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MACRO-FINANCE LINKAGES*

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Abstract. In this survey, I review the academic and policy-oriented literature on the linkages between financial markets and the rest of the economy. First, I summarize the leading economic theories for why the financial sector can influence the macroeconomy. Second, I consider empirical research on spillovers from the financial sector to the rest of the economy, as well as across financial markets in different countries. Third, I discuss key monetary policy debates regarding the appropriate response of central banks to financial conditions. Finally, I conclude with an overview of the major gaps in the existing literature.

Keywords. Contagion; Financial accelerator; Global Financial Crisis; Monetary policy

1. Introduction

The Global Financial Crisis (GFC) of 2007–2009 has renewed interest, academic and otherwise, in the linkages between financial markets and the macroeconomy. Here, I provide a highly selective survey of academic and policy-oriented research on these macro-finance linkages. The survey is intended to be accessible to a wider audience than just macroeconomists and financial economists, rather than being an exhaustive survey aimed at specialists (see Borio, 2011, for a more comprehensive and technical survey).

First, I summarize the leading economic theories of why the financial sector might influence the overall economy. Second, I consider empirical research on spillovers from the financial sector to the rest of the economy, as well as across financial markets in different countries. Third, I discuss key monetary policy debates regarding the appropriate response of central banks to financial conditions. Finally, I conclude with a overview of the major gaps in the existing literature.

This survey is focused on the relationship between financial markets and the business cycle. It does not cover the huge literature on the influence of financial markets on long-term economic growth (see Levine, 1997, for a survey of this topic).

2. Theories of Macro-Finance Linkages

The most basic theory of macro-finance linkages is that the financial sector is, for all intents and purposes, a "sideshow", with no direct effect on the macroeconomy. This is not to say that financial markets and the business cycle are unrelated. But the connection is a one-way street running from the "real" economy to financial markets. For example, when the economy falls into recession, the stock market invariably falls with it. But, a large decline in the stock market does not necessarily precipitate a recession.[1]

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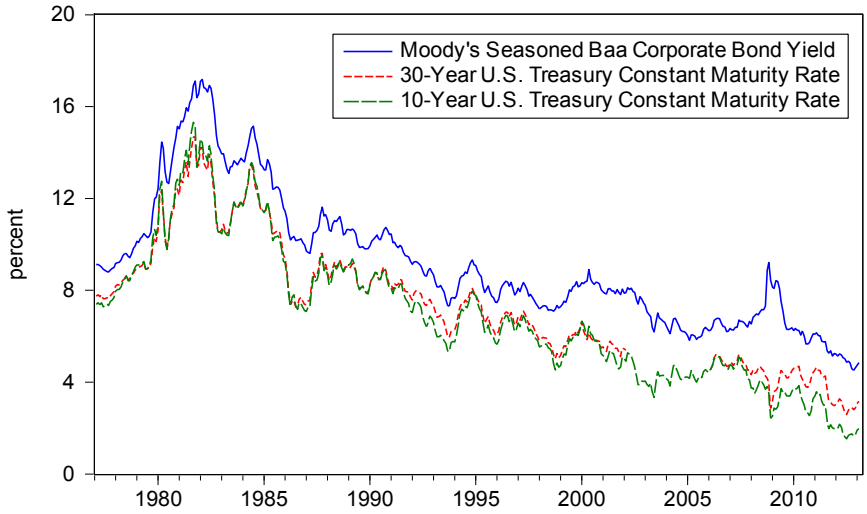

Figure 1. U.S. Corporate and Government Bond Yields 1977–2013
Source: Federal Reserve Economic Database

The foundation for the idea of finance as a sideshow is the Modigliani-Miller (1958) theorem. It states that debt versus equity financing of capital investment has no impact on the value of a firm. The indirect implication is that firms' investment decisions (e.g. how much new capital equipment to purchase) are driven by macroeconomic conditions—specifically, the real interest rate, determined by the marginal product of capital or possibly monetary policy in the short run—rather than developments in financial markets.

And, yet, there is a widespread belief amongst economists, policymakers, and practitioners that the financial sector does influence the real economy. Indeed, after the GFC, it would be hard to find anyone who would seriously argue against at least some role for financial markets in driving business cycles. The immediate question, then, is why finance matters after all. The strong assumptions underlying the Modigliani–Miller theorem help shed light on why it might fail. For example, the theorem assumes debt and equity have the same tax treatment. In reality, tax systems typically favour debt by making interest payments tax deductible, helping to explain why many firms are highly leveraged (i.e. they rely much more on debt than equity financing of their investments).

