The Financial Accelerator*

Oliver de Groot†

University of St Andrews

March 24, 2016

Abstract

The financial accelerator refers to the mechanism by which distortions (frictions) in financial markets amplify the propagation of shocks through an economy. This article sets out the theoretical foundations of the financial accelerator in financial friction DSGE (Dynamic Stochastic General Equilibrium) models and discusses the ability of these models to provide policy recommendations and a narrative for the 2007-08 financial crisis.

*This article was prepared for the the New Palgrave Dictionary of Economics
†Email: ovdg@st-andrews.ac.uk.

Introduction

The financial accelerator refers to the mechanism by which frictions in financial markets amplify the propagation of shocks through an economy. With the financial accelerator, an initial deterioration in credit market conditions leads to rising credit spreads, creating an additional weakening of credit market conditions, and resulting in a disproportionately large drop in economic activity.

The key building block of the financial accelerator is the existence of a friction in the intermediation of credit. In frictionless financial markets, loanable funds are intermediated efficiently between savers and borrowers. And, in line with the insights of Modigliani and Miller (1958), the composition of borrowers' internal (own net worth) and external (borrowed) funds do not affect real economic outcomes. However, in reality, asymmetric information and imperfect contract enforcement creates principal-agent problems between borrowers and lenders. The Modigliani-Miller theorem no longer holds and fluctuations in borrower net worth have real economic consequences. The mechanism involves an inverse relationship between credit spreads (the cost of borrowing over the risk-free rate) and net worth. This inverse relationship arises because, when a borrower's net worth is low, the borrower's incentive to, for example, truthfully report returns, exert high effort, or not abscond with assets, is also low. As borrowers' and lenders' interests become more divergent, agency costs and hence credit spreads increase. To the extent that borrowers' net worth is procyclical, credit spreads will be countercyclical, with borrowing costs increasing in downturns, amplifying fluctuations in investment and economic activity.

While the term was first coined by Bernanke et al. (1996), the idea that credit market conditions play a central role in economic fluctuations has much earlier origins. Many economists that lived through the 1930s, including Fisher (1933), Keynes (1936), Kindleberger (1978), and Minsky (1992), believed the financial sector—in excessively curtailing lending in response to falling asset prices—was largely responsible for the Great Depression.

By the 1980s, *real business cycle* models, with frictionless financial markets, dominated the macroeconomic research agenda. However, large fluctuations in economic activity often appeared to result from small disturbances and real business cycle models struggled to generate the propagation and amplification necessary to match this observation. The financial accelerator mechanism—by introducing a distortion in the credit market of an otherwise standard real business cycle model—was one solution to this "small disturbances, large fluctuations" puzzle.

The original microfoundation of the financial accelerator, in Bernanke and Gertler (1989) (and popularized by the quantitative business cycle framework of Bernanke et al. (1999)), was based on the "costly state verification" problem of Townsend (1979) in which costly bankruptcy resulted from an asymmetry of information between lenders and borrowers. A number of alternative microfoundations have since emerged. Kiyotaki and Moore (1997) generated credit cycles when lenders faced the "hold-up" problem studied by Hart and Moore (1994), giving rise to collateral constraints on borrowing. Both these early contributions to the financial accelerator literature focussed on non-financial borrowers. Since the 2007-08 financial crisis, however, many models have focussed instead on the problems faced by financial intermediaries (banks) in obtaining funds. Most popular among them, Gertler and Karadi (2011) proposed the so-called "running away" moral hazard problem in which bankers' ability to abscond with assets endogenously limits bank leverage.

In addition to these, Christiano and Ikeda (2013) introduce a microfounded financial accelerator by adopting an unobserved effort moral hazard problem on the part of borrowers, de Groot (2010) uses a (global games) coordination game between lenders in the spirit of Goldstein and Pauzner (2005), while Adrian and Shin (2014) introduce a Value-at-Risk constraint.

