC Unit Discussion Paper 50, Bank of England, London.

Forbes, K. J., and F. E. Warnock, 2012, "Capital Flow Waves: Surges, Stops, Flight, and Retrenchment," Journal of International Economics, Vol. 88, No. 2, pp. 235–51.

Fort, T., J. Haltiwanger, R. Jarmin, and J. Miranda, 2013, "How Firms Respond to Business Cycles: The Role of Firm Age and Firm Size," IMF Economic Review, Vol. 61, No. 3, pp. 520–59.

Fostel A., and J. Geanakoplos, 2012, "Why does Bad News Increase Volatility and Decrease Leverage," Journal of Economic Theory, Vol. 147, No. 2, pp. 501–25.

Francis, W. B., and M. Osborne, 2010, "On the Behavior and Determinants of Risk-Based Capital Ratios: Revisiting the Evidence from UK Banking Institutions," International Review of Finance, Vol. 10, No. 4, pp. 485–518.

Frankel, J., and R. Meese, 1987, "Are Exchange Rates Excessively Variable?" in NBER Macroeconomics Annual 1987, Vol. 2, S. Fischer (ed), pp. 117–62, Cambridge: MIT Press.

Frankel, J., D. Parsley, and S.-J. Wei, 2010, "Slow Pass-through Around the World: A New Import for Developing Countries?" Open Economies Review, Vol. 23, No. 2, pp. 213–51.

Frankel, J., and A. Rose, 1995, "Empirical Research on Nominal Exchange Rates," in Handbook of International Economics, Vol. 3, G. M. Grossman and K. Rogoff (eds), pp. 1689–729, Amsterdam: North-Holland.

Fratzscher, M., L. Juvenal, and L. Sarno, 2010, "Asset Prices, Exchange Rates and the Current Account," European Economic Review, Vol. 54, No. 5, pp. 643–58.

Fratzscher, M., D. Rime, L. Sarno, and G. Zinna, 2015, "The Scapegoat Theory of Exchange Rates: The First Tests," Journal of Monetary Economics, Vol. 70, pp. 1–21.

Freixas, X., and J. Jorge, 2008, "The Role of Interbank Markets in Monetary Policy: A Model with Rationing," Journal of Money, Credit and Banking, Vol. 40, No. 6, pp. 1151–76.

Freixas, X., A. Martin, and D. Skeie, 2011, "Bank Liquidity, Interbank Markets, and Monetary Policy," Review of Financial Studies, Vol. 24, No. 8, pp. 2656–692.

Freixas, X., and J. C. Rochet, 1997, Microeconomics of Banking, Cambridge: MIT Press.

Freixas, X., and J. C. Rochet, 2008, Microeconomics of Banking, 2nd edition, Cambridge: MIT Press.

Frenkel, J., 1976, "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence," Scandinavian Journal of Economics, Vol. 78, pp. 200–24.

Frenkel, J., 1981, "Flexible Exchange Rates, Prices and the Role of 'News'," Journal of Political Economy, Vol. 89, pp. 665–705.

Frenkel, J., and H. G. Johnson (eds), 1978, The Economics of Exchange Rates: Selected Studies, Reading: Addison-Wesley.

Friedman, B. M., and M. Woodford, 2011, Handbook of Monetary Economics, Vol. 3, Amsterdam: North-Holland.

Friedman, M., 1956, "The Quantity Theory of Money - A Restatement," in Studies in the Quantity Theory of Money, M. Friedman (ed), Chicago: University of Chicago Press.

Friedman, M., and K. N. Kuttner, 1993, "Economic Activity and the Short-Term Credit Markets: An Analysis of Prices and Quantities," Brookings Papers on Economic Activity, Vol. 1993, No. 2, pp. 193–284.

Friedman, M., and A. J. Schwartz, 1963, A Monetary History of the United States, 1867–1960, Princeton: Princeton University Press.

Froot, K. A., and J. A. Frankel, 1989, "Forward Discount Bias: Is It an Exchange Risk Premium?" Quarterly Journal of Economics, Vol. 104, No. 1, pp. 139–61.

Froot, K. A., and K. Rogoff, 1995, "Perspective of PPP and Long Run Real Exchange Rate," in Handbook of International Economics, Vol. 3, G. M. Grossman and K. Rogoff (eds), pp. 1647–88, Amsterdam: North-Holland.

Fry, M. J., 1988, Money, Interest, and Banking in Economic Development, Baltimore, John Hopkins University Press.

FSB, 2017, "Assessment of Shadow Banking Activities, Risks and the Adequacy of Post-Crisis Policy Tools to Address Financial Stability Concerns," Report to the G20, July, Basel.

FSB-IMF, 2016, "Second Phase of the G-20 Data Gaps Initiative (DGI-2): First Progress Report," Prepared by the Staff of the IMF and the FSB Secretariat, September, Financial Stability Board, Basel.

Funke, N., 2004, "Is There a Stock Market Wealth Effect in Emerging Markets?" Economics Letters, Vol. 83, No. 3, pp. 417–21.

Gabaix, X., 2011, "Disasterization: A Simple Way to Fix the Asset Pricing Properties of Macroeconomic Models," American Economic Review, Vol. 101, No. 3, pp. 406–9.

Gabaix, X., and M. Maggiori, 2016, "International Liquidity and Exchange Rate Dynamics," Quarterly Journal of Economics, Vol. 130, No. 3, pp. 1369–420.

Gagnon, J. E., 2011, Flexible Exchange Rates for a Stable World Economy, Washington, DC: Peterson Institute for International Economics.

Galati, G., A. Heath, and P. McGuire, 2007, "Evidence of Carry Trade Activity," BIS Quarterly Review, September, Bank for International Settlements, Basel.

Galati, G., and R. Moessner, 2013, "Macroprudential Policy – A Literature Review," Journal of Economic Surveys, Vol. 27, No. 5, pp. 846–78.

Galbraith, J. K., 1954, The Great Crash, 1929, Boston: Houghton Mifflin.

Gale, D., and M. Hellwig, 1985, "Incentive-Compatible Debt Contracts: The One-Period Problem," Review of Economic Studies, Vol. 52, pp. 647–64.

Gale, W. G., R. E. Hall, and J. Sabelhaus, 1999, "Perspectives on the Household Saving Rate," Brookings Papers of Economic Activity, Vol. 1999, No. 1, pp. 181–224.

Gambacorta, L., 2005, "Inside the Bank Lending Channel," European Economic Review, Vol. 49, pp. 1737–59.

Gambacorta, L., and D. Marques-Ibanez, 2011, "The Bank Lending Channel: Lessons from the Crisis," Economic Policy, Vol. 26, No. 66, pp. 135–82.

Gambacorta, L., and H. S. Shin, forthcoming, "Why Bank Capital Matters for Monetary Policy," Journal of Financial Intermediation.

Gan, J., 2007, "The Real Effects of Asset Market Bubbles: Loan and Firm Level Evidence of a Lending Channel," Review of Financial Studies, Vol. 20, pp. 1941–73.

Gan, J., 2010, "Housing Wealth and Consumption Growth: Evidence from a Large Panel of Households," Review of Financial Studies, Vol. 23, No. 6, pp. 2229–67.

Gandré, P., 2017, "Learning, House Prices and Macro-Financial Linkages," Paper presented at ADRES Doctoral Conference 2017, February 27–28, Toulouse.

Garber, P. M., 2000, Famous First Bubbles: The Fundamentals of Early Manias, Cambridge: MIT Press.

Geanakoplos, J., 2003, "Liquidity, Default, and Crashes: Endogenous Contracts in General Equilibrium," in Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress, M. Dewatripont, L. P. Hansen, and S. J. Turnovsky (eds), pp. 170–205, New York: Cambridge University Press.

Geanakoplos, J., 2008, "Arrow Debreu Model of General Equilibrium," in The New Palgrave Dictionary of Economics, 2nd edition, S. N. Durlauf and L. E. Blume (eds), Palgrave Macmillan.

Geanakoplos, J., 2010, "The Leverage Cycle," in NBER Macroeconomic Annual 2009, Vol. 24, D. Acemoglu, K. Rogoff, and M. Woodford (eds), pp. 1–65, Chicago: University of Chicago Press.

Geanakoplos, J., and H. M. Polemarchakis, 1986, "Existence, Regularity and Constrained Suboptimality of Competitive Allocations when the Asset Structure is Incomplete," in Uncertainty, information and communication: Essays in Honor of Kenneth J. Arrow, Vol. 3, W. P. Heller, R. M. Starr, and D. A. Starrett (eds), pp. 65–95, New York: Cambridge University Press.

Geithner, T., 2014, Stress Test: Reflections on Financial Crises, New York: Crown Publishers.

Gennaioli, N., A. Shleifer, and R. W. Vishny, 2013, "A Model of Shadow Banking," Journal of Finance, Vol. 68, No. 4, pp. 1331–63.

Gerali, A., S. Neri, L. Sessa, and F. M. Signoretti, 2010, "Credit and Banking in a DSGE Model of the Euro Area," Journal of Money, Credit and Banking, Vol. 42, No. 6, pp. 107–41.

Gerke, R., M. Jonsson, M. Kliem, M. Kolasa, P. Lafourcade, A. Locarno, K. Makarski, and P. McAdam, 2013, "Assessing Macro-Financial Linkages: A Model Comparison Exercise," Economic Modelling, Vol. 31, pp. 253–64.

Gertler, M., 1988, "Financial Structure and Aggregate Economic Activity: An Overview," Journal of Money, Credit and Banking, Vol. 20, No. 3, pp. 559–88.

Gertler, M., and S. Gilchrist, 1993, "The Cyclical Behavior of Short-Term Business Lending: Implications for Financial Propagation Mechanisms," European Economic Review, Vol. 37, No. 2–3, pp. 623–31.

Gertler, M., and S. Gilchrist, 1994, "Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms," Quarterly Journal of Economics, Vol. 109, No. 2, pp. 309–40.

Gertler, M., S. Gilchrist, and F. M. Natalucci, 2007, "External Constraints on Monetary Policy and the Financial Accelerator," Journal of Money, Credit and Banking, Vol. 39, No. 2–3, pp. 295–330.

Gertler, M., and R. G. Hubbard, 1988, "Financial Factors in Business Fluctuations," Proceedings of Economic Policy Symposium, Financial Market Volatility, Federal Reserve Bank of Kansas City, August 17–19, Jackson Hole, pp. 33–78.

Gertler, M., and P. Karadi, 2011, "A Model of Unconventional Monetary Policy," Journal of Monetary Economics, Vol. 58, pp. 17–34.

Gertler, M., and P. Karadi, 2013, "QE 1 vs. 2 vs. 3… A Framework for Analyzing Large Scale Asset Purchases as a Monetary Policy Tool," International Journal of Central Banking, Vol. 9, No. 1, pp. 5–53.

Gertler, M., and N. Kiyotaki, 2011, "Financial Intermediation and Credit Policy in Business Cycle Analysis," in Handbook of Monetary Economics, Vol. 3, B. M. Friedman and M. Woodford (eds), pp. 547–99, Amsterdam: North-Holland.

Gertler, M., and N. Kiyotaki, 2015, "Banking, Liquidity, and Bank Runs in an Infinite Horizon Economy," American Economic Review, Vol. 105, No. 7, pp. 2011–43.

Gertler, M, N. Kiyotaki, and A. Prestipino, 2016, "Wholesale Banking and Bank Runs in Macroeconomic Modeling of Financial Crises," in Handbook of Macroeconomics, Vol. 2, J. B. Taylor and H. Uhlig (eds), pp. 1345–425, Amsterdam: North-Holland.

Gervais, O., L. Schembri, and L. Suchanek, 2016, "Current Account Dynamics, Real Exchange Rate Adjustment, and the Exchange Rate Regime in Emerging-Market Economies," Journal of Development Economics, Vol. 119, pp. 86–99.

Ghironi, F., 2017, "Macro Needs Micro," NEBR Working Paper 23836, National Bureau of Economic Research, Cambridge.

Ghironi, F., J. Lee, and A. Rebucci, 2015, "The Valuation Channel of External Adjustment," Journal of International Money and Finance, Vol. 57, pp. 86–114.

Ghironi, F., and M. Melitz, 2005, "International Trade and Macroeconomic Dynamics with Heterogeneous Firms," Quarterly Journal of Economics, Vol. 120, pp. 865–915.

Ghosh, A. R., J. D. Ostry, and C. Tsangarides, 2010, "On the Stability of the International Monetary System: Exchange Rate Regime Choice and Sources of Systemic Stress," IMF Occasional Paper 270, International Monetary Fund, Washington, DC.

Giannetti, M., and A. Simonov, 2013, "On the Real Effects of Bank Bailouts: Micro Evidence from Japan," American Economic Journal: Macroeconomics, Vol. 5, No. 1, pp. 135–67.

Gilchrist, S., J.-O. Hairault, and H. Kempf, 2002, "Monetary Policy and the Financial Accelerator in a Monetary Union," International Finance Discussion Paper 750, Board of Governors of the Federal Reserve System, Washington, DC.

Gilchrist, S., and C. Himmelberg, 1999, "Investment: Fundamentals and Finance," in NBER Macroeconomics Annual 1998, Vol. 13, B. S. Bernanke and J. J. Rotenberg (eds), pp. 223–74, Cambridge: MIT Press.

Gilchrist, S., and J. W. Sim, 2007, "Investment During the Korean Financial Crisis: A Structural Econometric Approach," Department of Economics Working paper 2007–001, Boston University, Boston.

Gilchrist, S., J. W. Sim, and E. Zakrajšek, 2014, "Uncertainty, Financial Frictions, and Investment Dynamics," NBER Working Paper 20038, National Bureau of Economic Research, Cambridge.

Gilchrist, S., V. Yankov, and E. Zakrajšek, 2009, "Credit Market Shocks and Economic Fluctuations: Evidence from Corporate Bond and Stock Markets," Journal of Monetary Economics, Vol. 56, pp. 471–93.

Gilchrist, S., and E. Zakrajšek, 2008, "Linkages between the Financial and Real Sectors: An Overview," Paper prepared for the Academic Consultants Meeting, Federal Reserve Board, October 3, Washington, DC.

Gilchrist, S., and E. Zakrajšek, 2011, "Monetary Policy and Credit Supply Shocks," IMF Economic Review, Vol. 59, No. 2, pp. 195–232.

Gilchrist, S., and E. Zakrajšek, 2012, "Credit Spreads and Business Cycle Fluctuations," American Economic Review, Vol. 102, No. 4, pp. 1692–720.

Goetzmann, W. N., L. Li, and K. G. Rouwenhorst, 2005, "Long-Term Global Market Correlations," Journal of Business, Vol. 78, No. 1, pp. 1–38.

Goldberg, L., 1993, "Exchange Rates and Investment in United States Industry," Review of Economics and Statistics, Vol. 75, pp. 575–88.

Goldberg, L., and C. Tille, 2008, "Vehicle Currency Use in International Trade," Journal of International Economics, Vol. 76, No. 2, pp. 177–92.

Goldsmith, R. W, 1969, Financial Structure and Development, New Haven, CT: Yale University Press.

Goldsmith, R. W., 1987, Premodern Financial Systems: A Historical Comparative Study, New York: Cambridge University Press.

Golec, P., and E. Perotti, 2017, "Safe Assets: A Review," ECB Working Paper 2035, European Central Bank, Frankfurt am Main.

Gomes, J. F., 2001, "Financing Investment," American Economic Review, Vol. 91, No. 5, pp. 1263–85.