Assumptions need not be literally true to make a theory useful. But perhaps the most questionable assumption underlying the Modigliani–Miller theorem is one of perfect information. In reality, financial markets are plagued by "agency" problems due to asymmetric information. Specifically, borrowers usually know their prospects much better than their potential lenders, in part because borrowers can often influence those prospects with their investment decisions. This asymmetry in information available to borrowers and lenders can produce adverse selection and moral hazard in financial markets and motivates the existence of an "external finance premium"—that is, a wedge between the actual cost of borrowing faced by many firms and the risk-free real interest rate determined by the marginal product of capital or possibly monetary policy.

Figure 1 plots Moody's BAA Corporate Bond Yield, the 30-year U.S. Treasury Bond Yield, and the 10-year U.S. Treasury Bond Yield for the common sample period of February 1977 to February 2013. The corporate bond yield is for bonds with 30 years to maturity, although it includes some bonds with shorter

maturities (but always longer than 20 years) implying some duration mismatch that makes a comparison with the 30-year Treasury yield imperfect (see Gilchrist and Zakrajšek, 2012, on this point). Meanwhile, the 30-year Treasury yield series has a gap in the early 2000s. Thus, for completeness, I report both 30-year and 10-year Treasury yields. Note that the Treasury yields move closely together most of the time, so an exact match of maturities is not crucial for comparing large movements in corporate and Treasury yields.

The gap between the corporate bond yield and the Treasury yields, often referred to as the "credit risk spread", can be thought of as a measure of the external finance premium. The credit risk spread implied by Figure 1 is always positive and reasonably stable most of the time. In particular, most of the variation in the corporate bond yield corresponds to variation in the Treasury yield and presumably reflects macroeconomic factors. However, there are times when the spread is a lot larger than normal. Most notably, the spread jumps from about 2 percentage points in 2007 before the GFC to more than 5 percentage points at the height of the crisis in 2008. Remarkably, from an historical perspective, the corporate and Treasury yields actually moved in opposite directions during the GFC.

Assuming aggregate investment is sensitive to interest rates, changes over time in the external finance premium directly imply the possibility that developments in the financial sector spill over into the real economy. Indeed, the severe contraction in U.S. real GDP right after the spike in the credit risk spread is as close as we may ever get to prima facie evidence for a role of finance in driving business cycles. However, I will discuss the empirical evidence for spillovers from finance to the macroeconomy in much more detail in the next section. For now, the main point is to illustrate the existence of an external finance premium in order to motivate the theoretical literature on macro-finance linkages.

In principle, firms can avoid the external finance premium that results from asymmetric information by relying on internal financing from their retained earnings. Indeed, as discussed in an influential empirical study on financing constraints by Fazzari *et al.* (1988), firms face a hierarchy of financing options, with internal financing from cash flows being the least expensive, thus generating the highest returns. Debt financing is the next best option for tax reasons. But if the relative cost of debt financing increases with leverage (i.e. with the reliance on debt financing), some firms will also rely on equity financing by issuing shares on the stock market. This is also more expensive than internal financing for agency reasons. Indeed, depending on the agency costs, sometimes debt and equity financing in financial markets is prohibitively expensive or simply unavailable to many firms. A consequence is that investment will be highly dependent on cash flows and, therefore, highly procyclical.

On a pure accounting basis, investment is the primary source of fluctuations in overall economic activity. Thus, firms' investment boosts economic activity and economic activity boosts firms' investment. This feedback loop between investment and overall economic activity is often referred to by macroeconomists as an "investment accelerator". Specifically, there is a multiplier process that amplifies economic shocks much like the interaction between consumption spending by households and overall economic activity in the standard textbook Keynesian multiplier analysis. However, instead of being motivated by household spending behaviour, the investment accelerator can be motivated by firms' investment decisions in the face of an external finance premium due to agency problems in financial markets, with the specific link between the external finance premium due to borrower balance sheets and overall real economic activity via an investment accelerator often referred to as the "financial accelerator" as a short hand.

The importance of cash flows for investment financing motivates how the financial sector can amplify economic shocks. But there is also a question of whether financial markets are a source of economic shocks. In the face of a financing hierarchy and a scarcity of cash flows, many firms' investment decisions will be affected by the cost of debt and equity financing. Thus, large changes in the external finance premium, such as occurred in the GFC, should amplify economic shocks and provide a channel for shocks in financial markets to spread to the real economy.