Despite the financial accelerator literature having become well established by the mid-2000s, Vlcek and Roger (2012) show that financial frictions were almost non-existent in the quantitative DSGE models used by central banks and policy institutions at that time. The financial crisis naturally brought a renewed interest in adding these frictions to policy models to improve forecasting and provide insights for the design of monetary and macroprudential policy. However, while alternative microfoundations produce the same basic financial accelerator mechanism—in which deteriorating balance sheet conditions of borrowers exacerbate the agency problem, driving up credit spreads, and depressing economic activity—each has advantages and disadvantages in terms of tractability and realism and no consensus approach has emerged. Identifying empirically the key friction in credit markets remains an important aspect of the research agenda.

The growth in the macro-finance literature since the financial crisis has been so large that this short survey cannot hope to do it all justice. This survey will focus on a subset of the literature with models relying on linear approximation and frictions that always binds. Quadrini (2011), Christiano and Ikeda (2012), and Brunnermeier et al. (2013) survey the theoretical work on other financial instability phenomena including occasionally binding constraints, fire sales, bank runs, and pecuniary externalities.

The rest of this survey will proceed as follows. The next section sketches a simple model of the financial accelerator without reference to a particular microfoundation. The subsequent section describes three prominent microfoundations. The final section asks: i) How well do financial accelerator models fit the narrative of the 2007-08 financial crisis? ii) What are the policy implications of the financial accelerator? iii) What challenges remain?

A simple model with a financial accelerator

In order to expose the heart of the financial accelerator mechanism—countercyclical credit spreads driven by procyclical fluctuations in borrowers' net worth—consider first the simplest DSGE model, a frictionless real business cycle model al a Brock and Mirman (1972). This model reduces to a single equilibrium condition for the loanable funds market.

There exists an infinitely lived representative household with log utility over consumption, $\mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \log(c_t)$, where $\mathbb{E}_t(\cdot)$ is the expectations operator conditional on time t information,

$\beta \in (0,1)$ is the subjective discount factor, and c_t is consumption. There also exists a representative firm with production technology, $y_t = \epsilon_t k_{t-1}^{\alpha}$, where y_t is output, ϵ_t is a technology shock, k_{t-1} is the capital stock created in $t-1$ and productive in t, and $\alpha \in (0,1)$. Household labor supply is fixed (and normalized to one) with real wages equal to the marginal product of labor. Capital fully depreciates each period, so market clearing is given by $\epsilon_t k_{t-1}^{\alpha} = c_t + k_t$.

Suppose, for the purposes of story telling, there exists a competitive bank (ultimately owned by the household), intermediating loanable funds in a frictionless credit market in this economy. The household, as the supplier of loanable funds, saves via deposits and earns the gross risk-free return r_{t-1} at time t. The firm, as the demander of loanable funds for purchasing capital, borrows from the bank and pays the gross realized return on capital, $r_t^k = \alpha \epsilon_t k_{t-1}^{\alpha-1}$. The (upward sloping) supply curve for loanable funds is sketched by the household's Euler equation, $1 = \mathbb{E}_t \beta \left(c_t / c_{t+1} \right) r_t$, while the (downward sloping) demand curve is sketched by the expected marginal product of capital, $\mathbb{E}_t r_{t+1}^k = \alpha k_t^{\alpha-1}$.

Since the loanable funds market is frictionless, the bank is just a veil and the competitive equilibrium is the same as when households directly rent capital to firms. Arbitrage ensures that the expected discounted return on capital is equal to the discounted return on risk-free deposits,

$$\mathbb{E}_t \beta \left(c_t / c_{t+1} \right) r_{t+1}^k = \mathbb{E}_t \beta \left(c_t / c_{t+1} \right) r_t.$$

To a log-linear approximation there is no credit spread since the no-arbitrage condition becomes $\mathbb{E}_t \tilde{r}_{t+1}^k - \tilde{r}_t = 0$, where $\tilde{r}_t$, for example, denotes the log-linear deviation of r_t from steady state.