Gomme, P., B. Ravikumar, and P. Rupert, 2011, "The Return to Capital and the Business Cycle," Review of Economic Dynamics, Vol. 14, No. 2, pp. 262–78.

Goodhart, C., 1999, "Central Bankers and Uncertainty," Quarterly Bulletin, Vol. 39, No. 1, pp. 102–14, Bank of England, London.

Goodhart, C., and L. Figliuoli, 1991, "Every Minute Counts in Financial Markets," Journal of International Money and Finance, Vol. 10, pp. 23–52.

Goodhart, C. A. E., and B. Hofmann, 2008, "House Prices, Money, Credit and the Macroeconomy," Oxford Review of Economic Policy, Vol. 24, pp. 180–205.

Goodhart, C. A. E., A. K. Kashyap, D. P. Tsomocos, and A. P. Vardoulakis, 2012, "Financial Regulation in General Equilibrium," NBER Working Paper 17909, National Bureau of Economic Research, Cambridge.

Goodhart, C. A. E., A. K. Kashyap, D. P. Tsomocos, and A. P. Vardoulakis, 2013, "An Integrated Framework for Analyzing Multiple Financial Regulations," International Journal of Central Banking, Vol. 9, No. 1, pp. 109–43.

Gopinath, G., 2015, "The International Price System," Proceedings of Economic Policy Symposium, Inflation Dynamics and Monetary Policy, Federal Reserve Bank of Kansas City, August 27-29, Jackson Hole, pp. 71–150.

Gopinath, G., 2017, "Rethinking Macroeconomic Policy: International Economy Issues," Paper presented at the Rethinking Macroeconomic Policy Conference, Peterson Institute for International Economics, October 12–13, Washington, DC.

Gopinath, G., E. Helpman, and K. Rogoff (eds), 2014, Handbook of International Economics, Vol. 4, Amsterdam: North-Holland.

Gordon, M. J., 1959, "Dividends, Earnings, and Stock Prices," Review of Economics and Statistics, Vol. 41, No. 2, pp. 99–105.

Gordon, M. J., 1962, The Investment, Financing, and Valuation of the Corporation, Homewood: R. D. Irwin.

Gorton, G. B., 2010, Slapped by the Invisible Hand: The Panic of 2007, New York: Oxford University Press.

Gorton, G. B., 2012, Misunderstanding Financial Crises: Why We don't See Them Coming, New York: Oxford University Press.

Gorton, G. B., 2017, "The History and Economics of Safe Assets," Annual Review of Economics, Vol. 9, pp. 547–86.

Gorton, G. B., and P. He, 2008, "Bank Credit Cycles," Review of Economic Studies, Vol. 75, No. 4, pp. 1181–214.

Gorton, G., and L. Huang, 2004, "Liquidity, Efficiency, and Bank Bailouts," American Economic Review, Vol. 94, No. 3, pp. 455–83.

Gorton, G., and A. Metrick, 2010, "Haircuts," Review, Vol. 92, No. 6, pp. 507–20, Federal Reserve Bank of St. Louis, St. Louis.

Gorton, G., and A. Metrick, 2013, "Securitization," in Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 1–70, Amsterdam: North-Holland.

Gorton, G. B., and G. Ordoñez, 2013, "The Supply and Demand for Safe Assets," NBER Working Paper 18732, National Bureau of Economic Research, Cambridge.

Gorton, G., and G. Ordoñez, 2014, "Collateral Crises," American Economic Review, Vol. 104, No. 2, pp. 343–78.

Gorton, G., and A. Winton, 2017, "Liquidity Provision, Bank Capital, and the Macroeconomy," Journal of Money, Credit and Banking, Vol. 49, No. 1, pp. 5–37.

Gourinchas, P.-O., 2011, "Global Imbalances and Global Liquidity," in Asia's Role in the Post Crisis Global Economy, R. Glick and M. M. Spiegel (eds), pp. 305–40, San Francisco: Federal Reserve Bank of San Francisco.

Gourinchas, P.-O., and H. Rey, 2007, "International Financial Adjustment," Journal of Political Economy, Vol. 115, No. 4, pp. 665–703.

Gourinchas, P.-O., and H. Rey, 2014, "External Adjustment, Global Imbalances, Valuation Effects," in Handbook of International Economics, Vol. 4, G. Gopinath, E. Helpman, and K. Rogoff (eds), pp. 585–645. Amsterdam: North-Holland.

Gourinchas, P.-O., and H. Rey, 2016, "Real Interest Rates, Imbalances and the Curse of Regional Safe Asset Providers at the Zero Lower Bound," Proceedings of ECB Forum on Central Banking, The Future of the International Monetary and Financial Architecture, European Central Bank, June 27–29, Sintra, pp. 70–109.

Gourinchas, P.-O., H. Rey, and N. Govillot, 2010, "Exorbitant Privilege and Exorbitant Duty," IMES Discussion Paper 2010-E-20, Bank of Japan, Tokyo.

Gourinchas, P.-O., R. Valdes, and O. Landerretche, 2001, "Lending Booms: Latin America and the World," Economia, Spring, pp. 47–89.

Graham, J. R., 2013, "Do Taxes Affect Corporate Decisions? A Review," Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 123–210, Amsterdam: North-Holland.

Graham, J. R., and C. R. Harvey, 2001, "The Theory and Practice of Corporate Finance: Evidence from the Field," Journal of Financial Economics, Vol. 60, No. 2–3, pp. 187-243.

Greenbaum, S. I., A. V. Thakor, and A. Boot, 2016, Contemporary Financial Intermediation, 3rd edition, London: Academic Press.

Greenlaw, D., J. Hatzius, A. K. Kashyap, and H. S. Shin, 2008, "Leveraged Losses: Lessons from the Mortgage Market Meltdown," U.S. Monetary Policy Forum, University of Chicago and Brandeis University, February 29, New York.

Greenwald, B. C., and J. E. Stiglitz, 1993, "Financial Market Imperfections and Business Cycles," Quarterly Journal of Economics, Vol. 108, pp 77–114.

Grier, K. B., and A. D. Smallwood, 2013, "Exchange Rate Shocks and Trade: A Multivariate GARCH-M Approach," Journal of International Money and Finance, Vol. 37, pp. 282–305.

Griffin, J. M., J. H. Harris, T. Shu, and S. Topaloglu, 2011, "Who Drove and Burst the Tech Bubble?" Journal of Finance, Vol. 66, No. 4, pp. 1251–90.

Griffoli, T. M., and A. Ranaldo, 2010, "Limits to Arbitrage during the Crisis: Funding Liquidity Constraints and Covered Interest Parity," Swiss National Bank Working Paper 2010–14, Swiss National Bank, Zurich.

Gross, D. B., 1995, "The Investment and Financing Decisions of Liquidity Constrained Firms," Doctoral dissertation, Massachusetts Institute of Technology, Cambridge.

Große Steffen, C., 2015, "Essays on Macro-Financial Linkages in the Open Economy," Doctoral dissertation, Freie Universität Berlin, Berlin.

Grossman, G. M., and K. Rogoff (eds), 1995, Handbook of International Economics, Vol. 3, Amsterdam: North-Holland.

Grossman, S. J., and R. J. Shiller, 1981, "The Determinants of the Variability of Stock Market Prices," American Economic Review, Vol. 71, No. 2, pp. 222–7.

Guarda, P., and P. Jeanfils, 2012, "Macro-Financial Linkages: Evidence from Country-Specific VARs," CEPR Discussion Paper 8875, Centre for Economic Policy Research, London.

Guerrieri, L., and M. Iacoviello, 2013, "Collateral Constraints and Macroeconomic Asymmetries," International Finance Discussion Paper 1082, Board of Governors of the Federal Reserve System, Washington, DC.

Guerrieri, L., M. Iacoviello, and R. Minetti, 2012, "Banks, Sovereign Debt and the International Transmission of Business Cycles," in NBER International Seminar on

Macroeconomics 2012, F. Giavazzi and K. D. West (eds), pp. 181–213, Chicago: University of Chicago Press.

Guidolin, M., and A. Timmermann, 2007, "Asset Allocation under Multivariate Regime Switching," Journal of Economic Dynamics and Control, Vol. 31, No. 11, pp. 3503–44.

Guiso, L., L. Pistaferri, and F. Schivardi, 2013, "Credit within the Firm," Review of Economic Studies, Vol. 80, No. 1, pp. 211–47.

Guiso, L., and P. Sodini, 2013, "Household Finance: An Emerging Field," in Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 1397–532, Amsterdam: North-Holland.

Gürkaynak, R. S., and J. Wright, 2012, "Macroeconomics and the Term Structure," Journal of Economic Literature, Vol. 50, No. 2, pp. 331–67.

Gurley, J., and E. Shaw, 1955, "Financial Aspects of Economic Development," American Economic Review, Vol. 45, No. 4, pp. 515–38.

Gust, C., E. Herbst, D. López-Salido, and M. E. Smith, 2017, "The Empirical Implications of the Interest-Rate Lower Bound," American Economic Review, Vol. 107, No. 7, pp. 1971–2006.

Ha, J., M. A. Kose, C. Otrok, and E. S. Prasad, 2017, "Global Macro-Financial Cycles and Spillovers," Paper presented at the 18th Jacques Polak Annual Research Conference, International Monetary Fund, November 2–3, Washington, DC.

Haberler, G., 1937, Prosperity and Depression, A Theoretical Analysis of Cyclical Movements, New York: Columbia University Press.

Habib, M. A., and D. B. Johnsen, 1999, "The Financing and Redeployment of Specific Assets," Journal of Finance, Vol. 2, No. 4, pp. 693–720.

Habib, M. M., E. Mileva and L. Stracca, 2017, "The Real Exchange Rate and Economic Growth: Revisiting the Case Using External Instruments," Journal of International Money and Finance, Vol 73, pp. 386-98.

Hall, R. E., 1988, "Intertemporal Substitution in Consumption," Journal of Political Economy, Vol. 96, No. 2, pp. 339–57.

Hall, R. E., 2010, "Why Does the Economy Fall to Pieces after a Financial Crisis?" Journal of Economic Perspectives, Vol. 24, No. 4, pp. 3–20.

Hall, V. B., C. J. McDermott, and J. Tremewan, 2006, "The Ups and Downs of New Zealand House Prices," Motu Working Paper 06–03, Motu Economic and Public Policy Research, Wellington.

Halling, M., J. Yu, and J. Zechner, 2016, "Leverage Dynamics over the Business Cycle," Journal of Financial Economics, Vol. 122, No. 1, pp. 21–41.

Haltenhof, S., S. J. Lee, and V. Stebunovs, 2014, "The Credit Crunch and Fall in Employment during the Great Recession," Journal of Economic Dynamics and Control, Vol. 43, pp. 31–57.

Hancock, D., and W. Passmore, 2011, "Catastrophic Mortgage Insurance and the Reform of Fannie Mae and Freddie Mac," in The Future of Housing Finance: Restructuring the U.S. Residential Mortgage Market, M. N. Baily (ed), pp. 111–45, Washington, DC: Brookings Institution.

Hancock, D., and J. Wilcox, 1993, "Has There Been a 'Capital Crunch' in Banking? The Effects on Bank Lending of Real Estate Market Conditions and Bank Capital Shortfalls," Journal of Housing Economics, Vol. 3, No. 1, pp. 31–50.

Hancock, D., and J. Wilcox, 1994, "Bank Capital, Loan Delinquencies, and Real Estate Lending," Journal of Housing Economics, Vol. 3, No. 2, pp. 121–46.

Hansen, L. P., and T. J. Sargent, 2008, Robustness, Princeton: Princeton University Press.

Hanson, S. G., and J. C. Stein, 2015, "Monetary Policy and Long-Term Real Rates," Journal of Financial Economics, Vol. 115, No. 3, pp. 429–48.

Harchaoui, T., F. Tarkhani, and T. Yuen, 2005, "The Effects of the Exchange Rate on Investment: Evidence from Canadian Manufacturing Industries," Bank of Canada Working Paper 2005–22, Bank of Canada, Ottawa.

Harding, D., and A. Pagan, 2002, "Dissecting the Cycle: A Methodological Investigation," Journal of Monetary Economics, Vol. 49, No. 2, pp. 365–81.

Harding, D., and A. Pagan, 2016, The Econometric Analysis of Recurrent Events in Macroeconomics and Finance, Princeton: Princeton University Press.

Hart, O., and J. Moore, 1994, "A Theory of Debt Based on the Inalienability of Human Capital," Quarterly Journal of Economics, Vol. 109, No. 4, pp. 841–79.

Hartmann, P., 2017, "International Liquidity," CEPR Discussion Paper 12337, Centre for Economic Policy Research, London.

Hartmann, P., K. Hubrich, M. Kremer, and R. J. Tetlow, 2015, "Melting Down: Systemic Financial Instability and the Macroeconomy," mimeo, February 28.

Hassan, T. A., 2013, "Country Size, Currency Unions, and International Asset Returns," Journal of Finance, Vol. 68, No. 6, pp. 2269–308.

Hassan, T. A., and R. C. Mano, 2014, "Forward and Spot Exchange Rates in a Multi-Currency World," NBER Working Paper 20294, National Bureau of Economic Research, Cambridge.

Hassan, T. A., T. M. Mertens, and T. Zhang, 2016, "Not So Disconnected: Exchange Rates and the Capital Stock," Journal of International Economics, Vol. 99, No. S1, pp. S43–57.

Hau, H., 1998, "Competitive Entry and Endogenous Risk in the Foreign Exchange Market," Review of Financial Studies, Vol. 11, No. 4, pp. 757–87.

Hayashi, F., 1982, "Tobin's Marginal Q and Average Q: A Neoclassical Interpretation," Econometrica, Vol. 50, No. 1, pp. 213–24.

He, Z., and A. Krishnamurthy, 2012, "A Macroeconomic Framework for Quantifying Systemic Risk," Working Paper Research 233, National Bank of Belgium, Brussels

He, Z., and A. Krishnamurthy, 2013, "Intermediary Asset Pricing," American Economic Review, Vol. 103, No. 2, pp. 732–70.

Heath, R., and E. Bese Goksu, 2017, "Financial Stability Analysis: What are the Data Needs?" IMF Working Paper 17/153, International Monetary Fund, Washington, DC.

Heathcote, J., and F. Perri, 2002, "Financial Autarky and International Business Cycles," Journal of Monetary Economics, Vol. 49, No. 3, pp. 601–27.

Heathcote, J., and F. Perri, 2013, "The International Diversification Puzzle Is Not as Bad as You Think," Journal of Political Economy, Vol. 121, No. 6, pp. 1108–159.

Heathcote, J., and F. Perri, 2014, "Assessing International Efficiency," in Handbook of International Economics, Vol. 4, G. Gopinath, E. Helpman, and K. Rogoff (eds), pp. 523-84. Amsterdam: North-Holland.

Heathcote, J., K. Storesletten, and G. L. Violante, 2009, "Quantitative Macroeconomics with Heterogeneous Households," Annual Review of Economics, Vol. 1, No. 1, pp. 319–54.

Helbling, T., R. Huidrom, M. A. Kose, and C. Otrok, 2011, "Do Credit Shocks Matter? A Global Perspective," European Economic Review, Vol. 55, No. 3, pp. 340–53.

Hellerstein, R., D. Daly, and C. Marsh, 2006, "Have U.S. Import Prices Become Less Responsive to Changes in the Dollar?" Current Issues in Economics and Finance, September, Federal Reserve Bank of New York, New York.

Helwege, J., and N. Liang, 2004, "Initial Public Offerings in Hot and Cold Markets," Journal of Financial and Quantitative Analysis, Vol. 39, pp. 541–69.