Motivated by a role for balance-sheet considerations, Bernanke and Gertler (1989) and Greenwald and Stiglitz (1993) develop theoretical macroeconomic models that generate a financial accelerator. Their

models relate the external finance premium to firms' net worth and leverage, respectively. As net worth declines or leverage increases, the cost of external finance increases and firms cut back on investment. Assuming net worth is procyclical and leverage is countercyclical, economic shocks will be amplified by the financial accelerator.[2] Also, to the extent the changes in net worth or leverage are driven by financial factors, these models allow financial markets to influence the real economy.[3]

In a highly influential study, Kiyotaki and Moore (1997) develop a theoretical model that relates the external finance premium to the value of durable assets such as land that are used in the production of goods and services and can also be used as collateral to secure loans. Because the price of these durable assets will be procyclical given their role in production, their model also generates a financial accelerator and shows how developments in one asset market can spill over into others and into the real economy.

Bernanke *et al.* (1999) embed many of the insights of these previous models into a theoretical "New Keynesian" model of the business cycle that allows monetary policy to affect the real interest rate due to the assumption of sticky prices. Their model generates a financial accelerator and predicts that a financial shock generating a redistribution of wealth between lenders (households) and borrowers (entrepreneurs, who are less risk averse than households and make investment decisions) will have large effects on overall economic activity. Meanwhile, because of the financial accelerator, their model predicts that monetary policy will also have a large impact on economic activity.

If monetary policy is more effective because of the financial accelerator, an immediate question arises as to why shocks in the financial sector cannot simply be offset by well-designed policy. The short is answer is that often they can. However, when the economy hits the zero-lower-bound on nominal interest rates, as the United States and many other economies did with the GFC, the ability of monetary policy to offset the effects of financial shocks is strongly compromised.

A recent study by Eggertsson and Krugman (2012) develops a New Keynesian model with borrowers and lenders, where borrowers face a fixed debt limit. This serves as a simple approximation of the idea in Greenwald and Stiglitz (1993) that the external finance premium increases with leverage. Eggertsson and Krugman use their model to consider a large decline in the debt limit, corresponding to a "Minsky moment" when lenders suddenly become much more concerned about leverage.[4] When this happens, debtors will seek to deleverage. To accomplish this deleveraging, the real interest rate needs to be negative to induce patient households to borrow. However, if the change in the debt limit is large enough, the economy will hit the zero-lower-bound on the nominal interest rate and the attempts by debtors to deleverage produces deflation. Meanwhile, if long-term debt contracts are assumed to be set in nominal terms (as they often are in reality), the deflation works against the attempts of debtors to deleverage, causing prices to fall further. The debt limit also causes debtors to adjust their consumption spending with their current income, meaning that economic activity contracts through standard Keynesian multiplier channels. Thus, the model predicts a debt-deflation spiral, as was first suggested by Irving Fisher (1933) to explain the severity of the Great Depression.

To summarize, most of the theories discussed above suggest that financial markets have the ability to generate and amplify economic shocks through changes in the external finance premium faced by firms making capital investment decisions. The financial accelerator also implies monetary policy can be very effective at offsetting shocks, at least when the economy is away from the zero-lower-bound on nominal interest rates. I will discuss some of the policy implications of these theories in detail below. But before doing so, it is helpful to review some of the empirical literature on macro-finance linkages. I turn to this next.

3. Empirical Literature

Given that developments in financial markets can be important for the real economy in principle, the next question is whether they are important in practice. Here I consider two related strands of the empirical

literature. First, I review some studies that test whether developments in financial markets impact the real economy.[5] Then I consider how these developments might spread across financial markets in different countries. My purpose here is to provide a sense of how vulnerable a given economy is to both internal and external financial crises in order to help motivate the next section on monetary policy and financial conditions.

The key challenge in detecting whether the financial sector impacts the real economy is the age-old problem that "correlation is not necessarily causation". More specifically, it is clear that financial prices reflect what market participants anticipate about future economic conditions. So, it should be of little surprise that financial indicators are correlated with and can help predict those future economic conditions.[6] But the contention that financial conditions cause economic conditions will always be based on debatable assumptions used to separate causation from correlation.

The main approach in the academic literature to detecting causation in macro-finance linkages considers forecasting models of real economic activity to determine whether financial variables provide any *marginal* (in the sense of "additional" rather than "trivial") predictive content for economic activity beyond economic activity itself.[7] This might seem like a small distinction from checking whether financial variables predict economic activity in the first place. But it is an important one. In particular, this approach, which corresponds to checking for what econometricians refer to as "Granger causality", attempts to control for the inherent predictability of economic conditions due to macroeconomic shocks and their typical momentum.