Consider next the response of this frictionless economy to a negative technology shock. On impact, the demand curve for loanable funds does not shift while the supply curve shifts inwards. To see this, substitute the no-arbitrage condition and the aggregate resource constraint into the Euler equation and derive the log-linear approximation of the supply curve

$$\mathbb{E}_t \tilde{r}^k_{t+1} = a\Big(\underset{(-)}{\tilde{\epsilon}_t}, \underset{(-)}{\mathbb{E}_t \tilde{k}_{t+1}}\Big) + b\tilde{k}_t,$$

where the intercept, a, is a decreasing function of $\tilde{\epsilon}_t$ and $\mathbb{E}_t \tilde{k}_{t+1}$, and $b > 0$ is a positive slope coefficient (with both a and b functions of structural parameters). The negative shock, all else equal, reduces output (and consumption) at time t relative to $t+1$, reducing the stochastic discount factor and therefore reducing the supply of loanable funds for any given expected return on capital. In equilibrium, the expected return on capital, $\mathbb{E}_t \tilde{r}^k_{t+1}$, rises and capital expenditure, $\tilde{k}_t$ falls.

How can we amplify the effect of the negative shock? Suppose there is—for some reason—a wedge (a credit spread) between the expected return on capital and the risk-free rate, $\tilde{s}_t \equiv \mathbb{E}_t \tilde{r}^k_{t+1} - \tilde{r}_t$, that is countercyclical. In other words, $\tilde{s}_t = s(\underset{(-)}{\tilde{\epsilon}_t})$ and, on impact of a negative shock, $\tilde{s}_t$ becomes positive. The supply curve for loanable funds using this limit-to-arbitrage condition becomes

$$\mathbb{E}_t \tilde{r}^k_{t+1} = a\Big(\underset{(-)}{\tilde{\epsilon}_t}, \underset{(-)}{\mathbb{E}_t \tilde{k}_{t+1}}\Big) + \tilde{s}_t + b\tilde{k}_t.$$

For every given level of the expected return on capital, the risk-free rate (the return earned by the household on deposits) is $\tilde{s}_t$ percent lower. Hence, in this *frictional* market, the negative shock generates an additional inward shift of the supply curve as a result of the credit spread rise. In equilibrium, the expected return on capital, $\mathbb{E}_t r^k_{t+1}$, rises further and capital expenditure, $\tilde{k}_t$, falls further than in the frictionless case—and this, at its simplest, is the financial accelerator.

But, why are credit spreads countercyclical? What exactly is the nature of the credit market friction? In this model there are two steps in the intermediation of credit—the process of firms borrowing from banks and the process of banks borrowing from households—either of which could be the source of the friction. The firm might, for example, have an incentive to lie about the return on assets, or the bank might be tempted to abscond with assets, or not be incentivized to exert necessary effort to find good projects.

The next section will formalize these ideas. But, faced with these types of agency problems, the incentives of the borrower (be it the firm or the bank) need to be aligned with the incentives of the creditor (be it the bank or the household). This is achieved when the borrower has "skin in the game". In other words, the borrower can no longer rely only on external funds, but must also pledge internal funds. In the frictionless version of this model, the bank was effectively infinitely leveraged with 100% debt financing. When frictions exist, to make the household willing to supply funds, the bank also needs to provide internal funds.

The key additional state variable in financial friction models is therefore borrowers' net worth (or inside equity). To make profits and accumulate net worth, however, the borrower requires a positive spread between the return on its projects (its assets) and the rate it pays on external finance. When net worth is high, the borrower's incentives are well aligned with that of the household and credit spreads are low. When net worth is low, the benefit from low effort or absconding with funds is relatively high unless credit spreads are high enough such that the opportunity cost of exerting low effort or absconding with assets is also high. As a result, credit spreads are a direct measure of agency costs. And, the first key additional equilibrium condition in a financial friction model is one that negatively relates current (and future) net worth and current (and future) credit spreads (specific examples of which will be given in the next section).