Henriksen, E., F. E. Kydland, R. Šustek, 2013, "Globally Correlated Nominal Fluctuations," Journal of Monetary Economics, Vol. 60, No. 6, pp. 613–31.

Herrera, A. M., M. Kolar, and R. Minetti, 2011, "Credit Reallocation," Journal of Monetary Economics, Vol. 58, No. 6–8, pp. 551–63.

Hicks, J., 1937, "Mr. Keynes and the "Classics": A Suggested Interpretation," Econometrica, Vol. 5, pp. 147–59.

Hirata, H., M. A. Kose, C. Otrok, and M. E. Terrones, 2012, "Global House Price Fluctuations: Synchronization and Determinants," in NBER International Seminar on Macroeconomics 2012, F. Giavazzi and K. D. West (eds), pp. 119–66, Chicago: University of Chicago Press.

Hirshleifer, D., 2015, "Behavioral Finance," Annual Review of Financial Economics, Vol. 7, pp. 133–59.

Hnatkovska, V., A. Lahiri, and C. A. Vegh, 2013, "Interest Rates and the Exchange Rate: A Non-Monotonic Tale," European Economic Review, Vol. 53, pp. 68–93.

Hofmann, B., 2004, "The Determinants of Private Sector Credit in Industrialised Countries: Do Property Prices Matter?" International Finance, Vol. 7, No. 2, pp. 203-34.

Holmström, B., and J. Tirole, 1997, "Financial Intermediation, Loanable Funds, and the Real Sector," Quarterly Journal of Economics, Vol. 112, No. 3, pp. 663–91.

Holmström, B., and J. Tirole, 1998, "Private and Public Supply of Liquidity," Journal of Political Economy, Vol. 106, pp. 1–40.

Holmström, B., and J. Tirole, 2011, Inside and Outside Liquidity, Cambridge: MIT Press.

Holston, K., T. Laubach, and J. C. Williams, 2016, "Measuring the Natural Rate of Interest: International Trends and Determinants," Finance and Economics Discussion Paper Series 2016–073, Board of Governors of the Federal Reserve System, Washington, DC.

Hooper, P., and J. Marquez, 1995, "Exchange Rates, Prices, and External Adjustment in the United States and Japan," in Understanding Interdependence: The Macroeconomics of the Open Economy, P. B. Kenen (ed), pp. 107–68, Princeton: Princeton University Press.

Hordahl, P., and F. Packer, 2007, "Understanding Asset Prices: An Overview," BIS Working Paper 34, Bank of International Settlements, Basel.

Hoshi, T., A. Kashyap, and D. Scharfstein, 1991, "Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups," Quarterly Journal of Economics, Vol. 106, No. 1, pp. 33–60.

Hubbard, R. G., 1995, "Is There a 'Credit Channel' for Monetary Policy?" Review, Vol. 77, No. 3, pp. 63–77, Federal Reserve Bank of St. Louis, St. Louis.

Hubbard, R. G., 1998, "Capital-Market Imperfections and Investment," Journal of Economic Literature, Vol. 36, No. 1, pp. 193–225.

Hubbard, R. G., A. K. Kashyap, and T. M. Whited, 1995, "Internal Finance and Firm Investment," Journal of Money, Credit and Banking, Vol. 27, No. 3, pp. 683–701.

Hubbard, R. G., K. Kuttner, and D. Palia, 2002, "Are There Bank Effects in Borrowers' Cost of Funds? Evidence from a Matched Sample of Borrowers and Banks," Journal of Business, Vol. 75, pp. 559−81.

Huberman, G., and R. Repullo, 2014, "Moral Hazard and Debt Maturity," CEPR Discussion Paper 9930, Centre for Economic Policy Research, London.

Hubrich, K., A. D'Agostino, M. Ĉervená, M. Ciccarelli, P. Guarda, M. Haavio, P. Jeanfils, C. Mendicino, E. Ortega, M. T. Valderrama, and M. V. Endrész, 2013, "Financial Shocks and the Macroeconomy: Heterogeneity and Non-Linearities," ECB Occasional Paper 143, European Central Bank, Frankfurt am Main.

Hubrich, K., and R. J. Tetlow, 2015, "Financial Stress and Economic Dynamics: The Transmission of Crises," Journal of Monetary Economics, Vol. 70, pp. 100–15.

Huggett, M., 1993, "The Risk-Free Rate in Heterogeneous-Agent Incomplete-Insurance Economies," Journal of Economic Dynamics and Control, Vol. 17, No. 5–6, pp. 953–69.

Huidrom, R., 2014, "Credit Shocks and the U.S. Business Cycle: Is This Time Different?" mimeo, February 14, University of Virginia, Charlottesville.

Iacoviello, M., 2004, "Consumption, House Prices, and Collateral Constraints: A Structural Econometric Analysis," Journal of Housing Economics, Vol. 13, No. 4, pp. 304–20.

Iacoviello, M., 2005, "House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle," American Economic Review, Vol. 95, No. 3, pp. 739–64.

Iacoviello, M., 2015, "Financial Business Cycles," Review of Economic Dynamics, Vol. 18, No. 1, pp. 140–63.

Iacoviello, M., and R. Minetti, 2006a, "Liquidity Cycles," Society for Economic Dynamics Meeting Paper 676.

Iacoviello, M., and R. Minetti, 2006b, "International Business Cycles with Domestic and Foreign Lenders," Journal of Monetary Economics, Vol. 53, No. 8, pp. 2267–82.

Iacoviello, M., and R. Minetti, 2008, "The Credit Channel of Monetary Policy: Evidence from the Housing Market," Journal of Macroeconomics, Vol. 30, No. 1, pp. 69–96.

Iacoviello, M., and R. Minetti, 2010, "Foreign Lenders in Emerging Economies," Society for Economic Dynamics Meeting Paper 1050.

Iacoviello, M., and M. Pavan, 2013, "Housing and Debt Over the Life Cycle and Over the Business Cycle," Journal of Monetary Economics, Vol. 60, pp. 221–38.

Igan, D., and P. Loungani, 2012, "Global Housing Cycles," IMF Working Paper 12/127, International Monetary Fund, Washington, DC.

Ilut, C., 2012, "Ambiguity Aversion: Implications for the Uncovered Interest Rate Parity Puzzle," American Economic Journal: Macroeconomics, Vol. 4, No. 3, pp. 33–65.

IMF-FSB-BIS, 2016, "Elements of Effective Macroprudential Policies: Lessons from International Experience," Report to the G-20, August 31.

International Monetary Fund, 1999, "From Crisis to Recovery in the Emerging Market Economies," World Economic Outlook, September.

International Monetary Fund, 2000, World Economic Outlook: Asset Prices and the Business Cycle, May, Washington, DC: International Monetary Fund.

International Monetary Fund, 2002, World Economic Outlook: Trade and Finance, September, Washington, DC: International Monetary Fund.

International Monetary Fund, 2005, "Global Imbalances: A savings and investment perspective," World Economic Outlook, September.

International Monetary Fund, 2006, World Economic Outlook: Globalization and Inflation, April, Washington, DC: International Monetary Fund.

International Monetary Fund, 2007, World Economic Outlook: Spillovers and Cycles in the Global Economy, April, Washington, DC: International Monetary Fund.

International Monetary Fund, 2008, World Economic Outlook: Housing and Business Cycle, April. Washington, DC: International Monetary Fund.

International Monetary Fund, 2009, World Economic Outlook: Sustaining the Recovery, October, Washington, DC: International Monetary Fund.

International Monetary Fund, 2013, "Unconventional Monetary Policies–Recent Experience and Prospects," Board Paper, International Monetary Fund, Washington, DC.

International Monetary Fund, 2015, "Exchange Rates and Trade Flows: Disconnected?" World Economic Outlook, October.

Ioannidou, V., S. Ongena, and J.-L. Peydró, 2015, "Monetary Policy, Risk-Taking, and Pricing: Evidence from a Quasi-Natural Experiment," Review of Finance, Vol. 19, No. 1, pp. 95–144.

Islamaj, E., and M. A. Kose, 2016, "How does the Sensitivity of Consumption to Income Vary over Time? International Evidence," Journal of Economic Dynamics and Control, Vol. 72, pp. 169–79.

Ismailov, A., and B. Rossi, 2017, "Uncertainty and Deviations from Uncovered Interest Rate Parity," Journal of International Money and Finance, forthcoming.

Jaffee, D. M., and T. Russell, 1976, "Imperfect Information, Uncertainty, and Credit Rationing," Quarterly Journal of Economics, Vol. 90, No. 4, pp. 651–66.

Jaimovich, N., and S. Rebelo, 2008, "News and Business Cycles in Open Economies," Journal of Money, Credit and Banking, Vol. 40, No. 8, pp. 1699–711.

Jappelli, T., and L. Pistaferri, 2010, "The Consumption Response to Income Changes," Annual Review of Economics, Vol. 2, No. 1, pp. 479–506.

Jeanne, O., 2014, "Macroprudential Policies in a Global Perspective," NBER Working Paper 19967, National Bureau of Economic Research, Cambridge.

Jeanne, O., 2016, "The Macroprudential Role of International Reserves," American Economic Review, Vol. 106, No. 5, pp. 570–3.

Jeanne, O., and A. Korinek, 2010, "Excessive Volatility in Capital Flows: A Pigouvian Taxation Approach," American Economic Review, Vol. 100, No. 2, pp. 403–7.

Jeanne, O., and A. K. Rose, 2002, "Noise Trading and Exchange Rate Regimes," Quarterly Journal of Economics, Vol. 117, No. 2, pp. 537–69.

Jensen, M. C., 1986, "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," American Economic Review, Vol. 76, No. 2, pp 323–9.

Jensen, M. C., and W. H. Meckling, 1976, "Theory of the Firm: Managerial Behavior, Agency Cost and Ownership Structure," Journal of Financial Economics, Vol. 3, No. 4, pp. 305–60.

Jermann, U., and V. Quadrini, 2012, "Macroeconomic Effects of Financial Shocks," American Economic Review, Vol. 102, No. 1, pp. 238–71.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina, 2012, "Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications," American Economic Review, Vol. 102, No. 5, pp. 2301–26.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina, 2014, "Hazardous Times for Monetary Policy: What do Twenty-Three Million Bank Loans Say about the Effects of Monetary Policy on Credit Risk-Taking?" Econometrica, Vol. 82, No. 2, pp. 463–505.

Jordà, Ò., M. Schularick, and A. M. Taylor, 2016, "The Great Mortgaging: Housing Finance, Crises and Business Cycles," Economic Policy, Vol. 31, No. 85, pp. 107–52.

Jordà, Ò., M. Schularick, and A. M. Taylor, 2017, "Macrofinancial History and the New Business Cycle Facts," in NBER Macroeconomics Annual 2016, Vol. 31, M. Eichenbaum and J. A. Parker (eds), pp. 213–63, Chicago: University of Chicago Press.

Jordà, O., and A. M. Taylor, 2012, "The Carry Trade and Fundamentals: Nothing to Fear but FEER Itself," Journal of International Economics, Vol. 88, No. 1, pp. 74–90.

Jorion, P., 1990, "The Exchange Rate Exposure of US Multinationals," Journal of Business, Vol. 63, pp. 331–45.

Jorion, P., 1991, "The Pricing of Exchange Rate Risk in the Stock Market," Journal of Financial and Quantitative Analysis, Vol. 26, pp. 363–76.

Joslin, S., M. Priebsch, and K. J. Singleton, 2014, "Risk Premiums in Dynamic Term Structure Models with Unspanned Macro Risks," Journal of Finance, Vol. 69, No. 3, pp. 1197–233.

Ju, N., and J. Miao, 2012, "Ambiguity, Learning, and Asset Returns," Econometrica, Vol. 80, No. 2, pp. 559–91.

Juglar, C., 1862, Des Crises Commerciales en leur Retour Périodique en France, en Angleterre et aux États-Unis, Paris: Libraire Gillaumin.et Cie.

Juselius, M., and M. Drehmann, 2015, "Leverage Dynamics and the Real Burden of Debt," BIS Working Paper 501, Bank for International Settlements, Basel.

Justiniano, A., G. E. Primiceri, and A. Tambalotti, 2010, "Investment Shocks and Business Cycles," Journal of Monetary Economics, Vol. 57, No. 2, pp. 132–45.

Justiniano, A., G. E. Primiceri, and A. Tambalotti, 2011, "Investment Shocks and the Relative Price of Investment," Review of Economic Dynamics, Vol. 14, No. 1, pp. 102-21.

Kahneman, D., and A. Tversky, 1979, "Prospect Theory: An Analysis of Decision under Risk," Econometrica, Vol. 47, No. 2, pp. 263–92.

Kakes, J., and J. E. Sturm, 2002, "Monetary Policy and Bank Lending: Evidence from German Banking Groups," Journal of Banking & Finance, Vol. 26, No. 11, pp. 2077–92.

Kalantzis, Y., 2015, "Financial Fragility in Small Open Economies: Firm Balance Sheets and the Sectoral Structure," Review of Economic Studies, Vol. 82, No. 3, pp. 1194–222.

Kalemli-Ozcan, S., E. Papaioannou, and J.-L. Peydró, 2013, "Financial Regulation, Financial Globalization, and the Synchronization of Economic Activity," Journal of Finance, Vol. 68, No. 3, pp. 1179–228.

Kamin, S. B., and L. P. DeMarco, 2012, "How Did a Domestic Slump Turn into a Global Financial Crisis?" Journal of International Money and Finance, Vol. 31, No. 1, pp. 10-41.

Kaminsky, G. L., and S. L. Schmukler, 2008, "Short-Run Pain, Long-Run Gain: Financial Liberalization and Stock Market Cycles," Review of Finance, Vol. 12, No. 2, pp. 253-92.

Kannan, P., P. Rabanal, and A. Scott, 2012, "Monetary and Macroprudential Policy Rules in a Model with House Price Booms," B.E. Journal of Macroeconomics, Vol. 12, pp. 1–44.

Kaplan, G., G. L. Violante, and J. Weidner, 2014, "The Wealthy Hand-to-Mouth," Brookings Papers on Economic Activity, Vol. 2004, No. 1, pp. 77–138.

Kaplan, S. N., and L. Zingales, 1997, "Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?" Quarterly Journal of Economics, Vol. 112, No. 1, pp. 169–215.

Kaplan, S. N., and L. Zingales, 2000, "Investment-Cash Flow Sensitivities are not Valid Measures of Financing Constraints," Quarterly Journal of Economics, Vol. 115, No. 2, pp. 707–12.

Kara, G. I., and S. M. Ozsoy, 2016, "Bank Regulation under Fire Sale Externalities," Finance and Economics Discussion Series 2016-026, Board of Governors of the Federal Reserve System, Washington, DC.

Karolyi, G. A., 2004, "Does International Financial Contagion Really Exist?" Journal of Applied Corporate Finance, Vol. 16, No. 2–3, pp. 136–46.

Karolyi, G. A., and R. M. Stulz, 2003, "Are Financial Assets Priced Locally or Globally?" in Handbook of the Economics of Finance, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), Vol. 1, pp. 975–1020, Amsterdam: North-Holland.

Kashyap, A. K., R. Rajan, and J. C. Stein, 2002, "Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-Taking," Journal of Finance, Vol. 57, No. 1, pp. 33–73.

Kashyap, A. K., and J. C. Stein, 1994, "Monetary Policy and Bank Lending," in Monetary Policy, N. G. Mankiw (ed), pp. 221–61, Chicago: University of Chicago Press.

Kashyap, A. K., and J. C. Stein, 1995, "The Impact of Monetary Policy on Bank Balance Sheets," Carnegie-Rochester Conference Series on Public Policy, Vol. 42, No. 1, pp. 151–95.