In a recent study, Hatzius *et al.* (2010) consider whether key individual financial variables and broader financial conditions indices (FCIs) have marginal predictive content for future economic activity, as measured by real GDP growth, beyond what is implied by past economic activity. As with the literature on the overall predictive relationship between financial variables and economic activity, they find evidence of large changes in the marginal predictive relationship for individual financial variables. They hypothesize that this could either reflect an unstable relationship between the financial sector and the real economy or that the individual variables are unstable indicators of overall financial conditions. They find that FCIs developed by Bloomberg, Citibank, Deutsche Bank, Goldman Sachs, the Kansas City Fed, Macroeconomic Advisers, and the OECD generally do better than the individual financial variables, but dramatically vary in performance over time. This motivates their development of a new FCI based on factor analysis of 45 financial variables covering a broad range of the financial sector.

A challenge in identifying financial shocks using an FCI is that some of the changes in financial conditions are driven by changes in monetary policy in response to economic conditions. Indeed, some of the FCIs considered in Hatzius *et al.* (2010) are explicitly designed to capture the stance of monetary policy. The authors address this problem by purging their FCI of movements in financial variables related to output growth and inflation. They also exclude the Federal Funds Rate (the key instrument of monetary policy in the United States) and related financial variables (other short-term interest rates and even the yield curve in a robustness check) when constructing their FCI.

The main finding in Hatzius *et al.* (2010) is that their FCI has marginal predictive content for real economic activity and outperforms other financial indicators, especially in recent years. Because their FCI measure includes variables reflecting the "shadow banking system" such as asset-backed-securities (ABS) issuance, it suggests that financial conditions continue to exert more of a drag on economic activity after the GFC than implied by traditional FCIs focusing on interest rates, credit spreads, and stock prices, which all suggest more of a recovery of financial conditions since the worst of the crisis.

Although Hatzius *et al.* (2010) find support for financial conditions playing a role in driving economic activity, their results may understate the importance of this role by focusing on a linear relationship between their FCI and real GDP growth. It is possible that the apparent instability in the marginal predictive content of FCIs for real GDP growth reflects a nonlinear relationship whereby small changes in financial conditions have little impact on the economy, but large abrupt changes can trigger a recession. Along these lines, Chauvet (1998/1999) finds that regime-shifts in the mean and variance of an FCI based

on stock market data and the short-term interest rate, possibly corresponding to the alternation between "bull" and "bear" markets, lead to regime shifts in a coincident index of real economic activity that correspond to the alternation between NBER-dated "expansions" and "recessions". Also, using a vector autoregressive model, Hubrich and Tetlow (2015) find regime-shifts in the extent to which identified shocks for a financial stress index (that was actually available to the Federal Reserve Board staff in real time) affect the real economy.

Recently, Gilchrist and Zakrajšek (2012) find that changes in the "excess bond premium" (movements in the credit risk spread above and beyond what is implied by the current state of the economy) predict significant fluctuations in real economic activity and a sharp increase in this variable in 2008 was the proximate cause of the GFC. However, except for the early 2000s and during the GFC, the excess bond premium was fairly stable over most of their 1973–2009 sample period. Nason and Tallman (2015) consider a much longer sample period of annual data from 1890 to 2010 with identified credit shocks from a vector autoregressive model and find that the credit shocks have repeatedly played a role in business cycles, although, again with the exception of the GFC, credit shocks were more important in the pre-World War II sample period than afterwards.

Much of the focus of the empirical literature on finance-macro linkages has been on the U.S. economy.[8] However, a notable aspect of the GFC, featured in its very name, is its global scope. Specifically, the crisis spread across countries, largely through linkages between financial markets. Countries that escaped the worst of the crisis were not the ones with the fewest trade links. Instead, it was the countries with relatively insulated financial systems. For example, Canada is a major trading partner of the United States and should have been on the front line of the GFC. But its relatively uncompetitive banking system meant it was much less exposed to U.S. subprime mortgage default than, say, European banks.

There are large academic literatures on cross-country finance linkages and on cross-country business cycle linkages, although there is very little work on cross-country finance-macro linkages.[9] Given the notion, emphasized above, that financial conditions can impact economic activity, the focus here is on the extent to which financial conditions spill over across countries.

The idea that financial crises quickly spill over across countries is often referred to as "financial-market contagion". Influential studies of contagion include Eichengreen *et al.* (1996), Calvo and Mendoza (2000), and Kaminsky *et al.* (2003). The empirical literature on contagion, as well as casual observation, leaves little doubt that asset returns are more highly correlated across markets during periods of crisis than during periods of calm. However, once again, correlation does not necessarily imply causation. In particular, higher correlation during a crisis could just reflect larger common macroeconomic shocks operating through traditional channels such as trade linkages.