The second key additional equilibrium condition is the law of motion of net worth, $\tilde{n}_t$. Net worth depends positively on the realized return on capital and positively on net worth in the previous period,

$$\tilde{n}_t = n\big(\underset{(+)}{\tilde{r}_t^k}, \underset{(+)}{\tilde{n}_{t-1}}\big).$$

The bank suffers a hit to net worth whenever the realized return on its assets is below the expected return. This is the case when there is an unexpected negative technology shock since $r_t^k = \alpha \epsilon_t k_{t-1}^{\alpha-1}$. The fall in net worth is persistent, propagating the effect of the shock.

In summary, we have established that when microfounded distortions exist in credit markets, credit spreads and borrowers' net worth are negatively related and net worth is procyclical. Thus, we have a model that delivers the countercyclical credit spread needed to generate the financial accelerator.

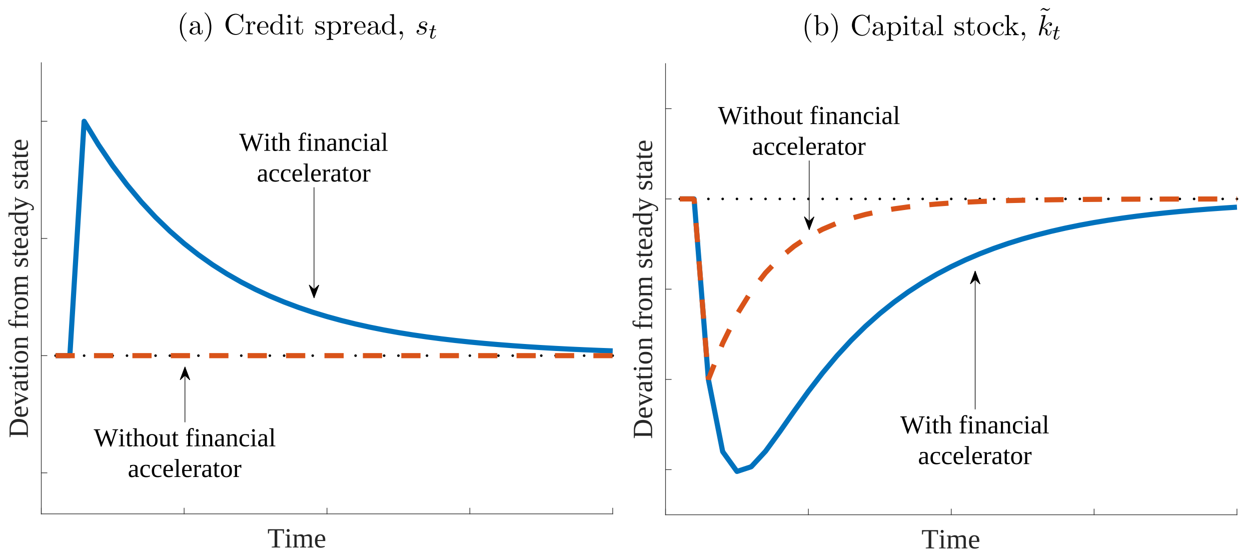
The financial accelerator sketched above is stylized due to the simplicity of the model. To demonstrate financial accelerator dynamics in a richer DSGE model, Figure 1 shows the response of the credit spread and capital stock to a negative *capital quality* shock—a shock intended to capture a financial crisis. Specifically, the shock ε_t decreases effective capital from k_t to $\varepsilon_t k_t$ as well as reducing the value of banks' assets.

In Figure 1a without the financial accelerator, as in the simple model, there are no agency costs and there is no credit spread. In Figure 1b, the capital stock falls on impact, but, with the marginal product of capital high as a result, investment rises following the shock and the capital stock recovers quickly. With the financial accelerator, the negative capital quality shock causes an unexpected fall in the return on bank assets. Since the bank pays a predetermined risk-free rate on deposits, the bank's net worth gets hit by the shock. Bank net worth falls, exacerbates the friction in the market and drives up the credit spread, as shown in Figure 1a. This reduces the willingness of households to supply loanable funds, causing investment to fall and the capital stock, as shown in Figure 1b, to continue falling after the shock (before eventually recovering). Just like the simple model, in this richer DSGE model, the financial accelerator created a large credit spread and an amplified and persistent fall in capital (investment, and output).