Kashyap, A. K., and J. C. Stein, 2000, "What Do a Million Observations on Banks Say about the Transmission of Monetary Policy?" American Economic Review, Vol. 90, No. 3, pp. 407–28.

Kashyap, A., J. C. Stein, and D. W. Wilcox, 1993, "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance," American Economic Review, Vol. 83, No. 1, pp. 78–98.

Kashyap, A. K., D. P. Tsomocos, and A. P. Vardoulakis, 2017, "Optimal Bank Regulation in the Presence of Credit and Run Risk," Finance and Economics Discussion Series 2017–97, Board of Governors of the Federal Reserve Systems, Washington, DC.

Kearns, J., and N. Patel, 2016, "Does the Financial Channel of Exchange Rates Offset the Trade Channel?" BIS Quarterly Review, December, pp. 95–113, Bank for International Settlements, Basel.

Kehoe, P. J., and F. Perri, 2002, "International Business Cycles with Endogenous Incomplete Markets," Econometrica, Vol. 70, No. 3, pp. 907–28.

Kennedy, N., and P. Andersen, 1994, "Household Saving and Real House Prices: An International Perspective," BIS Working Paper 20, Bank for International Settlements, Basel.

Keynes, J. M., [1936] 1973, The General Theory of Employment Interest and Money, Vol. VII, The Collected Writings of John Maynard Keynes, D. E. Moggridge (ed), London: Palgrave Macmillan.

Khan, A., and J. K. Thomas, 2013, "Credit Shocks and Aggregate Fluctuations in an Economy with Production Heterogeneity," Journal of Political Economy, Vol. 121, No. 6, pp. 1055–107.

Kho, B.-C., R. M. Stulz, and F. E. Warnock, 2009, "Financial Globalization, Governance, and the Evolution of the Home Bias," Journal of Accounting Research, Vol. 47, No. 2, pp. 597–635.

Kiley, M. T., 2000, "Stock Prices and Fundamentals in a Production Economy," Finance and Economics Discussion Series 2000–05, Board of Governors of the Federal Reserve System, Washington, DC.

Killen, W. P., R. K. Lyons, and M. J. Moore, 2006, "Fixed versus Flexible: Lessons from EMS Order Flow," Journal of International Money and Finance, Vol. 25, No. 4, pp. 551-79.

Kim, K. H., 2004, "Housing and the Korean Economy," Journal of Housing Economics, Vol. 13, pp. 321–41.

Kim, S., and N. Roubini, 2008, "Twin Deficit or Twin Divergence? Fiscal Policy, Current Account, and Real Exchange Rate in the U.S.," Journal of International Economics, Vol. 74, No. 2, pp. 362–83.

Kindleberger, C., 1996, Manias, Panics and Crashes, 3rd edition, New York: Wiley.

King, M., 2012, "Twenty Years of Inflation Targeting," Stamp Memorial Lecture, London School of Economics, October 9.

King, M., 2016, The End of Alchemy: Money, Banking and the Future of the Global Economy, New York: W. W. Norton & Company.

King, R. G., C. I. Plosser, and S. T. Rebelo, 1988, "Production, Growth and Business Cycles: I. The Basic Neoclassical Model," Journal of Monetary Economics, Vol. 21, No. 2–3, pp. 195–232.

King, R. G., and R. Levine, 1993, "Finance and Growth: Schumpeter might be Right," Quarterly Journal of Economics, Vol. 108, No. 3, pp. 717–37.

Kishan, R., and T. Opiela, 2000, "Bank Size, Bank Capital, and the Bank Lending Channel," Journal of Money, Credit and Banking, Vol. 32, No. 1, pp. 121–41.

Kishan, R., and T. Opiela, 2006, "Bank Capital and Loan Asymmetry in the Transmission of Monetary Policy," Journal of Banking and Finance, Vol. 30, pp. 259–85.

Kishor, N. K., 2007, "Does Consumption Respond More to Housing Wealth Than to Financial Market Wealth? If So, Why?" Journal of Real Estate Finance and Economics, Vol. 35, No. 4, pp. 427–48.

Kiyotaki, N., and J. Moore, 1997, "Credit Cycles," Journal of Political Economy, Vol. 105, pp. 211–48.

Klein, M. W., and J. C. Shambaugh, 2010, Exchange Rate Regimes in the Modern Era, Cambridge: MIT Press.

Knight, M. D., 2006, "Marrying the Micro- and Macroprudential Dimensions of Financial Stability: Six Years On," Address at the 14th International Conference of Banking Supervisors, October 4–5, Merida.

Kocherlakota, N. R., 1996, "The Equity Premium: It's Still a Puzzle," Journal of Economic Literature, Vol. 34, No. 1, pp. 42–71.

Kocherlakota, N. R., 2000, "Creating Business Cycles Through Credit Constraints," Quarterly Review, Vol. 24, pp. 2–10, Federal Reserve Bank of Minneapolis, Minneapolis.

Kocherlakota, N. R., 2009, "Bursting Bubbles: Consequences and Cures," Paper presented at the Macroeconomic and Policy Challenges Following Financial Meltdowns Conference, April 3, International Monetary Fund, Washington, DC.

Kocherlakota, N., 2010, "Modern Macroeconomic Models as Tools for Economic Policy," The Region, May, pp. 5–21, Federal Reserve Bank of Minneapolis, Minneapolis.

Kocherlakota, N., 2016, "Fragility of Purely Real Macroeconomic Models," NBER Working Paper 21866, National Bureau of Economic Research, Cambridge.

Kok Sørensen, C., and T. Werner, 2006, "Bank Interest Rate Pass-Through in the Euro Area: A Cross Country Comparison," ECB Working Paper 580, European Central Bank, Frankfurt am Main.

Kollmann, R., Z. Enders, and G. J. Müller, 2011, "Global Banking and International Business Cycles," European Economic Review, Vol. 55, No. 3, pp. 407–26.

Korinek, A., and E. G. Mendoza, 2014, "From Sudden Stops to Fisherian Deflation: Quantitative Theory and Policy," Annual Review of Economics, Vol. 6, pp. 299–332.

Korinek, A., and A. Simsek, 2016, "Liquidity Trap and Excessive Leverage," American Economic Review, Vol. 106, No. 3, pp. 699–738.

Kose, M. A., S. Kurlat, F. Ohnsorge, and N. Sugawara, 2017a, "A Cross-Country Database of Fiscal Space," World Bank Policy Research Working Paper 8157, World Bank, Washington, DC.

Kose, M. A., F. Ohnsorge, L. S. Ye, and E. Islamaj, 2017b, "Weakness in Investment Growth: Causes, Implications and Policy Responses," World Bank Policy Research Working Paper 7990, World Bank, Washington, DC.

Kose, M. A., and E. S. Prasad, 2010, Emerging Markets: Resilience and Growth amid Global Turmoil, Washington, DC: Brookings Institution.

Kose, M. A., E. S. Prasad, K. Rogoff, and S. J. Wei, 2009, "Financial Globalization: A Reappraisal," IMF Staff Papers, Vol. 56, No. 1, pp. 8–62.

Kose, M. A., and M. E. Terrones, 2012, "How does Uncertainty Affect Economic Performance?" in World Economic Outlook: Coping with High Debt and Sluggish Growth, October, International Monetary Fund, Washington, DC.

Kose, M. A., and M. E. Terrones, 2015, Collapse and Revival: Understanding Global Recessions and Recoveries, Washington, DC: International Monetary Fund.

Kose, M. A., and K.-M. Yi, 2001, "International Trade and Business Cycles: Is Vertical Specialization the Missing Link?" American Economic Review, Vol. 91, No. 2, pp. 371-5.

Kose, M. A., and K.-M. Yi, 2006, "Can the Standard International Business Cycle Model Explain the Relation Between Trade and Comovement?" Journal of International Economics, Vol. 68, No. 2, pp. 267–95.

Krishnamurthy, A., and A. Vissing-Jorgensen, 2011, "The Effects of Quantitative Easing on Interest Rates," Brookings Papers on Economic Activity, Vol. 2011, No. 2, pp. 215-65.

Krishnamurthy, A., and A. Vissing-Jorgensen, 2012, "The Aggregate Demand for Treasury Debt," Journal of Political Economy, Vol. 120, No. 2, pp. 233–67.

Krishnamurthy, A., and A. Vissing-Jorgensen, 2013, "The Ins and Outs of LSAPs," Proceedings of Economic Policy Symposium, Global Dimensions of Unconventional Monetary Policy, Federal Reserve Bank of Kansas City, August 21–23, Jackson Hole, pp. 57–111.

Krueger, D., K. Mitman, and F. Perri, 2016, "Macroeconomics and Household Heterogeneity," in Handbook of Macroeconomics, Vol. 2, J. B. Taylor and H. Uhlig (eds), pp. 843–921. Amsterdam: North-Holland.

Krugman, P., 1999, "Balance Sheets, the Transfer Problem, and Financial Crises," International Tax and Public Finance, Vol. 6, No. 4, pp. 459–72.

Krugman, P., 2009a, "How did Economists Get It So Wrong?" New York Times Magazine, September 2.

Krugman, P., 2009b, The Return of Depression Economics and the Crisis of 2008, New York: W. W. Norton & Company.

Krusell, P., and A. A. Smith, 1998, "Income and Wealth Heterogeneity in the Macroeconomy," Journal of Political Economy, Vol. 106, No. 5, pp. 867–96.

Kudlyak, M., and J. M. Sánchez, 2017, "Revisiting the Behavior of Small and Large Firms during the 2008 Financial Crisis," Journal of Economic Dynamics and Control, Vol. 77, pp. 48–69.

Kydland, F. E., and E. C. Prescott, 1982, "Time to Build and Aggregate Fluctuations," Econometrica, Vol. 50, No. 6, pp. 1345–70.

La Porta, R., F. Lopez-de-Silanes, and A. Shleifer, 2013, "Law and Finance After a Decade of Research," in Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 425–91, Amsterdam: North-Holland.

Laeven, L., and F. Valencia, 2013, "The Real Effects of Financial Sector Interventions During Crises," Journal of Money, Credit and Banking, Vol. 45, No. 1, pp. 147–77.

Lambrias, K., 2016, "Real Exchange Rates and International Co-Movement: News-Shocks and Non-Tradable Goods with Complete Markets," ECB Working Paper 1946, European Central Bank, Frankfurt am Main.

Lamont, O., 1997, "Cash Flow and Investment: Evidence from Internal Capital Markets," Journal of Finance, Vol. 52, pp. 83–110.

Lamont, O., and J. C. Stein, 1999, "Leverage and House-Price Dynamics in U.S. Cities," RAND Journal of Economics, Vol. 30, No. 3, pp. 498–514.

Landau, J.-P., 2013, "Global Liquidity: Public and Private," Proceedings of Economic Policy Symposium, Global Dimensions of Unconventional Monetary Policy, Federal Reserve Bank of Kansas City, August 21–23, Jackson Hole, pp. 223–259.

Landon, S., and C. E. Smith, 2009, "Investment and the Exchange Rate: Short Run and Long Run Aggregate and Sector-Level Estimates," Journal of International Money and Finance, Vol. 28, pp. 813–35.

Lane, P. R., 2001, "The New Open Economy Macroeconomics: A Survey," Journal of International Economics, Vol. 54, No. 2, pp. 235–66.

Lane, P. R., and G. M. Milesi-Ferretti, 2009, "Where did All the Borrowing Go? A Forensic Analysis of the U.S. External Position," Journal of the Japanese and International Economies, Vol. 23, No. 2, pp. 177–99.

Laubach, T., and J. C. Williams, 2016, "Measuring the Natural Rate of Interest Redux," Business Economics, Vol. 51, No. 2, pp. 57–67.

Leamer, E. E., 2007, "Housing is the Business Cycle," Proceedings of Economic Policy Symposium, Housing, Housing Finance, and Monetary Policy, Federal Reserve Bank of Kansas City, August 30–September 1, Jackson Hole, pp. 149–233.

Lee, J., G. M. Milesi-Ferretti, J. D. Ostry, A. Prati, and L. A. Ricci, 2008, "Exchange Rate Assessments: CGER Methodologies," IMF Occasional Paper 261, International Monetary Fund, Washington, DC.

Lee, J., and M. K. Tang, 2007, "Does Productivity Growth Appreciate the Real Exchange Rate?" Review of International Economics, Vol. 15, pp. 164–87.

Leeper, E. M., and J. M. Nason, 2015, "Bringing Financial Stability into Monetary Policy," Sveriges Riksbank Working Paper 305, Sveriges Riksbank, Stockholm.

LeRoy, S. F., 2008, "Excess Volatility Tests," in The New Palgrave Dictionary of Economics, 2nd edition, S. N. Durlauf and L. E. Blume (eds), Palgrave Macmillan.

Lettau, M., and S. C. Ludvigson, 2004, "Understanding Trend and Cycle in Asset Values: Reevaluating the Wealth Effect of Consumption," American Economic Review, Vol. 94, No. 1, pp. 276–99.

Lettau, M., S. C. Ludvigson, J. A. Wachter, 2008, "The Declining Equity Premium: What Role Does Macroeconomic Risk Play?" Review of Financial Studies, Vol. 21, No. 4, pp. 1653–87.

Levich, R., 2017, "CIP: Then and Now, A Brief Survey of Measuring and Exploiting Deviations from Covered Interest Parity," Paper presented at the conference "CIP - RIP?" Bank for International Settlements, May, 22–23, Basel.

Levin, A. T., and F. M. Natalucci, 2005, "Corporate Leverage and Financial Fragility in General Equilibrium," Computing in Economics and Finance 2005, No. 182, Society for Computational Economics.

Levin, A. T., F. M. Natalucci, and E. Zakrajšek, 2004, "The Magnitude and Cyclical Behavior of Financial Market Frictions," Finance and Economics Discussion Series 2004–70, Board of Governors of the Federal Reserve System, Washington, DC.

Levine, R., 1997, "Financial Development and Economic Growth: Views and Agenda," Journal of Economic Literature, Vol. 35, No. 2, pp. 688–726.

Levine, R., 2005, "Finance and Growth: Theory and Evidence," in Handbook of Economic Growth, Vol. 1, P. Aghion and S. N. Durlauf (eds), pp. 865–934, Amsterdam: North-Holland.

Lewis, K., 1999, "Trying to Explain Home Bias in Equities and Consumption," Journal of Economic Literature, Vol. 37, No. 2, pp. 571–608.

Lewis, K., 2011, "Global Asset Pricing," Annual Review of Financial Economics, Vol. 3, pp. 435–66.

Lewis, M., 2010, The Big Short: Inside the Doomsday Machine, New York: W. W. Norton & Company.

Lin, C., Y. Ma, and Y. Xuan, 2011, "Ownership Structure and Financial Constraints: Evidence from a Structural Estimation," Journal of Financial Economics, Vol. 102, No. 2, pp. 416–31.

Lintner, J., 1965, "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," Review of Economics and Statistics, Vol. 47, No. 1, pp. 13–37.

Liu, Z., P. Wang, and T. Zha, 2013, "Land-Price Dynamics and Macroeconomic Fluctuations," Econometrica, Vol. 81, No. 3, pp. 1147–84.

Lo, A. W., 2012, "Reading about the Financial Crisis: A Twenty-One-Book Review," Journal of Economic Literature, Vol. 50, No. 1, pp. 151–78.

Lo, A. W., and A. C. MacKinlay, 1999, A Non-Random Walk Down Wall Street, Princeton: Princeton University Press.