Much of the focus of the literature on contagion has been on whether financial crises alter how shocks are transmitted across financial markets. Put simply, are the vulnerabilities of countries to financial crises larger than simple correlation analysis would suggest? And, somewhat analogous to the theoretical literature on macro-finance linkages, is it something about financial markets themselves that generate and amplify crises rather than just reflecting large macroeconomic shocks?

Forbes and Rigabon (2002) find that increased co-movement across equity markets during the Asian financial crises in the late 1990s reflected larger shocks operating through traditional channels, rather than "contagion" or "shift-contagion" in the sense of an alteration in how markets were linked. Corsetti *et al.* (2005) show that Forbes and Rigabon's findings hinge crucially on the assumption that crises only affect the volatility of common shocks to financial markets across countries. They find evidence of shift-contagion in more countries during the Asian financial crisis than was found by Forbes and Rigabon.

Gravelle *et al.* (2006) develop an empirical model that addresses Corsetti *et al.*'s concerns and find evidence of shift-contagion across currency markets, but not bond markets. Importantly, this model does not impose the origin of crises or the exact timing, and considers lengthy sample periods that cover many crises. More recently, Dungey *et al.* (2010) consider related models and find that the degree of

shift-contagion depends on the crisis, with higher levels during the Russian/LTCM crisis in 1998 and the U.S. subprime mortgage crisis in 2007 than in the intervening Brazilian, dot-com, and Argentinian crises.

Overall, despite a lot of co-movement across financial markets when hit by large shocks, it is not clear from the empirical literature that financial markets are playing a strong role in propagating these shocks across countries.[10] Yet, the possibility that some crises lead to more contagion than others suggests that any given country may be more vulnerable to external financial shocks than its own historical record indicates. Specifically, apparent immunity for a country from one financial crisis does not imply immunity from the next one. However, as discussed below, it is hard to draw strong policy conclusions from such mixed empirical results.

4. Monetary Policy and Financial Conditions

Based on the theoretical literature reviewed above, the financial accelerator mechanism means that the overall economy can be sensitive to developments in the financial sector. The empirical evidence discussed above provides some support for the importance of the financial sector for overall economic activity, especially when considering broad indicators of financial conditions.

An implication of these theoretical and empirical findings is that monetary policy can be effective at offsetting financial shocks hitting the economy, at least when interest rates are away from the zero-lower-bound. Meanwhile, at the zero-lower-bound, an immediate implication of Eggertsson and Krugman's (2012) theoretical findings discussed above is that expansionary fiscal policy can have multiplier effects that offset a debt-deflationary spiral. Thus, the traditional Keynesian prescription of focusing on fiscal policy instead of monetary policy when the economy is mired in a liquidity trap has some theoretical justification.[11] In addition, there is growing empirical evidence that fiscal multipliers are larger during periods of weak economic activity than when the economy is closer to capacity (see, for example, Auerbach and Gorodnichenko, 2012, and Fazzari *et al.*, 2015).

The ability of central banks to stimulate the economy through unconventional monetary policies, such as trying to influence expectations via communications about keeping interest rates low for an extended period of time or open market purchases of risky assets in order to bring down credit risk spreads (which is, arguably, a form a fiscal policy by proxy and is often referred to as "quantitative easing" due to its effect of massively increasing the quantity of central bank liabilities), remains an open question.[12] Casual observation of recent events suggests that such actions taken by the Federal Reserve and other central banks following the GFC have mitigated the effects of the crisis on real economic activity and stabilized inflation expectations so as to prevent a debt-deflation spiral, such as occurred in the Great Depression. However, these actions have also clearly failed to generate a strong recovery in economic activity towards its pre-crisis path. Thus, in addition to the central bank measures, a stronger fiscal policy response may be needed (see Bernanke, 2012).

Beyond the immediate question of a role for unconventional monetary policies and fiscal policy in responding to a large financial crisis that pushes interest rates to the zero-lower-bound, there is also a question of how monetary policy should be designed in the face of macro-finance linkages that lead to crises in the first place. Borio (2011) provides a survey of this topic. He discusses how, with the exception of acting as a "lender of last resort" in liquidity crises, central banks have largely treated their banking supervision duties as being entirely unrelated to macroeconomic conditions or the conduct of monetary policy. Specifically, banking supervision in the past few decades has largely taken the form of *microprudential* regulation that attempts to manage the solvency risks of individual bank balance sheets in isolation of the rest of the financial system or the state of the business cycle.