Three microfoundations of the financial accelerator

The previous section describes the financial accelerator without reference to a particular microfounded financial friction. This section describes three prominent microfoundations.

Figure 1: Response to a negative capital quality shock



Costly state verification problem

The costly state verification problem is the microfoundation developed by Bernanke and Gertler (1989). The borrowers facing the friction in this case are risk-neutral entrepreneurs. Entrepreneurs use their own net worth, n_t, and external financing from a bank to purchase capital, k_t, and at price q_t for a project. The project is subject to an idiosyncratic productivity shock, $\omega \in (0, \infty)$, the realization of which is privately observable to the entrepreneur but only verifiable by the bank by paying a proportional monitoring cost μ. An entrepreneur has an incentive to underreport its gross profit (which is a function of ω). The optimal contract, that ensures truthful reporting by the entrepreneur and minimizes the deadweight cost of monitoring, is a standard debt contract. The contract implies a threshold, $\overline{\omega}$. When $\omega \geq \overline{\omega}$, the entrepreneur makes a fixed payment to the bank (and there is no monitoring). When $\omega < \overline{\omega}$, the entrepreneur declares bankruptcy, pays its entire gross profit to the bank, and the bank pays the monitoring cost to audit the entrepreneur. When net worth is low, all else equal, an entrepreneur's incentive to underreport is high. In equilibrium, this causes $\overline{\omega}$, the number of (costly) bankruptcies, and the credit spread to all rise. The key equilibrium condition is a tradeoff between the credit spread and entrepreneurs' aggregate capital-to-net worth ratio

$$\mathbb{E}_t \tilde{r}^k_{t+1} - \tilde{r}_t = \phi \left(\tilde{q}_t + \tilde{k}_t - \tilde{n}_t \right),$$

where the slope coefficient, ϕ, is a function of the monitoring cost, μ. When $\mu = 0$, then $\phi = 0$ and the model replicates the dynamics of the frictionless economy. Bernanke et al. (1999) showed how variability in the price of capital (through capital adjustment costs) can add additional amplification to the accelerator.

An important technicality of these models is that since the expected discounted return on net worth is above the risk-free rate, it pays for the entrepreneur to always build net worth. With infinitely lived entrepreneurs this would eventually result in the entrepreneurs no longer requiring external finance and the financial accelerator disappearing. To prevent this, there needs to be an exogenous exit rate of entrepreneurs being replaced with new (low net worth) entrepreneurs, to ensure that the constraint, in aggregate, continues to bind.

Hold-up problem

The hold-up problem is the microfoundation developed by Kiyotaki and Moore (1997). Output is produced in two sectors. In the first sector, *productive* agents are impatient and have a constant returns to scale technology. In the second sector, *unproductive* agents are patient and have a decreasing returns to scale technology. The productive agents want to borrow from the unproductive agents but are subject to a friction. Productive agents cannot precommit their human capital, an essential input in production. Thus, they can threaten to repudiate their debt obligations. If they do, the creditors can pay a proportional transaction cost $1 - m$ to repossess the borrower's assets. This generates an endogenous collateral constraint $b_t \leq m\mathbb{E}_t \left(q_{t+1} k_t / r_t \right)$, where b_t is the amount borrowed. In the costly state verification problem, the credit spread was increasing in the relative amount borrowed since more borrowing required more monitoring. In the hold-up problem the cost of external finance is r_t up to the constraint and then become infinite. There are therefore no explicit credit spreads in this model but the Lagrange multiplier on the collateral constraint can be interpreted as the shadow cost of borrowing. It is the price at which capital can be sold and reallocated—the liquidity of physical capital—that is the key transmission mechanism of shocks. In response to a negative shock, the fire sale of capital from the productive to the unproductive sector depresses asset prices, reducing the collateralizability of assets and hence depressing economic activity. In equilibrium, the productive agents borrow up to the limit and do not consume any of the tradeable output produced. While the productive agents can threaten bankruptcy, in equilibrium, this never happens. The problem of productive agents postponing consumption indefinitely also exists in this model, like in Bernanke et al. (1999), and is dealt with by assuming that some output is non-tradeable.