López-Salido, D., J. C. Stein, and E Zakrajšek, 2017, "Credit-Market Sentiment and the Business Cycle," Quarterly Journal of Economics, Vol. 132, No. 3, pp. 1373–426.

Lorenzoni, G., 2007, "News Shocks and Optimal Monetary Policy," NBER Working Paper 12898, National Bureau of Economic Research, Cambridge.

Lorenzoni, G., 2008. "Inefficient Credit Booms," Review of Economic Studies, Vol. 75, No. 3, pp. 809–33.

Lorenzoni, G., 2011, "News and Aggregate Demand Shocks," Annual Review of Economics, Vol. 3, No. 1, pp. 537–57.

Lorenzoni, G., 2014, "International Financial Crises," in Handbook of International Economics, Vol. 4, G. Gopinath, E. Helpman, and K. Rogoff (eds), pp. 689–740, Amsterdam: North-Holland.

Loutskina, E., and P. E. Strahan, 2015, "Financial Integration, Housing, and Economic Volatility," Journal of Financial Economics, Vol. 115, No. 1, pp. 25–41.

Lowe, P., and T. Rohling, 1993, "Agency Costs, Balance Sheets and The Business Cycle," Research Discussion Paper 9311, Reserve Bank of Australia, Sydney.

Lown, C. S., and D. P. Morgan, 2002, "Credit Effects in the Monetary Mechanism," Economic Policy Review, Vol. 8, No. 1, pp. 217–35, Federal Reserve Bank of New York, New York.

Lown, C. S., and D. P. Morgan, 2006, "The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Survey," Journal of Money, Credit and Banking, Vol. 38, No. 6, pp. 1575–97.

Lucas, R. E. Jr., 1975, "An Equilibrium Model of the Business Cycle," Journal of Political Economy, Vol. 83, No. 6, pp. 1113–44.

Lucas, R. E. Jr., 1976, "Econometric Policy Evaluation: A Critique," Carnegie-Rochester Conference Series on Public Policy, Vol. 1, pp. 19–46.

Lucas, R. E. Jr., 1978, "Asset Prices in an Exchange Economy," Econometrica, Vol. 46, No. 6, pp. 1429–45.

Lucas, R. E. Jr., 1982, "Interest Rates and Currency Prices in a Two-Country World," Journal of Monetary Economics, Vol. 10, No. 3, pp. 335–59.

Ludvigson, S., 1998, "The Channel of Monetary Transmission to Demand: Evidence from the Market for Automobile Credit," Journal of Money, Credit and Banking, Vol. 30, No. 3, pp. 365–83.

Ludvigson, S., 1999, "Consumption and Credit: A Model of Time-Varying Liquidity Constraints," Review of Economics and Statistics, Vol. 81, No. 3, pp. 434–47.

Ludvigson, S. C., 2013, "Advances in Consumption-Based Asset Pricing: Empirical Tests," in Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 799–906, Amsterdam: North-Holland.

Ludvigson, S. C., and C. Steindel, 1999, "How Important is the Stock Market Effect on Consumption?" Economic Policy Review, July, pp. 29–51, Federal Reserve Bank of New York, New York.

Ludwig, A., and T. Sløk, 2004, "The Relationship between Stock Prices, House Prices and Consumption in OECD Countries," Topics in Macroeconomics, Vol. 4, No. 1, Article 4.

Lustig, H., N. Roussanov, and A. Verdelhan, 2011, "Common Risk Factors in Currency Markets," Review of Financial Studies, Vol. 24, pp. 3731–77.

Lyons, R. K., 1995, "Tests of Microstructural Hypotheses in the Foreign Exchange Market," Journal of Financial Economics, Vol. 39, No. 2–3, pp. 321–51.

Lyons, R. K., 2001, The Microstructure Approach to Exchange Rates, Cambridge: MIT Press.

Maddaloni, A., and J. L. Peydró, 2011, "Bank Risk-Taking, Securitization, Supervision, and Low Interest Rates: Evidence from the Euro-Area and the U.S. Lending Standards," Review of Financial Studies, Vol. 24, No. 6, pp. 2121–65.

Mankiw, N. G., 1986, "The Equity Premium and the Concentration of Aggregate Shocks," Journal of Financial Economics, Vol. 17, No. 1, pp. 211–9.

Mankiw, N. G., 2006, "The Macroeconomist as Scientist and Engineer," Journal of Economic Perspectives, Vol. 20, No. 4, pp. 29–46.

Mankiw, N. G., and R. Reis, 2017, "Friedman's Presidential Address in the Evolution of Macroeconomic Thought," CEPR Discussion Paper 12442, Centre for Economic Policy Research, London.

Mankiw, N. G., and D. Romer (eds), 1991, New Keynesian Economics, Volume 1: Imperfect Competition and Sticky Prices, Cambridge: MIT Press.

Mankiw, N. G., D. Romer, and M. D. Shapiro, 1985, "An Unbiased Reexamination of Stock Market Volatility," Journal of Finance, Vol. 40, No. 3, pp. 677–87.

Mankiw, N. G., D. Romer, and M. D. Shapiro, 1989, "Stock Market Forecastability and Volatility: A Statistical Appraisal," NBER Working Paper 3154, National Bureau of Economic Research, Cambridge.

Mark, N. C., 1995, "Exchange Rates and Fundamentals: Evidence on Long-Horizon Predictability," American Economic Review, Vol. 85, No. 1, pp. 201–18.

Mark, N. C., 2001, International Macroeconomics and Finance: Theory and Econometric Methods, Malden: Blackwell Publishers.

Mark, N. C., 2009, "Changing Monetary Policy Rules, Learning, and Real Exchange Rate Dynamics," Journal of Money, Credit and Banking, Vol. 41, No. 6, pp. 1047–70.

Mark, N. C., and D. Sul, 2001, "Nominal Exchange Rates and Monetary Fundamentals: Evidence from a Small post-Bretton Woods Panel," Journal of International Economics, Vol. 53, No. 1, pp. 29–52.

Markowitz, H., 1952, "Portfolio Selection," Journal of Finance, Vol. 7, No. 1, pp. 77–91.

Marschak, J., 1938, "Money and the Theory of Assets," Econometrica, Vol. 6, No. 4, pp. 311–25.

Marston, R. C., 1995, International Financial Integration A Study of Interest Differentials between the Major Industrial Countries, New York: Cambridge University Press.

Martin, A., and J. Ventura, 2011, "Theoretical Notes on Bubbles and the Current Crisis," IMF Economic Review, Vol. 59, No. 1, pp. 6–40.

Martin, A., and J. Ventura, 2015, "The International Transmission of Credit Bubbles: Theory and Policy," Journal of Monetary Economics, Vol. 76, pp. S37–56.

Martin, F. E., 2016, "Exchange Rate Regimes and Current Account Adjustment: An Empirical Investigation," Journal of International Money and Finance, Vol. 65, pp. 69-93.

Matsuyama, K., 2005, "Credit Market Imperfections and Patterns of International Trade and Capital Flows," Journal of the European Economic Association, Vol. 3, No. 2–3, pp. 714–23.

Matsuyama, K., 2008, "Aggregate Implications of Credit Market Imperfections," in NBER Macroeconomics Annual 2007, Vol. 22, D. Acemoglu, K. Rogoff, and M. Woodford (eds), pp. 1–60, Chicago: University of Chicago Press.

McCauley, R. N., and P. McGuire, 2009, "Dollar Appreciation in 2008: Safe Haven, Carry Trades, Dollar Shortage and Overhedging," BIS Quarterly Review, December, pp. 85-93, Bank for International Settlements, Basel.

McKay, A., E. Nakamura, and J. Steinsson, 2016, "The Power of Forward Guidance Revisited," American Economic Review, Vol. 106, No. 10, pp. 3133–58.

McKenzie, M., 1999, "The Impact of Exchange Rate Volatility on International Trade Flows," Journal of Economic Surveys, Vol. 13, No. 1, pp. 71–106.

McKinnon, R. I., 1973, Money and Capital in Economic Development, Washington DC: Brookings Institution.

McKinnon, R., 1990, "Interest Rate Volatility and Exchange Risk: New Rules for a Common Monetary Standard," Contemporary Policy Issues, Vol. 8, No. 2, pp. 1–17.

Meeks, R., 2012, "Do Credit Market Shocks Drive Output Fluctuations? Evidence from Corporate Spreads and Defaults," Journal of Economic Dynamics and Control, Vol. 36, No. 4, pp. 568–84.

Meese, R., and K. Rogoff, 1983a, "The Out-of-Sample Failure of Empirical Exchange Rate Models: Sampling Error or Misspecification?" in Exchange Rates and International Macroeconomics, J. A. Frenkel (ed), pp. 67–112, Chicago: University of Chicago Press.

Meese, R., and K. Rogoff, 1983b, "Empirical Exchange Rate Models of the Seventies : Do They Fit Out of Sample?" Journal of International Economics, Vol. 14, No. 1–2, pp. 3–24.

Meghir, C., 2004, "A Retrospective on Friedman's Theory of Permanent Income," Economic Journal, Vol. 114, No. 496, pp. 293–306.

Meh, C. A., and K. Moran, 2010, "The Role of Bank Capital in the Propagation of Shocks," Journal of Economic Dynamics and Control, Vol. 34, No. 3, pp. 555–76.

Mehl, A., 2009, "The Yield Curve as a Predictor and Emerging Economies," Open Economies Review, Vol. 20, No. 5, pp. 683–716.

Mehra, R., and E. C. Prescott, 1985, "The Equity Premium: A Puzzle," Journal of Monetary Economics, Vol. 15, No. 2, pp. 145–61.

Mehra, R., and E. C. Prescott, 2003, "The Equity Premium in Retrospect," in Handbook of the Economics of Finance, Vol. 1, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 889–938, Amsterdam: North-Holland.

Meier, A., and G. J. Muller, 2006, "Fleshing out the Monetary Transmission Mechanism: Output Composition and the Role of Financial Frictions," Journal of Money, Credit and Banking, Vol. 38, No. 8, pp. 2099–134.

Mendoza, E. G., 2005, "The Contribution of Total Factor Productivity to Output Changes in Emerging Economies: The Case of Mexico," mimeo, International Monetary Fund.

Mendoza, E. G., 2010, "Sudden Stops, Financial Crises and Leverage," American Economic Review, Vol. 100, No. 5, pp. 1941–66.

Mendoza, E. G., 2016, "Macroprudential Policy: Promise and Challenges," NBER Working Paper 22868, National Bureau of Economic Research, Cambridge.

Mendoza, E. G., V. Quadrini, and J.-V. Rios-Rull, 2009, "Financial Integration, Financial Development and Global Imbalances," Journal of Political Economy, Vol. 117, pp. 371-416.

Mendoza, E. G., and M. E. Terrones, 2008, "An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data," NBER Working Paper 14049, National Bureau of Economic Research, Cambridge.

Mendoza, E., and M. Uribe, 1996, "The Syndrome of Exchange Rate-Based Stabilizations and the Uncertain Duration of Currency Pegs," International Finance Discussion Paper 548, Board of Governors of the Federal Reserve System, Washington, DC.

Menkhoff, L., L. Sarno, M. Schmeling, and A. Schrimpf, 2012, "Carry Trades and Global Foreign Exchange Volatility," Journal of Finance, Vol. 67, No. 2, pp. 681–718.

Menkhoff, L., L. Sarno, M. Schmeling, and A. Schrimpf, 2016, "Information Flows in Foreign Exchange Markets: Dissecting Customer Currency Trades," Journal of Finance, Vol. 71, No. 2, pp. 601–34.

Menkhoff, L., L. Sarno, M. Schmeling, and A. Schrimpf, 2017, "Currency Value," Review of Financial Studies, Vol. 30, No. 2, pp. 416–41.

Merton, R. C., 1973, "An Intertemporal Capital Asset Pricing Model," Econometrica, Vol. 41, No. 5, pp. 867–87.

Meyers, S., 2015, "Finance: Theoretical and Applied," Annual Review of Financial Economics Vol. 7, pp. 1–34.

Mian, A., K. Rao, and A. Sufi, 2013, "Household Balance Sheets, Consumption, and the Economic Slump," Quarterly Journal of Economics, Vol. 128, No. 4, pp. 1687–726.

Mian, A., and A. Sufi, 2010, "Household Leverage and the Recession of 2007–09," IMF Economic Review, Vol. 58, No. 1, pp. 74–117.

Mian, A., and A. Sufi, 2014a, House of Debt: How They (and You) Caused the Great Recession, and How We can Prevent It from Happening Again, Chicago: University of Chicago Press.

Mian, A., and A. Sufi, 2014b, "What Explains the 2007–2009 Drop in Employment?" Econometrica, Vol. 82, No. 6, pp. 2197–223.

Mian, A., A. Sufi, and E. Verner, 2017, "Household Debt and Business Cycles Worldwide," Quarterly Journal of Economics, Vol. 132, No. 4, pp. 1755–817.

Miles, W., 2017, "Has There Actually Been a Sustained Increase in the Synchronization of House Price (and Business) Cycles across Countries?" Journal of Housing Economics, Vol. 36, pp. 25–43.

Mills, J., 1867, "On Credit Cycles and the Origin of Commercial Panics," in Transactions of the Manchester Statistical Society for the Session 1867–1868, pp. 9–40.

Minetti, R., 2007, "Bank Capital, Firm Liquidity, and Project Quality," Journal of Monetary Economics, Vol. 57, pp. 2584–94.

Minetti, R., and T. Peng, 2013, "Lending Constraints, Real Estate Prices and Business Cycles in Emerging Economies," Journal of Economic Dynamics and Control, Vol. 37, No. 12, pp. 2397–416.

Minsky, H. P., 1982, Can "It" Happen Again? Essays on Instability and Finance, Armonk: M. E. Sharpe.

Minsky, H. P., 1986, Stabilizing an Unstable Economy, New Haven: Yale University Press.

Miranda-Agrippino, S., and H. Rey, 2015, "World Asset Markets and the Global Financial Cycle," NBER Working Paper 21722, National Bureau of Economic Research, Cambridge.

Mishkin, F. S., 1978, "The Household Balance Sheet and the Great Depression," Journal of Economic History, Vol. 38, pp. 918–37.

Mishkin, F. S., 1995, "Symposium on the Monetary Transmission Mechanism," Journal of Economic Perspectives, Vol. 9, No. 4, pp. 3–10.

Mishkin, F. S., 2007, "Enterprise Risk Management and Mortgage Lending," Speech at the Forecaster's Club of New York, January 17.

Mishkin, F. S., 2008, "Exchange Rate Pass-Through and Monetary Policy," NBER Working Paper 13889, National Bureau of Economic Research, Cambridge.

Modigliani, F., 1944, "Liquidity Preference and the Theory of Interest and Money," Econometrica, Vol.12, pp. 45–88.

Modigliani, F., and R. A. Cohn, 1979, "Inflation, Rational Valuation and the Market." Financial Analysts Journal, Vol. 35, pp. 24–44.

Modigliani, F., and M. Miller, 1958, "The Cost of Capital, Corporation Finance and the Theory of Investment," American Economic Review, Vol. 48, No. 3, pp. 261–97.

Mody, A., and M. P. Taylor, 2003, "The High-Yield Spread as a Predictor of Real Economic Activity: Evidence of a Financial Accelerator for the United States," IMF Staff Papers, Vol. 50, No. 3, pp. 373–402.

Mojon, B., 2000, "Financial Structure and the Interest Rate Channel of ECB Monetary Policy," ECB Working Paper 40, European Central Bank, Frankfurt am Main.