With the GFC, it has become clear that solvency risks cannot be looked at in isolation of the linkages between banks (and other financial institutions) or of related liquidity risks that can trigger "fire sales" of assets that exacerbate crises. This has led to more of focus on systemic risk and the proposal of

macroprudential regulations such as links of capital requirements or loan-to-value ratios to economic conditions. Drehmann *et al.* (2011) argue that credit-to-GDP measures would have provided the best historical trigger for procyclical adjustments in capital requirements. These credit-to-GDP measures performed best in their study in the sense of appearing to have been more timely and reliable (in the sense of minimal false positives) indicators of financial crises than credit risk spreads. However, there is much controversy about the efficacy and distributional effects of macroprudential policies, especially in settings where they have actually been applied (e.g. the recent experience with loan-to-value restrictions in New Zealand since October 2013).

The other key question for systematic policy discussed in Borio's (2011) survey is whether central banks should place more emphasis on housing and asset prices in setting interest rates. Related to this question is the debate about the role of monetary policy in creating the conditions that led to the GFC. The "broad consensus" view discussed in Borio's survey is that the crisis was primarily due to a failure of prudential policy (i.e. financial institutions had highly fragile balance sheets that only looked sound due to a severe mispricing of risks associated with ABS, with these new financial instruments fuelling the housing boom, making its eventual collapse more severe). However, another view raised in Borio's survey is that the housing boom and subsequent bust was largely driven by U.S. monetary policy being too loose in early 2000s (see Taylor, 2007, and the rebuttal by Bernanke, 2009).

To the extent that loose monetary policy did play a role in precipitating the GFC, a key policy question is whether central banks have been too focused on inflation targets. Should central banks target asset and housing prices above and beyond the direct impact they have on consumer goods prices? It might seem in retrospect that the answer is yes. Borio's (2011) survey certainly takes this view. However, the idea that it is best to avoid targeting asset prices has a long tradition in macroeconomics and is likely to persist in both academic and policy circles.[13]

A strong motivation for avoiding targeting asset prices is the historical experience with the gold standard. As a nominal anchor, fixing the price of gold certainly prevents hyperinflations. However, it can also require large adjustments of consumer prices in the case of large changes in supply or demand for gold (see Hamilton, 2012, for an accessible discussion of the problem). For example, when gold discoveries were not enough to keep up with growing demand in the late 1800s, there was a natural upward pressure on the real price of gold. Because of a fixed nominal price of gold under the gold standard, this appreciation in the real price of gold led to a long period of deflation (and to William Jennings Bryan famously declaring "Thou shalt not crucify mankind upon a cross of gold" at the 1896 Democratic National Convention).[14] As a result of this historical experience, combined with the link in timing between when countries abandoned the gold standard and when they recovered from the Great Depression (see Friedman and Schwartz, 1963, and Bernanke, 2002), many economists believe that a broad basket of consumer prices provides a better nominal anchor, explaining the popularity of inflation targets. Given the inherent volatility of real asset prices, any targeting of asset prices could produce persistent periods of deflation or excessive inflation in the prices of goods and services. To the extent that the risks associated with large asset price appreciations can be addressed by other means such as macro-prudential regulations, it would seem far more desirable to pursue these alternative policies instead of abandoning inflation targets and living with persistent periods of deflation whenever there are upward pressures on the real price of assets.

In terms of the New Keynesian theoretical framework with a financial accelerator discussed above, Iacoviello (2005) considers systematic monetary policy in an extended version of Bernanke *et al.*'s (1999) model that incorporates collateral constraints tied to real estate values, as in Kiyotaki and Moore (1997), and assumes the existence of nominal debt contracts. Estimation of his model suggests that incorporating collateral constraints is important to capture the empirical response of aggregate consumption to house price shocks. He then uses the model to examine two key monetary policy issues. First, given the underlying goals of stabilizing output and inflation, the benefits of targeting house prices are shown to be negligible, similar to findings in Bernanke and Gertler (2001) on the benefits of targeting stock

prices or, more recently, Cúrdia and Woodford (2010) on the benefits of targeting credit spreads. Second, while indexed debt would reduce the amplification of demand shocks that can, in any event, be offset by monetary policy, nominal debt contracts are, perhaps surprisingly, better than indexed debt at mitigating the effects of inflation and technology shocks that monetary policy cannot offset. Thus, the benefits of promoting indexed debt contracts are not as clear as might have been thought given the difficulty economic theorists have had in coming up with welfare-theoretic justifications for the existence of nominal debt contracts in the first place.

Finally, the implications of the mixed empirical results on financial market contagion across countries for monetary policy are far from clear. To the extent that contagion is a possibility, it might seem that central banks should "take out insurance" against any particular external crisis spreading to their country by cutting interest rates when faced with an international financial shock and quickly reversing the cut if it becomes clear that a crisis was not transmitted in any unusual way. But another possible interpretation of the mixed evidence on contagion is that central banks should put more weight on domestic economic (and financial) conditions than international conditions when formulating policy.