Collateral constraints in the spirit of Kiyotaki and Moore (1997) have been used extensively in the literature with, for example, Iacoviello (2005) using them to study housing dynamics in a new-Keynesian model and Jermann and Quadrini (2012) using collateral constraints and financial shocks to explain the role of debt and equity financing in economic fluctuations.

"Running away" moral hazard problem

This is the microfoundation developed by Gertler and Karadi (2011). The borrowers facing the friction in this case are financial intermediaries (banks). Households are made up of workers and bankers. Bankers are endowed with an initial net worth from their households and collect deposits from other households to lend to firms. After raising funds, a banker is able to "run away" with a fraction λ of the bank's total assets. The incentive compatibility constraint is that the fraction of assets with which the banker can run away with must be less than the banker's expected discounted terminal net worth. Households therefore only deposit funds at a bank up to the point at which the banker is just indifferent between running away and not. When a banker's current net worth is low, all else equal, its expected discounted terminal net worth is low, and its willingness to run away is high. Thus, in equilibrium, households reduce the quantity of deposits (reducing the absolute value of assets that can be stolen) and credit spreads rise, raising bankers' expected discounted terminal net worth. A contraction in net worth therefore lowers credit creation and raises credit spreads in the economy. The key equilibrium condition is given by

$$\left(\tilde{q}_t + \tilde{k}_t - \tilde{n}_t\right) = \gamma_s \left(\mathbb{E}_t \tilde{r}^k_{t+1} - \tilde{r}_t\right) - \gamma_s \tilde{r}_t + \gamma_\phi \mathbb{E}_t \left(\tilde{q}_{t+1} + \tilde{k}_{t+1} - \tilde{n}_{t+1}\right),$$

where the parameters $\gamma_s, \gamma_\phi > 0$ are functions of λ. Whereas Bernanke et al. (1999) had a static financial friction, with the current credit spread proportional to current leverage, in this set up there is a dynamic financial friction with current leverage increasing in the weighted sum of future credit spreads. As in Kiyotaki and Moore (1997), there is no bankruptcy in equilibrium.

Applications and challenges

This section discusses the application of financial accelerator models to provide a narrative for the 2007-08 financial crisis and inform monetary and macroprudential policy design, as well as discussing further research challenges.

The financial accelerator and the 2007-08 financial crisis

The financial crisis was a watershed for the financial accelerator, providing a test case for existing theory and spurring new research. Adrian et al. (2013) assessed the ability of financial friction DSGE models to explain the 2007-08 financial crisis and concluded that models should be able to capture four stylized facts: i) Bank credit falling and credit spreads rising sharply, ii) bond finance increasing, taking up part of the bank credit supply shortfall, iii) bank equity remaining largely unchanged, and iv) bank leverage being highly procyclical.

The simple model described in the earlier section, and most models in the literature, capture stylized fact (i). Few papers, however, capture stylized fact (ii), largely because few explicitly model the choice of large firms between bond and bank financing. Adrian et al. (2013) showed that large firms heavily substituted the decline in bank credit with increased bond issuance. This facts helps to identify the collapse in economic activity as a contraction in credit supply by intermediaries rather than a contraction in credit demand by non-financial borrowers. Hence, models of Gertler and Karadi (2011) and Gertler and Kiyotaki (2010), focusing on financial intermediaries, provide a better description of the crisis than earlier models of Bernanke et al. (1999) and Kiyotaki and Moore (1997) focusing on entrepreneurs. However, in stylized models, frictions facing non-financial borrowers can be almost isomorphic to frictions facing intermediaries and entrepreneurs in many models can be relabelled "bankers" without much difficulty.