Moll, B., 2014, "Productivity Losses from Financial Frictions: Can Self-Financing Undo Capital Misallocation?" American Economic Review, Vol. 104, No. 10, pp. 3186–221.

Molodtsova, T., A. Nikolsko-Rzhevskyy, and D. H. Papell, 2008, "Taylor Rules with Real-Time Data: A Tale of Two Countries and One Exchange Rate" Journal of Monetary Economics, Vol. 55, pp. S63–79.

Molodtsova, T., and D. H. Papell, 2009, "Out-of-Sample Exchange Rate Predictability with Taylor Rule Fundamentals," Journal of International Economics, Vol. 77, No. 2, pp. 167–80.

Monacelli, T., 2009, "New Keynesian Models, Durable Goods, and Collateral Constraints," Journal of Monetary Economics, Vol. 56, No. 2, pp. 242–54.

Monacelli, T., and R. Perotti, 2011, "Fiscal Policy, the Real Exchange Rate and Traded Goods," Economic Journal, Vol. 120, No. 544, pp. 437–61.

Moneta, F., 2005, "Does the Yield Spread Predict Recessions in the Euro Area?" International Finance, Vol. 8, No. 2, pp. 263–301.

Morais, B., J.-L. Peydro, and C. Ruiz, 2015, "The International Bank Lending Channel of Monetary Policy Rates and QE: Credit Supply, Reach-for-Yield, and Real Effects." International Finance Discussion Paper 1137, Board of Governors of the Federal Reserve System, Washington, DC.

Morley, J., 2016, "Macro-Financial Linkages," Journal of Economic Surveys, Vol. 30, No. 4, pp. 698–711.

Mossin, J., 1966, "Equilibrium in a Capital Asset Market," Econometrica, Vol. 34, No. 4, pp. 768–83.

Muellbauer, J. N., 2007, "Housing, Credit and Consumer Expenditure," Proceedings of Economic Policy Symposium, Housing, Housing Finance, and Monetary Policy, Federal Reserve Bank of Kansas City, August 30–September 1, Jackson Hole, pp. 267–334.

Muir, T., 2017, "Financial Crises and Risk Premia," Quarterly Journal of Economics, Vol. 132, No. 2, pp. 765–809.

Mundell, R., 1963, "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," Canadian Journal of Economic and Political Science, Vol. 29, No. 4, pp. 475–85.

Muth, J. F., 1961, "Rational Expectations and the Theory of Price Movements," Econometrica, Vol. 29, No. 3, pp. 315–35.

Myers, S., and N. Majluf, 1984, "Corporate Financing and Investment Decisions When Firms Have Information that Investors do not Have," Journal of Financial Economics, Vol. 13, pp. 187– 221.

Nakamura, E., D. Sergeyev, and J. Steinsson, 2017, "Growth-Rate and Uncertainty Shocks in Consumption: Cross-Country Evidence," American Economic Journal: Macroeconomics, Vol. 9, No. 1, pp. 1–39.

Nam, D., and J. Wang, 2010, "The Effects of News about Future Productivity on International Relative Prices: An Empirical Investigation," Globalization and Monetary Policy Institute, Working Paper 64, Federal Reserve Bank of Dallas, Dallas.

Ng, S., and J. H. Wright, 2013, "Facts and Challenges from the Great Recession for Forecasting and Macroeconomic Modeling," Journal of Economic Literature, Vol. 51, No. 4, pp. 1120–54.

Niehans, J., 1992, "Juglar's Credit Cycles," History of Political Economy, Vol. 24, No. 3, pp. 545–69.

Nolan, C., and C. Thoenissen, 2009, "Financial Shocks and the US Business Cycle," Journal of Monetary Economics, Vol. 56, No. 4, pp. 596–604.

Nowotny, E., D. Ritzberger-Grünwald, and P. Backé (eds), 2014, Financial Cycles and the Real Economy: Lessons for CESEE Countries, London: Edward Elgar.

Nuño, G., and C. Thomas, 2017, "Bank Leverage Cycles," American Economic Journal: Macroeconomics, Vol. 9, No. 2, pp. 32–72.

Obstfeld, M., 2004, "Globalization, Macroeconomic Performance, and the Exchange Rates of Emerging Economies," Monetary and Economic Studies, Vol. 22, No. S1, pp. 29–55.

Obstfeld, M., 2007, "International Risk Sharing and the Costs of Trade," The Ohlin Lectures, May 23–24, Stockholm School of Economics, Stockholm.

Obstfeld, M., 2008, "Pricing-to-Market, the Interest-Rate Rule, and the Exchange Rate," in Money, Crises, and Transition: Essays in Honor of Guillermo A. Calvo, C. M. Reinhart, C. A. Végh, and A. Velasco (eds), pp. 3–19, Cambridge: MIT Press.

Obstfeld, M., and K. Rogoff, 1995a, "Exchange Rate Dynamics Redux," Journal of Political Economy, Vol. 103, No. 3, pp. 624–60.

Obstfeld, M., and K. Rogoff, 1995b, "The Intertemporal Approach to the Current Account," in Handbook of International Economics, Vol. 3, G. M. Grossman and K. Rogoff (eds), pp. 1731–99, Amsterdam: North-Holland.

Obstfeld, M., and K. Rogoff, 1996, Foundations of International Macroeconomics, Cambridge: MIT Press.

Obstfeld, M., and K. Rogoff, 2000a, "New Directions for Stochastic Open Economy Models," Journal of International Economics, Vol. 50, No. 1, pp. 117–53.

Obstfeld, M., and K. Rogoff, 2000b, "Perspectives on OECD Economic Integration: Implications for U.S. Current Account Adjustment," Proceedings of Economic Policy Symposium, Global Economic Integration: Opportunities and Challenges, Federal Reserve Bank of Kansas City, August 24–26, Jackson Hole, pp. 169–208.

Obstfeld, M., and K. Rogoff, 2000c, "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" in NBER Macroeconomics Annual 2000, Vol. 15, B. Bernanke, and K. Rogoff (eds), pp. 339–412, Chicago: University of Chicago Press.

Obstfeld, M., and K. Rogoff, 2002. "Global Implications of Self-Oriented National Monetary Rules," Quarterly Journal of Economics, Vol. 117, No. 2, pp. 503–35.

Obstfeld, M., and K. Rogoff, 2007, "The Unsustainable U.S. Current Account Position Revisited," in G7 Current Account Imbalances: Sustainability and Adjustment, R. Clarida (ed), pp. 339–76, Chicago: Ministry of Chicago Press.

Obstfeld, M., J. C. Shambaugh, and A. M. Taylor, 2005, "The Trilemma in History: Tradeoffs Among Exchange Rates, Monetary Policies, and Capital Mobility," Review of Economics and Statistics, Vol. 87, No. 3, pp. 423–38.

Obstfeld, M., and A. M. Taylor, 2017, "International Monetary Relations: Taking Finance Seriously," Journal of Economic Perspectives, Vol. 31, No. 3, pp. 3–28.

Ohanian, L. E., 2009, "What – or Who – Started the Great Depression?" Journal of Economic Theory, Vol. 144, No. 6, pp. 2310–35.

Ohanian, L. E., 2010, "The Economic Crisis from a Neoclassical Perspective," Journal of Economic Perspectives, Vol. 24, No. 4, pp. 45–66.

Ohn, J., L. W. Taylor, and A. Pagan, 2004, "Testing for Duration Dependence in Economic Cycles," Econometrics Journal, Vol. 7, No. 2, pp. 528–49.

Ohnsorge, F., and S. Yu, 2016, "Recent Credit Surge in Historical Context," World Bank Policy Research Working Paper 7704, World Bank, Washington, DC.

Oliner, S. D., and G. D. Rudebusch, 1993, "Is There a Bank Credit Channel for Monetary Policy?" Finance and Economics Discussion Series 93–8, Board of Governors of the Federal Reserve System, Washington, DC.

Oliner, S. D., and G. D. Rudebusch, 1996, "Is There a Broad Credit Channel for Monetary Policy?" FRBSF Economic Review, No. 1, pp. 3–13, Federal Reserve Bank of San Francisco, San Francisco.

Opazo, L., 2006, "The Backus-Smith Puzzle: The Role of Expectations," Central Bank of Chile Working Paper 395, Central Bank of Chile, Santiago.

Owens, R. E., and S. L. Schreft, 1995, "Identifying Credit Crunches," Contemporary Economic Policy, Vol. 13, No. 2, pp. 63–76.

Paasche, B., 2001, "Credit Constraints and International Financial Crises," Journal of Monetary Economics, Vol. 48, No. 3, pp. 623–50.

Pagan, A., and K. Sossounov, 2003, "A Simple Framework for Analysing Bull and Bear Markets," Journal of Applied Econometrics, Vol. 18, No. 1, pp. 23–46.

Passari, E., and H. Rey, 2015, "Financial Flows and the International Monetary System," Economic Journal, Vol. 125, pp. 675–98.

Pastor, L., and P. Veronesi, 2006, "Was There a Nasdaq Bubble in the Late 1990s?" Journal of Financial Economics, Vol. 81, No. 1, pp. 61–100.

Patinkin, D., 1956, Money, Interest, and Prices: An Integration of Monetary and Value Theory, Evanston: Row, Peterson and Company.

Paulson, H. M. Jr., 2010, On the Brink: Inside the Race to Stop the Collapse of the Global Financial System, New York: Business Plus.

Pavlova, A., and R. Rigobon, 2012, "International Macro-Finance," in Handbook of Safeguarding Global Financial Stability: Political, Social, Cultural, and Economic Theories and Models, G. Caprio (ed), pp. 169–76, Cambridge: Academic Press.

Peek, J., and E. S. Rosengren, 1994, "Bank Real Estate Lending and the New England Capital Crunch," Real Estate Economics, Vol. 22, No. 1, pp. 33–58.

Peek, J., and E. S. Rosengren, 1995a, "Banks and the Availability of Small Business Loans," Working Paper 95–1, Federal Reserve Bank of Boston, Boston.

Peek, J., and E. S. Rosengren, 1995b, "Small Business Credit Availability: How Important is Size of Lender?" Working Paper 95–5, Federal Reserve Bank of Boston, Boston.

Peek, J., and E. S. Rosengren, 1997, "The International Transmission of Financial Shocks: The Case of Japan," American Economic Review, Vol. 87, No. 4, pp. 495–505.

Peek, J., and E. S. Rosengren, 2000, "Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States," American Economic Review, Vol. 90, No. 1, pp. 30–45.

Peek, J., and E. S. Rosengren, 2016, "Credit Supply Disruptions: From Credit Crunches to Financial Crisis', Annual Review of Financial Economics, Vol. 8, pp. 81–95.

Peltonen, T. A., R. M. Sousa, and I. S. Vansteenkiste, 2012, "Wealth Effects in Emerging Market Economies," International Review of Economics and Finance, Vol. 24, pp. 155-66.

Pennacchi, G., 2007, Theory of Asset Pricing, 1st edition, Boston: Pearson Addison Wesley.

Pereira da Silva, L. 2016, "Towards an Integrated Inflation Targeting Framework in Middle-Income Countries: A Research Agenda", Keynote speech at the Second ECBN Policy Research Conference on "Macroprudential Instruments and Financial Cycles," September 29, Ljubljana.

Perri, F., and V. Quadrini, forthcoming, "International Recessions," American Economic Review.

Petersen, M. A., and R. G. Rajan, 1995, "The Effect of Credit Market Competition on Lending Relationships," Quarterly Journal of Economics, Vol. 110, No. 2, pp. 407–43.

Philippon, T., 2006, "Corporate Governance over the Business Cycle," Journal of Economic Dynamics and Control, Vol. 30, No. 11, pp. 2117–41.

Phylaktis, K., and F. Ravazzolo, 2005, "Stock Prices and Exchange Rate Dynamics," Journal of International Money and Finance, Vol. 24, No. 7, pp. 1031–53.

Piazzesi, M., and M. Schneider, 2016, "Housing and Macroeconomics," in Handbook of Macroeconomics, Vol. 2, J. B. Taylor and H. Uhlig (eds), pp. 1547–1640, Amsterdam: North-Holland.

Piazzesi, M., and M. Schneider, 2017, "Payments, Credit and Asset Prices," mimeo, Stanford University, Stanford.

Posen, A. S., 2009, "Finding the Right Tool for Dealing with Asset Price Booms," Speech to the MPR Monetary Policy and the Economy Conference, December 1, London.

Pozsar, Z., T. Adrian, A. Ashcraft, and H. Boesky, 2013, "Shadow Banking," Economic Policy Review, Vol. 19, No. 2, pp 1–16, Federal Reserve Bank of New York, New York.

Prieto, E., S. Eickmeier, and M. Marcellino, 2016, "Time Variation in Macro-Financial Linkages," Journal of Applied Econometrics, Vol. 31, No. 7, pp. 1215–33.

Pritsker, M., 2011, "Definitions and Types of Financial Contagion," The Evidence and Impact of Financial Globalization, G. Caprio Jr., T. Beck, S. Claessens, and S. L. Schmukler (eds), pp. 547–59, Boston: Academic Press.

Quadrini, V., 2011, "Financial Frictions in Macroeconomic Fluctuations," Economic Quarterly, Vol. 97, No. 3, pp. 209–54, Federal Reserve Bank of Richmond, Richmond.

Quadrini, V., 2014, "Macroeconomic Effects of Asset-Price Shocks in a Globalized Financial Market," Scandinavian Journal of Economics, Vol. 116, No. 1, pp. 190–217.

Quinn, D., and H.-J. Voth, 2010, "Free Flows, Limited Diversification: Openness and the Fall and Rise of Stock Market Correlations, 1980–2001," in NBER International Seminar on Macroeconomics 2009, L. Reichlin and K. West (eds), pp. 7–39, Chicago: University of Chicago Press.

Rajan, R. G., 1994, "Why Bank Credit Policies Fluctuate: A Theory and Some Evidence," Quarterly Journal of Economics, Vol. 109, No. 2, pp. 399–441.

Rajan, R. G., 1998. "The Past and Future of Commercial Banking Viewed through an Incomplete Contract Lens," Journal of Money, Credit and Banking, Vol. 30, No. 3, pp. 524–50.

Rajan, R. G., 2005, "Has Financial Development Made the World Riskier?" Proceedings of Economic Policy Symposium, The Greenspan Era: Lessons for the Future, Federal Reserve Bank of Kansas City, August 25–27, Jackson Hole, pp. 313–69.

Rajan, R. G., and I. Tokatlidis, 2005, "Dollar Shortages and Crises," International Journal of Central Banking, Vol. 1, pp. 177–220.

Rajan, R. G., and A. Winton, 1995, " Covenants and Collateral as Incentives to Monitor," Journal of Finance, Vol. 50, No. 4, pp. 1113–46.

Ramey, V., 1993, "How Important is the Credit Channel in the Transmission of Monetary Policy?" Carnegie-Rochester Conference Series on Public Policy, Vol. 39, pp. 1–45.

Rapach, D. E., and M. E. Wohar, 2002, "Testing the Monetary Model of Exchange Rate Determination: New Evidence from a Century of Data," Journal of International Economics, Vol. 58, No. 2, pp. 359–85.

Ravn, M. O., S. SchmIitt-Grohe, and M. Uribe, 2012, "Consumption, Government Spending, and the Real Exchange Rate," Journal of Monetary Economics, Vol. 59, No. 3, pp. 215–34.

Rebelo, S., 2005, "Real Business Cycle Models: Past, Present and Future," Scandinavian Journal of Economics, Vol. 107, No. 2, pp 217–38.