5. Conclusions

Macroeconomic theory explains the possible importance of the financial sector and financial shocks to the overall macroeconomy as being due to "agency" problems and a resulting "financial accelerator" mechanism. The empirical evidence suggests some role for finance in driving the business cycle through these channels, but it is important to look at broad classes of assets in monitoring financial conditions. Meanwhile, financial crises increase co-movement of asset prices across countries, but they do not necessarily reflect a fundamental change in the linkages between economies. From a monetary policy perspective, the financial accelerator implies that central banks can be effective at offsetting financial and other shocks, except at the zero-lower-bound when fiscal policy may have to be relied on. Recent events suggest an importance of monitoring credit conditions, but the argument for targeting asset prices with monetary policy rather than pursuing procyclical macroprudential regulation of banks has not swayed most academic economists or policymakers. Meanwhile, the mixed empirical evidence on financial market contagion suggests that central banks should focus primarily on domestic economic and financial conditions.

In terms of gaps in the current literature, Gertler and Kiyotaki (2010) and Woodford (2010) argue that there should be more theoretical modelling of frictions within financial markets (i.e. within financial intermediation) rather than between "non-financial" borrowers and lenders accessing (assumed) frictionless financial markets. Some recent theoretical contributions along these lines that also address nonlinearities in the interaction between the financial sector and the macroeconomy include Mendoza (2010), He and Krishnamurhy (2012), Brunnermeier and Sannikov (2014), and Boissay *et al.* (2016), but much more work needs to be done in terms of modelling nonlinearities theoretically and empirically (see Blanchard, 2014). Also, it is clear that more research is needed on monetary policy rules that target asset prices. For example, given the problems with responding to all movements in real asset prices discussed above, nonlinear rules that only imply a response to asset price movements that exceed certain thresholds may perform better than basic linear rules that imply a continuous response that is proportional to the change in asset prices. Meanwhile, research on crisis indicators should address the econometric shortcomings with the credit-to-GDP measures considered in Drehmann *et al.*'s (2011) analysis, which are based on statistical filters that are generally inappropriate for the type of data they consider. In terms of measuring the impact of financial conditions on the macroeconomy, the ever-evolving set of financial instruments available in financial markets suggests that empirical research on financial conditions indices should allow for time-varying weights on underlying financial variables. Also, there should be more empirical analysis of how macroeconomic and financial shocks transmit across countries, including

allowing for nonlinear transmission of shocks in a global vector autoregressive model. This analysis would be helpful in informing how policy should respond to international conditions.

But the deepest and more challenging question for macro-finance research is whether it is really feasible to prevent financial crises with well-chosen systematic policies or should research focus on how policymakers can best respond to (possibly inevitable) crises. Benigno *et al.* (2013) argue policy interventions after a crisis are preferable to macroprudential policies that may reduce the probability of crises but also lead to inefficient levels of borrowing that reduce the long-run level of economic activity. However, fully answering this extremely important question will require a broad research initiative that draws from the macroeconomic literature discussed in the survey, as well as from the literatures on finance and growth (again, see the survey by Levine, 1997) and financial crises (see, for example, the recent influential book by Reinhart and Rogoff, 2009).