Adrian et al. (2013) argue that standard financial friction models having more difficulty matching stylized facts (iii) and (iv). To match stylized fact (iii) models have often introduced ad hoc costs for issuing bank equity. Stylized fact (iv), that bank leverage is procyclical, is largely at odds with most financial friction models as they generate countercyclical leverage. However, Gertler (2013) rejects (iii) and (iv) as criticisms of current financial accelerator models, arguing that if bank equity and leverage are measured in the data as in the models, then the discrepancy disappears. In models, equity is measured in terms of market values and is highly procyclical, resulting in a countercyclical leverage ratio. In the data, in contrast, equity and assets are measured using a mixture of book value and fair value accounting. And, during liquidity disruptions, even fair value accounting replaces market values with a "smoothed" value. Thus, bank equity in the data is less procyclical than actual market values would suggest, hence generating procyclical leverage ratios.

A related shortcoming of early generation financial accelerator models was an explanation for why borrowers in 2007 were so leveraged and so reliant on debt. With borrowers assumed to only issue debt in most models, the calibration of a model largely pins down the strength of the financial accelerator. Gertler et al. (2012) extended the model of Gertler and Karadi (2011) by allowing banks to endogenously choose both debt and outside equity financing.

Gertler et al. (2012) showed how changes in aggregate risk and macroprudential policy, while de Groot (2014) showed how changes in monetary policy, provides an explanation for the increased reliance of banks on short-term debt financing prior to the crisis and hence an endogenous explanation of why the financial accelerator at that time was so large.

Policy implications of the financial accelerator

The simple financial accelerator model sketched earlier showed technology and capital quality shocks generating inefficient economic fluctuations. An important policy question is whether monetary policy should directly respond to credit market conditions, or respond only in so far as credit market conditions affect output and inflation. Carlstrom et al. (2010), using a hold-up friction, and Fiore and Tristani (2013), using a costly state verification friction, showed, by deriving a utility-based quadratic loss function in a new-Keynesian DSGE model, that welfare is directly affected not just by the usual inflation and output gap volatility terms but also by a credit spread volatility term. However, the weight on the credit spread term in the welfare approximation is small from a quantitative perspective. Thus, outcomes in response to non-financial shocks would be close to optimal even if monetary policy took no direct account of credit market conditions. In response to technology shocks, near complete inflation stabilization remains optimal.

With financial shocks, more decisive movements in monetary policy are warranted. However, using monetary policy to offset movements in credit spreads may not be consistent with price stability. This motivates the potential benefits of a second, *macroprudential*, policy instrument with a financial stability mandate, allowing monetary policy to focus on price stability. Finding the right instrument and coordinating its use with monetary policy are important research questions. Potential instruments include time-varying loan-to-value ratios, liquidity requirements, and taxes on borrowing. De Paoli and Paustian (2013) study the coordination problem between monetary and macroprudential policy by deriving a utility-based quadratic loss function in a new-Keynesian DSGE model using a banking friction al a

Gertler and Karadi (2011). First, they showed that a macroprudential instrument improved outcomes irrespective of potential coordination problems. Second, they showed that while policy set cooperatively and under commitment is optimal, having one instrument act as leader can improve upon policy set non-cooperatively and under discretion (as long as the macroprudential instrument does not affect the economy in too similar a fashion to monetary policy).

Challenges for the financial accelerator

The financial accelerator remains an active area of research and recent contributions have challenged some of the basic assumptions employed in the literature. Dmitriev and Hoddenbagh (2014) and Carlstrom et al. (2016) note that the financial contract between entrepreneurs and banks, specified by Bernanke et al. (1999), was not optimal. First, the original contract assumed that entrepreneurs were myopic, maximizing profits today rather than expected discounted terminal net worth. Second, the contract (incorrectly) posited that households want a risk-free return. When the optimal lending contract is derived, with forward looking entrepreneurs and a state-contingent return for households, the financial accelerator largely disappears. In a similar vein, Candian and Dmitriev (2015) question the commonly used assumption that entrepreneurs are risk-neutral. First, they showed that risk-averse entrepreneurs are more consistent with cross-sectional data. Second, with risk-averse entrepreneurs, they showed that the strength of the financial accelerator was significantly reduced.