Reinhart, C. M., and K. S. Rogoff, 2008, "Is the 2007 US Sub-Prime Financial Crisis So Different? An International Historical Comparison," American Economic Review, Vol. 98, No. 2, pp. 339–44.

Reinhart, C. M., and K. S. Rogoff, 2009a, "The Aftermath of Financial Crises," American Economic Review, Vol. 99, pp. 466–572.

Reinhart, C. M., and K. Rogoff, 2009b, This Time Is Different: Eight Centuries of Financial Folly, Princeton: Princeton Press.

Reinhart, C. M., and K. S. Rogoff, 2011, "The Forgotten History of Domestic Debt," Economic Journal, Vol. 121, No. 552, pp. 319–50.

Reinhart, C. M., and K. S. Rogoff, 2014, "Recovery from Financial Crises: Evidence from 100 Episodes," American Economic Review, Vol. 104, No. 5, pp. 50–55.

Reis, R., 2017, "Is Something Really Wrong with Macroeconomics?" CESifo Working Paper 6446, CESifo, Munich.

Repullo, R., and J. Suarez, 2000, "Entrepreneurial Moral hazard and Bank Monitoring: A model of the Credit Channel," European Economic Review, Vol. 44, No. 10, pp. 1931–50.

Repullo, R., and J. Suarez, 2013, "The Procyclical Effects of Bank Capital Regulation," Review of Financial Studies, Vol. 26, No. 2, pp. 452–90.

Rey, H., 2015, "Dilemma Not Trilemma: The Global Financial Cycle and Monetary Policy Independence," NBER Working Paper 21162, National Bureau of Economic Research, Cambridge.

Rey, H., 2016, "International Channels of Transmission of Monetary Policy and the Mundellian Trilemma," IMF Economic Review, Vol. 64, No. 6, pp. 6–35.

Ricci, L. A., G. M. Milesi-Ferretti, and J. Lee, 2013, "Real Exchange Rates and Fundamentals: A Cross-Country Perspective," Journal of Money, Credit and Banking, Vol. 45, No. 5, pp. 845–65.

Riddick, L., and T. Whited, 2009, "The Corporate Propensity to Save," Journal of Finance, Vol. 64, No. 4, pp. 1729–66.

Rieger, M. O., and M. Wang, 2012, "Can Ambiguity Aversion Solve the Equity Premium Puzzle? Survey Evidence from International Data," Finance Research Letters, Vol. 9, No. 2, pp. 63–72.

Rime, D., L. Sarno, and E. Sojli, 2010, "Exchange Rate Forecasting Order Flow and Macroeconomic Information," Journal of International Economics, Vol. 80, No. 1, pp. 72–88.

Rime, D., A. Schrimpf, and O. Syrstad, 2017, "Segmented Money Markets and Covered Interest Parity Arbitrage," BIS Working Paper 651, Bank for International Settlements, Basel.

Ritter, J., 1984, "The Hot Issue Market of 1980," Journal of Business, Vol. 57, pp. 215-40.

Rogoff, K., 1996, "The Purchasing Power Parity Puzzle," Journal of Economic Literature, Vol. 34, No. 2, pp. 647–68.

Rogoff, K., 2017, "Dealing with Monetary Paralysis at the Zero Bound," Journal of Economic Perspectives, Vol. 31, No. 3, pp. 47–66.

Rogoff, K. S., and T. Tashiro, 2015, "Japan's Exorbitant Privilege," Journal of the Japanese and International Economies, Vol. 35, pp. 43–61.

Romer, C. D., and D. H. Romer, 1989, "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz," in NBER Macroeconomics Annual 1989, Vol. 4, O. J. Blanchard and S. Fischer (eds), pp. 121–84, Cambridge: MIT Press.

Romer, C. D., and D. H. Romer, 1994, "Credit Channel or Credit Actions? An Interpretation of the Postwar Transmission Mechanism," NBER Working Paper 4485, National Bureau of Economic Research, Cambridge.

Romer, P., 2016, "The Trouble with Macroeconomics," American Economist, forthcoming.

Rose, A., 2011, "Exchange Rate Regimes in the Modern Era: Fixed, Floating, and Flaky," Journal of Economic Literature, Vol. 49, No. 3, pp. 652–72.

Rose, A. K., and M. M. Spiegel, 2010, "Cross-Country Causes and Consequences of the 2008 Crisis: International Linkages and American Exposure," Pacific Economic Review, Vol. 15, No. 3, pp. 340–63.

Rose, A. K., and M. M. Spiegel, 2011, "Cross-Country Causes and Consequences of the Crisis: An Update," European Economic Review, Vol. 55, No. 3, pp. 309–24.

Rossi, B., 2013, "Exchange Rate Predictability," Journal of Economic Literature, Vol. 51, No. 4, pp. 1063–119.

Rothschild, M., and J. Stiglitz, 1976, "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information," Quarterly Journal of Economics, Vol. 90, pp. 629–49.

Rudebusch, G. D., 2010, "Macro-Finance Models of Interest Rates and the Economy," Manchester School, Vol. 78, pp. 25–52.

Rudebusch, G. D., and J. C. Williams, 2009, "Forecasting Recessions: The Puzzle of the Enduring Power of the Yield Curve." Journal of Business and Economic Statistics, Vol. 27, pp. 492–503.

Rudebusch, G. D., and T. Wu, 2008, "A Macro-Finance Model of the Term Structure, Monetary Policy and the Economy," Economic Journal, Vol. 118, No. 530, pp. 906–26.

Sa, F., 2013, "Bilateral Financial Links," in The Evidence and Impact of Financial Globalization, G. Caprio, Jr., T. Beck, S. Claessens, and S. L. Schmukler (eds), pp. 51–65, Boston: Academic Press.

Samphantharak, K., and R. M. Townsend, 2009, Households as Corporate Firms: An Analysis of Household Finance Using Integrated Household Surveys and Corporate Financial Accounting, New York: Cambridge University Press.

Samuelson, P., 1964, "Theoretical Notes on Trade Problems," Review of Economics and Statistics, Vol. 46, pp. 145–54.

Sargent, T. J., 1981, "Interpreting Economic Time Series," Journal of Political Economy, Vol. 89, No. 2, pp. 213–48.

Sargent, T. J., and N. Wallace, 1976, "Rational Expectations and the Theory of Economic Policy," Journal of Monetary Economics, Vol. 2, No. 2, pp. 169–83.

Sarno, L., and M. Schmeling, 2014, "Which Fundamentals Drive Exchange Rates? A Cross-Sectional Perspective," Journal of Money, Credit and Banking, Vol. 46, No. 2–3, pp. 267–92.

Sarno, L., and E. Sojli, 2009, "The Feeble Link Between Exchange Rates and Fundamentals: Can We Blame the Discount Factor?" Journal of Money, Credit and Banking, Vol. 41, pp. 437–42.

Sarno, L., and M. P. Taylor, 2002, "Purchasing Power Parity and the Real Exchange Rate," IMF Staff Papers, Vol. 49, No. 1, pp. 65–105.

Sarno, L., and M. P. Taylor, 2003, "An Empirical Investigation of Asset Price Bubbles in Latin American Emerging Financial Markets," Applied Financial Economics, Vol. 13, No. 9, pp. 635–43.

Sarno, L., and G. Valente, 2009, "Exchange Rates and Fundamentals: Footloose or Evolving Relationship?" Journal of the European Economic Association, Vol. 7, No. 4, pp. 786–830.

Scherbina, A., and B. Schlusche, 2014, "Asset Price Bubbles: A Survey," Quantitative Finance, Vol. 14, No. 4, pp. 589–604.

Schmidt, L., A. Timmermann, and R. Wermers, 2016, "Runs on Money Market Mutual Funds," American Economic Review, Vol. 106, No. 9, pp. 2625–57.

Schneider, M., and A. Tornell, 2004, "Balance Sheet Effects, Bailout Guarantees and Financial Crises," Review of Economic Studies, Vol. 71, pp. 883–913.

Schularick, M., and A. M. Taylor, 2012, "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008," American Economic Review, Vol. 102, No. 2, pp. 1029–61.

Schwert, G. W., 1989, "Why Does Stock Market Volatility Change over Time?" Journal of Finance, Vol. 44, No. 5, pp. 1115–53.

Schwert, G. W., 2003, "Anomalies and Market Efficiency," in Handbook of the Economics of Finance, Vol. 1, G. Constantinides, M. Harris, and R. M. Stulz, (eds), pp. 939–74, Amsterdam: North-Holland.

Sercu, P., and R. Vanpee, 2007, "Home Bias in International Equity Portfolios: A Review," Katholieke Universiteit Leuven.

Sharpe, S., 1994, "Financial Market Imperfections, Firm Leverage, and the Cyclicality of Employment," American Economic Review, Vol. 84, No. 4, pp. 1060–74.

Sharpe, W. F., 1964, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk," Journal of Finance, Vol. 19, pp. 425–42.

Shaw, E., 1973, Financial Deepening in Economic Development, New York: Oxford University Press.

Shiller, R. J., 1979, "The Volatility of Long Term Interest Rates and Expectation Models of the Term Structure," Journal of Political Economy, Vol. 87, pp. 1190–219.

Shiller, R. J., 1981, "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?" American Economic Review, Vol. 71, No. 3, pp. 421–36.

Shiller, R. J., 1982, "Consumption, Asset Markets, and Macroeconomic Fluctuations," Carneige-Rochester Conference Series on Public Policy, Vol. 17, pp. 203–38.

Shiller, R. J., 1989, Market Volatility, Cambridge: MIT Press.

Shiller, R. J., 2000, Irrational Exuberance, Princeton: Princeton University Press.

Shiller, R. J., 2003, "From Efficient Market Theory to Behavioral Finance," Journal of Economic Perspectives, Vol. 17, No. 1, pp. 83–104.

Shin, H., 2012, "Global Banking Glut and Loan Risk Premium," IMF Economic Review, Vol. 60, No. 2, pp. 155–92.

Shleifer, A., 2000, Inefficient Markets: An Introduction to Behavioral Finance, Clarendon Lectures in Economics, New York: Oxford University Press.

Shleifer, A., and R. Vishny, 1997, "The Limits of Arbitrage," Journal of Finance, Vol. 52, No. 1, pp. 35–55.

Shleifer, A., and R. Vishny, 2011, "Fire Sales in Finance and Macroeconomics," Journal of Economic Perspectives, Vol. 25, No. 1, pp. 29–48.

Sims, C. A., 1972, "Money, Income, and Causality," American Economic Review, Vol. 62, No. 4, pp. 540–52.

Sims, C. A., 1980, "Macroeconomics and Reality," Econometrica, Vol. 48, No. 1, pp. 1-48.

Sinai, A., 1992, "Financial and Real Business Cycles," Eastern Economic Journal, Vol. 18, No. 1, pp. 1–54.

Sinai, A., 1993, "Financial and Credit Cycles: Generic or Episodic?" Quarterly Review, Vol. 18, No. 1, pp. 40–45, Federal Reserve Bank of New York, New York.

Singleton, K. J., 2006, Empirical Dynamic Asset Pricing: Model Specification and Econometric Assessment, Princeton: Princeton University Press.

Siregar, R., and C. S. V. Lim, 2011, "Living with Macro-Financial Linkages: Policy Perspectives and Challenges for SEACEN Countries," SEACEN Centre Staff Paper 79, South East Asian Central Banks Research and Training Centre, Kuala Lumpur.

Slacalek, J., 2009, "What Drives Personal Consumption? The Role of Housing and Financial Wealth," B.E. Journal of Macroeconomics, Vol. 9, No. 1, Article 37.

Smets, F., 1995, "Central Banks Macroeconomic Models and the Monetary Policy Transmission Mechanism," in BIS Paper 0, Financial Structure and the Monetary Policy Transmission Mechanism, pp. 225–66, Bank for International Settlements, Basel.

Smets, F., and K. Tsatsaronis, 1997, "Why does the Yield Curve Predict Economic Activity? Dissecting the Evidence for Germany and the United States," BIS Working Paper 49, Bank for International Settlements, Basel.

Smets, F., and R. Wouters, 2003, "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area," Journal of the European Economic Association, Vol. 1, No. 5, pp. 1123–75.

Smets, F., and R. Wouters, 2007, "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach," American Economic Review, Vol. 97, No. 3, pp. 586–606.

Solimano, A., 2010, "An Overview of IMF Research on Macro-Financial Linkages: Relevance, Diversity of Approaches and Context," Paper prepared for the IEO of IMF, May 10, International Center for Globalization and Development, Santiago.

Solnik, B. H., 1974, "The International Pricing of Risk: An Empirical Investigation of the World Capital Market Structure," Journal of Finance, Vol. 29, pp. 365–78.

Sørensen, B. E., Y. T. Wu, O. Yosha, and Y. Zhu, 2007, "Home Bias and International Risk Sharing: Twin Puzzles Separated at Birth," Journal of International Money and Finance, Vol. 26, No. 4, pp. 587–605.

Sorkin, A. R., 2009, Too Big to Fail: The Inside Story of How Wall Street and Washington Fought to Save the Financial System–and Themselves, New York: Viking Press.

Srinivasan, T. N., 1986, "The Costs and Benefits of Being a Small, Remote, Island Landlocked, or Ministate Economy," World Bank Research Observer, Vol. 1, No. 2, pp. 205–18.

Stein, J. C., 1998, "An Adverse-Selection Model of Bank Asset and Liability Management with Implications for the Transmission of Monetary Policy," RAND Journal of Economics, Vol. 29, No. 3, pp. 466–86.

Stein, J. C., 2003, "Agency, Information and Corporate Investment," in Handbook of the Economics of Finance, Vol. 1, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 111–65, Amsterdam: North-Holland.

Stein, J. C., 2012, "Monetary Policy as Financial Stability Regulation," Quarterly Journal of Economics, Vol. 127, No. 1, pp. 57–95.

Steinsson, J., 2008, "The Dynamic Behavior of the Real Exchange Rate in Sticky Price Models," American Economic Review, Vol. 98, No. 1, pp. 519–33.

Sterk, V., 2015, "Home Equity, Mobility, and Macroeconomic Fluctuations," Journal of Monetary Economics, Vol. 74, pp. 16–32.

Stiglitz, J. E., 1982, "Information and Capital Markets," in Financial Economics: Essays in Honor of Paul Cootner, W. F. Sharpe and C. M. Cootner (eds), pp. 118–58, Englewood Cliffs: Prentice Hall.

Stiglitz, J. E., and A. Weiss, 1981, "Credit Rationing in Markets with Imperfect Information," American Economic Review, Vol. 71, pp. 393–410.

Stock, J. H., and M. W. Watson, 1999, "Business Cycle Fluctuations in US Macroeconomic Time Series," in Handbook of Macroeconomics, Vol. 1, J. B. Taylor and M. Woodford (eds), pp. 3–64, Amsterdam: North-Holland.

Stock, J. H., and M. W. Watson, 2003, "Forecasting Output and Inflation: The Role of Asset Prices," Journal of Economic Literature, Vol. 41, No. 3, pp. 788–829.

Stockman, A. C., 1980, "A Theory of Exchange Rate Determination," Journal of Political Economy, Vol. 88, No. 4, pp. 673–98.

Stulz, R. M., 1981, "On the Effects of Barriers to International Investment," Journal of Finance, Vol. 36, No. 4, pp. 923–34.

Stulz, R. M., 2005, "The Limits of Financial Globalization," Journal of Finance, Vol. 60, No. 4, pp. 1595–638.

Suarez, J., and O. Sussman, 1997, "A Stylized Model of Financially-Driven Business Cycles," CEMFI Working Paper 9722, Centro de Estudios Monetarios Y Financieros, Madrid.