Notes

1. As the Nobel Prize winning economist Paul Samuelson famously quipped in a 1966 *Newsweek* article, "Wall Street indexes predicted nine out of the last five recessions!"
2. Financial acceleration is often a "knife-edge" result for theoretical models that depends heavily on assumptions about preferences and production technologies (see Córdoba and Ripoll, 2004). Indeed, some models with adverse selection imply a financial decelerator (e.g., House, 2006), while models based on costly state verification can generate a procyclical external finance premium (e.g., Carlstrom and Fuerst, 1997).
3. See Brunnermeier *et al.* (2012) for a recent and highly-technical survey of theoretical models in which financial frictions generate business cycle fluctuations.
4. Hyman Minsky argued that economic booms often involve unsustainable credit expansion as borrowers, lenders, and regulators are lulled by myopia into a sense of complacency about underlying risks. Given the unsustainability of the credit expansion, there is inevitably a switch from lax lending standards to a severe tightening of standards. See Yellen (2009) for an accessible discussion of Minsky's "financial instability hypotheses" and its relevance for the GFC as a "Minsky moment" following on from the so-called "Great Moderation" in macroeconomic volatility since the 1980s.
5. A somewhat different approach, known as "business cycle accounting", considers theory-based measurement of deviations from a frictionless real business cycle model to analyze the importance frictions. Based on this approach, Hall (2011) argues that financial frictions are very important for overall fluctuations in economic activity. However, the empirical relevance of the frictionless model as a counterfactual benchmark is debatable.
6. The literature on financial variables predicting real GDP growth or recessions is voluminous and will not be covered in any detail here (Estrella, 2014, lists well over 100 entries in his online bibliography for the yield curve as a predictor of U.S. recessions alone). Briefly, however, consistent with Samuelson's quip about overprediction mentioned in the first footnote, many variables such as stock market returns over-predict recessions, which goes against the notion of a simple deterministic causation from financial conditions to the real economy. The yield curve (i.e., the spread between interest rates on long and short maturity government debt) appears to be one of the more reliable predictors of recessions (see Estrella and Mishkin, 1998). However, even this relationship appears to have changed dramatically in recent years, making the yield curve a less reliable indicator than it used to be (see, for example, Chauvet and Potter, 2002), although Rudebusch and Williams (2009) argue that real-time forecasting models based on it still outperform most professional forecasters. The evidence for the yield curve predicting real GDP growth has also diminished over time (see the survey by Wheelock and Wohar, 2009).
7. There also exists a more structural empirical literature on macro-finance linkages, including Ang and Piazzesi (2003), Diebold *et al.* (2006), and Gürkaynak and Wright (2012) (also see the recent book by

Diebold and Rudebusch, 2013). However, the focus of this research is often more on understanding the effects of macroeconomic factors on financial prices, especially the term structure of interest rates, than the effects of financial factors on the real economy, although there is some consideration of this issue as well. There is less work on the links between the stock market and the real economy, although numerous studies have noted a relationship between stock return volatility and the business cycle (see, for example, Schwert, 1989).

8. The studies by Chauvet (1998/1999), Hatzius *et al.* (2010), Gilchrist and Zakrajšek (2012), Hubrich and Tetlow (2015) all focus on U.S. data, although there are also a couple of recent studies by Holló *et al.* (2012) and Angelopoulou *et al.* (2013) that construct FCIs for the Eurozone, while Hartmann *et al.* (2014) consider nonlinearities in the relationship between Holló *et al.*'s FCI and the Eurozone macroeconomy.
9. Notable exceptions are empirical studies by Dées *et al.* (2007), Eickmeier and Ng (2011), and Xu (2012), which all consider global vector autoregressive models and find that financial shocks (measured using equity prices, bank credit, and other financial measures) have spillovers to the macroeconomy and can transmit relatively quickly across countries. Also, a recent study by Hubrich *et al.* (2013) considers the transmission of shocks in the Eurozone using country-specific and panel vector autoregressive models.
10. Providing some support for the role of financial markets, Fry-McKibbin *et al.* (2013) find that crises with clear financial origins spread more than sovereign-debt crises (e.g., the GFC vs. the recent European debt crisis) and financial linkages are more likely to result in crisis transmission than trade linkages.
11. Also see Werning (2012), who examines the role of commitment for the effectiveness of monetary and fiscal policies in a liquidity trap, and Aruoba and Schorfheide (2013), who find that large fiscal multipliers depend crucially on monetary policy being in an inflation-targeting regime.
12. There is a quickly growing literature on the effects of unconventional monetary policies at the zero-lower-bound. Woodford (2012) provides an accessible introduction and overview on the debate between using "forward-guidance" communications vs. large-scale asset purchases (LSAPs). Campbell *et al.* (2012) also examine the effects of forward guidance in Federal Reserve communications, while Williams (2011) surveys the empirical literature on the effects of LSAPs on long-term yields. Other recent empirical studies include Wright (2012), Li and Wei (2013), Bauer and Rudebusch (2013), and Swanson and Williams (2014), with the general finding of significant effects of LSAPs. Kapetanios *et al.* (2012) look directly at the effects of LSAPs on U.K. real GDP and find significant effects. In terms of more theoretical analysis, del Negro *et al.* (2012) and Carlstrom *et al.* (2012) find a "forward-guidance puzzle" that communications about future policy (under commitment) have much larger effects in New Keynesian models than they appear to have in practice, while Krippner (2012, 2013) considers shadow policy rates at the zero-lower-bound based on the option-pricing approach of Black (1995).
13. Bean *et al.* (2010) review different proposals for the conduct of monetary policy following the GFC and provide a robust defense of inflation targets at their pre-crisis levels.
14. See Rockoff (1990) for an engaging monetary history of this era that also explains how the children's novel (and later movie) *The Wizard of Oz* is a monetary allegory with Bryan being represented by the lion who finds his courage.

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