Sushko, V., C. Borio, R. N. McCauley and P. McGuire, 2016, "The Failure of Covered Interest Rate Parity: FX Hedging Demand and Costly Balance Sheets," BIS Working Paper 590, Bank for International Settlements, Basel.

Sutton, G. D., 2002, "Explaining Changes in House Prices," BIS Quarterly Review, September, pp. 46–55, Bank for International Settlements, Basel.

Svensson, L. E.O., 2016, "Cost-Benefit Analysis of Leaning against the Wind: Are Costs Larger also with Less Effective Macroprudential Policy?" IMF Working Paper 16/3, International Monetary Fund, Washington, DC.

Svensson, L. E.O., 2017, "Leaning Against the Wind: Costs and Benefits, Effects on Debt, Leaning in DSGE Models, and a Framework for Comparison of Results," International Journal of Central Banking, Vol. 13, No. 3, pp. 385–408.

Swanson, E. T., and J. C. Williams, 2014, "Measuring the Effect of the Zero Lower Bound on Medium- and Longer-Term Interest Rates," American Economic Review, Vol. 104, No. 10, pp. 3154–85.

Tarashev, N., S. Avdjiev, and B. Cohen, 2016, "International Capital Flows and Financial Vulnerabilities in Emerging Market Economies: Analysis and Data Gaps," Note submitted to the G20 International Financial Architecture Working Group, August, Bank for International Settlements, Basel.

Tavares, J., 2009, "Economic Integration and the Comovement of Stock Returns," Economics Letters, Vol. 103, No. 2, pp. 65–7.

Taylor, A. M., and M. P. Taylor, 2004, "The Purchasing Power Parity Debate," Journal of Economic Perspectives, Vol. 18, pp. 135–58.

Taylor, J. B., 1995, "The Monetary Transmissions Mechanism: An Empirical Framework," *Journal of Economic Perspectives*, Vol. 9, No. 4, pp. 11–26.

Taylor, J. B., 2008, "Monetary Policy and the State of the Economy," Testimony before the Committee on Financial Services, U.S. House of Representatives, February 26, Washington, DC.

Taylor, J. B., 2011, "Macroeconomic Lessons from the Great Deviation," in NBER Macroeconomics Annual 2010, Vol. 25, D. Acemoglu and M. Woodford (eds), pp. 387-95, Chicago: University of Chicago Press.

Taylor, J. B., 2016, Policy Stability and Economic Growth: Lessons from the Great Recession, London: Institute of Economic Affairs.

Taylor, M. P., D. A. Peel, and L. Sarno, 2001, "Nonlinear Mean-Reversion in Real Exchange Rates: Toward a Solution to the Purchasing Power Parity Puzzles," International Economic Review, Vol. 42, No. 4, pp. 1015–42.

Terrones, M. E., 2004, "The Global House Price Boom," Essay in Chapter 2 of World Economic Outlook, September, International Monetary Fund, Washington, DC.

Thaler, R. H. (ed), 2005, Advances in Behavioral Finance, Vol. 2, Princeton: Princeton University Press.

Thaler, R. H., 2015, Misbehaving: The Making of Behavioral Economics, New York: W. W. Norton & Company.

Thomas, C. P., and J. Marquez, 2009, "Measurement Matters for Modeling US Import Prices," International Journal of Finance & Economics, Vol. 14, No. 2, pp. 120–38.

Tica, J., and I. Druzic, 2006, "The Harrod-Balassa-Samuelson Effect: A Survey of Empirical Evidence," Faculty of Economics and Business Working Paper No. 06–07, University of Zagreb, Zagreb.

Tille, C., 2008, "Financial Integration and the Wealth Effect of Exchange Rate Fluctuations," Journal of International Economics, Vol. 75, No. 2, pp. 283–94.

Tille, C., and E. Van Wincoop, 2014a, "International Capital Flows under Dispersed Private Information," Journal of International Economics, Vol. 93, No. 1, pp. 31–49.

Tille, C., and E. Van Wincoop, 2014b, "Solving DSGE Portfolio Choice Models with Dispersed Private Information," Journal of Economic Dynamics and Control, Vol. 40, pp. 1–24.

Tirole, J., 2006, The Theory of Corporate Finance, Princeton: Princeton University Press.

Tirole, J., 2011, "Illiquidity and All Its Friends," Journal of Economic Literature, Vol. 49, No. 2, pp. 287–325.

Titman, S., 2013, "Financial Markets and Investment Externalities," Journal of Finance, Vol. 68, No. 4, pp. 1307–29.

Tobin, J., 1958, "Liquidity Preference as Behavior towards Risk," Review of Economic Studies, Vol. 25, pp. 65–86.

Tobin, J., 1969, "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit and Banking, Vol. 1, No. 1, pp. 15–29.

Townsend, R. M., 1979, "Optimal Contracts and Competitive Markets with Costly State Verification," Journal of Economic Theory, Vol. 21, No. 2, pp. 265–93.

Townsend, R. M., 1988, "Information Constrained Insurance: The Revelation Principle Extended," Journal of Monetary Economics, Vol. 21, No. 2–3, pp. 411–50.

Treynor, J. L., 1962, "Toward a Theory of Market Value of Risky Assets," unpublished manuscript.

Trichet, J.-C., 2006, "Corporate Finance and Monetary Policy: An Overview of the Issues," Address at the ECB Workshop, Corporate Finance and Monetary Policy, May 15, Frankfurt am Main.

Tsatsaronis, K., and H. Zhu, 2004, "What Drives Housing Price Dynamics: Cross-Country Evidence," BIS Quarterly Review, March, pp. 65–78, Bank for International Settlements, Basel.

Turner, A., 2012, Economics After the Crisis: Objectives and Means, Cambridge: MIT Press.

Uhlig, H., 2005, "What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure," Journal of Monetary Economics, Vol. 52, No. 2, pp. 381–419.

Uppal, R., 1993, "A General Equilibrium Model of International Portfolio Choice," Journal of Finance, Vol. 48, No. 2, pp. 529–53.

Uribe, M., 1997, "Exchange-Rate-Based Inflation Stabilization: The Initial Real Effects of Credible Plans," Journal of Monetary Economics, Vol. 39, No. 2, pp. 197–221.

Valencia, F., 2014, "Monetary Policy, Bank Leverage, and Financial Stability," Journal of Economic Dynamics and Control, Vol. 47, pp. 20–38.

Van den Heuvel, S. J., 2006, "The Bank Capital Channel of Monetary Policy," Society for Economic Dynamics, Meeting Paper 512.

Van den Heuvel, S. J., 2008, "The Welfare Cost of Bank Capital Requirements," Journal of Monetary Economics, Vol. 55, No. 2, pp. 298–320.

van Leuvensteijn, M., C. Kok Sørensen, J. A. Bikker, and A. A.R.J.M. van Rixtel, 2011, "Impact of Bank Competition on the Interest Rate Pass-Through in the Euro Area," Applied Economics, Vol. 45, No. 10–12, pp. 1359–80.

Vansteenkiste, I., and P. Hiebert, 2011, "Do House Price Developments Spillover across Euro Area Countries? Evidence from a Global VAR," Journal of Housing Economics, Vol. 20, No. 4, pp. 299–314.

Vavra, J., 2014, "Inflation Dynamics and Time-Varying Volatility: New Evidence and An SS Interpretation," Quarterly Journal of Economics, Vol. 129, No. 1, pp. 215–58.

Vayanos, D., and J. Wang, 2013, "Market Liquidity – Theory and Empirical Evidence," in Handbook of the Economics of Finance, Vol. 2, G. M. Constantinides, M. Harris, and R. M. Stulz (eds), pp. 1289–361, Amsterdam: North-Holland.

Viceira, L. M., 2011, "Bond Risk, Bond Return Volatility, and the Term Structure of Interest Rates," International Journal of Forecasting, Vol. 28, No. 1, pp. 97–117.

Vissing-Jørgensen, A., 2002, "Limited Asset Market Participation and the Elasticity of Intertemporal Substitution," Journal of Political Economy, Vol. 110, No. 10, pp. 825-53.

Von Heideken, V. Q., 2009, "How Important are Financial Frictions in the United States and the Euro Area?" Scandinavian Journal of Economics, Vol. 111, No. 3, pp. 567–96.

Wachter, S., M. Cho, and M. J. Tcha (eds), 2014, The Global Financial Crisis and Housing: A New Policy Paradigm, London: Edward Elgar.

Walsh, C., 2010, Monetary Theory and Policy, 3rd edition, Cambridge: MIT Press.

Walti, S., 2011, "Stock Market Synchronization and Monetary Integration," Journal of International Money and Finance, Vol. 30, No. 1, pp. 96–110.

Weil, P., 1989, "The Equity Premium Puzzle and the Risk Free Rate Puzzle," Journal of Monetary Economics, Vol. 24, No. 3, pp. 401–21.

Wessel, D., 2009, In Fed We Trust: Ben Bernanke's War on the Great Panic, New York: Crown Business.

West, K. D., 1988, "Bubbles, Fads, and Stock Price Volatility Tests: A Partial Evaluation," Journal of Finance, Vol. 43, No. 3, pp. 639–56.

Wheelock, D. C., and M. E. Wohar, 2009, "Can the Term Spread Predict Output Growth and Recessions? A Survey of the Literature," Review, Vol. 91, No. 5, pp. 419–40, Federal Reserve Bank of St. Louis, St. Louis.

Whited, T., 1992, "Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data," Journal of Finance, Vol. 47, pp. 425–60.

Williams, J. C., 2013, "Bubbles Tomorrow, Yesterday, but Never Today?" FRBSF Economic Letter, September, Federal Reserve Bank of San Francisco.

Williamson, O. E., 1988, "Corporate Finance and Corporate Governance," Journal of Finance, Vol. 43, No. 3, pp. 567–91.

Williamson, S. D., 1987, "Costly Monitoring, Loan Contracts, and Equilibrium Credit Rationing," Quarterly Journal of Economics, Vol. 102, No. 1, pp. 135–45.

Williamson, S. D., 2012, "Liquidity, Monetary Policy, and the Financial Crisis: A New Monetarist Approach," American Economic Review, Vol. 102, No. 6, pp. 2570–605.

Wojnilower, A. M., 1980, "The Central Role of Credit Crunches in Recent Financial History," Brookings Paper on Economic Activity, Vol. 1980, No. 2, pp. 277–339.

Wojnilower, A. M., 1985, "Private Credit Demand, Supply and Crunches – How Different are the 1980s," American Economic Review, Vol. 75, No. 2, pp 351–6.

Wolf, M., 2014, The Shifts and the Shocks: What We've Learned–and Have Still to Learn–from the Financial Crisis, New York: Penguin Press.

Wong, A., 2016, "Transmission of Monetary Policy to Consumption and Population Aging," mimeo, April 21, Princeton University, Princeton.

Woo, D., 2003, "In Search of 'Capital Crunch': Supply Factors Behind the Credit Slowdown in Japan," Journal of Money, Credit and Banking, Vol 35, No. 6, pp. 1019-38.

Woodford, M., 2003, Interest and Prices: Foundations of a Theory of Monetary Policy, Princeton: Princeton University Press.

Woodford, M., 2010a, "Financial Intermediation and Macroeconomic Analysis," Journal of Economic Perspectives, Vol. 24, No. 4, pp. 21–44.

Woodford, M., 2010b, "Globalization and Monetary Control," in International Dimensions of Monetary Policy, J. Gali and M. J. Gertler (eds), pp. 13–77, Chicago: University of Chicago Press.

Woodford, M., 2011, "Optimal Monetary Stabilization Policy," in Handbook of Monetary Economics, Vol. 3, B. M. Friedman and M. Woodford (eds), pp. 723–828, Amsterdam: North-Holland.

Woodford, M., 2012a, "Inflation Targeting and Financial Stability," NBER Working Paper 17967, National Bureau of Economic Research, Cambridge.

Woodford, M., 2012b, "Methods of Policy Accommodation at the Interest-Rate Lower Bound," Proceedings of Economic Policy Symposium, The Changing Policy Landscape,

Federal Reserve Bank of Kansas City, August 30–September 1, Jackson Hole, pp. 185-288.

World Bank, 2015a, Global Economic Prospects: The Global Economy in Transition, June, Washington, DC: World Bank.

World Bank, 2015b, Global Economic Prospects: Having Fiscal Space and Using It, January, Washington, DC: World Bank.

World Bank, 2016, Global Economic Prospects: Divergences and Risks, June, Washington, DC: World Bank.

World Bank, 2017a, Global Economic Prospects: Weak Investment in Uncertain Times, January, Washington, DC: World Bank.

World Bank, 2017b, Global Economic Prospects: A Fragile Recovery, June, Washington, DC: World Bank.

Yogo, M., 2004, "Estimating the Elasticity of Intertemporal Substitution When Instruments Are Weak," Review of Economics and Statistics, Vol. 86, No.3, pp. 797-810.

Yuan, K., 2005, "Asymmetric Price Movements and Borrowing Constraints: A Rational Expectations Equilibrium Model of Crisis, Contagion, and Confusion," Journal of Finance, Vol. 60, No. 1, pp. 379–411.

Zeldes, S., 1989, "Consumption and Liquidity Constraints: An Empirical Investigation," Journal of Political Economy, Vol. 97, No. 2, pp. 305–46.

Zetlin-Jones, A., and A. Shourideh, 2017, "External Financing and the Role of Financial Frictions over the Business Cycle: Measurement and Theory," Journal of Monetary Economics, Vol. 92, pp. 1–15.

Zingales, L., 2015, "Presidential Address: Does Finance Benefit Society?" Journal of Finance, Vol. 70, No. 4, pp. 1327–1363.

## Previous volumes in this series

| No | Title | Issue date |
|---|---|---|
| BIS Papers No 94 | Macroprudential frameworks, implementation and relationship with other policies | December 2017 |
| BIS Papers No 93 | Building Resilience to Global Risks: Challenges for African Central Banks | August 2017 |
| BIS Papers No 92 | Long-term issues for central banks | August 2017 |
| BIS Papers No 91 | Financial systems and the real economy | March 2017 |
| BIS Papers No 90 | Foreign exchange liquidity in the Americas | March 2017 |
| BIS Papers No 89 | Inflation mechanisms, expectations and monetary policy | November 2016 |
| BIS Papers No 88 | Expanding the boundaries of monetary policy in Asia and the Pacific | October 2016 |
| BIS Papers No 87 | Challenges of low commodity prices for Africa | September 2016 |
| BIS Papers No 86 | Macroprudential policy | September 2016 |
| BIS Papers No 85 | A spare tire for capital markets: fostering corporate bond markets in Asia | June 2016 |
| BIS Papers No 84 | Towards a "new normal" in financial markets? | May 2016 |
| BIS Papers No 83 | What do new forms of finance mean for EM central banks? | November 2015 |
| BIS Papers No 82 | Cross-border financial linkages: challenges for monetary policy and financial stability | October 2015 |
| BIS Papers No 81 | Currency carry trades in Latin America | April 2015 |
| BIS Papers No 80 | Debt | January 2015 |
| BIS Papers No 79 | Re-thinking the lender of last resort | September 2014 |
| BIS Papers No 78 | The transmission of unconventional monetary policy to the emerging markets | August 2014 |
| BIS Papers No 77 | Globalisation, inflation and monetary policy in Asia and the Pacific | March 2014 |
| BIS Papers No 76 | The role of central banks in macroeconomic and financial stability | February 2014 |
| BIS Papers No 75 | Long-term finance: can emerging capital markets help? | December 2013 |

All volumes are available on the BIS website (www.bis.org).