Another challenge for financial frictions models is that of identification—the ability to draw inference about the parameters of the model from data. It is usually possible to pin down two friction relevant parameters by matching steady state moments on leverage and credit spreads. However, insufficient information in time series data causes other parameters to be poorly identified. In estimated versions of Gertler and Karadi (2011), for example, the parameter that governs the life-expectancy of bankers is often arbitrarily set at around 10 years. Yet fixing troublesome parameters at arbitrary values can create distortions and lead to false models being selected. With this identification problem it is also difficult to test for time-variation in the strength of the financial accelerator.

A third challenge was brought by Chari et al. (2007). Applying a business cycle accounting framework in a canonical business cycle model with wedges, they concluded that the investment wedge—the wedge between the return on capital and the risk-free rate created by financial frictions—did not play a significant role in the Great Depression or postwar recessions, implying that financial accelerator models cannot account for a large share of business cycle dynamics. However, two more recent papers, Jermann and Quadrini (2012) and Christiano et al. (2014), argue that financial frictions combined with financial shocks do play an important role in US business cycles.

Jermann and Quadrini (2012) added a collateral constraint to non-financial borrowers in a quantitative DSGE model and studied the role of financial shocks—shocks to the fraction of assets that can be collateralized for borrowing, m. In line with the suggestion of Chari et al. (2007), Jermann and Quadrini (2012) assumed that firms' labour wage bill also requires financing. With this setup they found that financial shocks play an important role in economic fluctuations, largely because they drive the labour wedge in ways consistent with data. Christiano et al. (2014) estimate a quantitative DSGE model with a costly state verification problem and study the role of *risk* shocks—shocks to the standard deviation, σ, of entrepreneurs' idiosyncratic productivity shocks, $\log \omega$. They find that risk shocks can account for approximately 60% of US output growth fluctuations.

These two papers have shifted the focus from studying the role of the financial accelerator as an amplifier of standard technology and monetary policy shocks, to studying the role of shocks originating in the financial sector. The challenge remains to understand whether these new shocks are structural, originating in the financial sector, or are reduced form representations of important transmission channels lacking in current models.

Conclusion

The theoretical foundations of the financial accelerator mechanism and its qualitative implications are well established. Less agreement—and more scope for future research—exist regarding what are empirically the right financial shocks and frictions and what quantitatively is the role of the financial accelerator in business cycle fluctuations and financial crises. In addition, modelling occasionally binding credit constraints and the full nonlinear implications of financial frictions remains an exciting area of active research.

Oliver de Groot

Keywords

business cycles; calibration; dynamic macroeconomics; dynamic stochastic general equilibrium (DSGE) models; estimation; expectations; identification; intertemporal optimization problems; monetary policy shocks; technology shocks; linear models

Linked articles within the New Palgrave Dictionary of Economics

adjustment costs; calibration; credit cycle; great depression (mechanisms); great depression, monetary and financial forces in; liquidity constraints; Modigliani-Miller theorem; monetary business cycle models (sticky prices and wages); monetary transmission mechanism; real business cycles

JEL codes

C63, E32, E44, E52, G11

References

Adrian, T., P. Colla, and H. S. Shin (2013). Which Financial Frictions? Parsing the Evidence from the Financial Crisis of 2007 to 2009. *NBER Macroeconomics Annual 27*(1), 159–214.

Adrian, T. and H. S. Shin (2014). Procyclical leverage and value-at-risk. *Review of Financial Studies 27*, 373–403.

Bernanke, B. S. and M. Gertler (1989). Agency costs, net worth, and business fluctuations. *The American Economic Review 79*(1), 14–31.

Bernanke, B. S., M. Gertler, and S. Gilchrist (1996). The financial accelerator and the flight to quality. *The Review of Economics and Statistics 78*(1), 1–15.

Bernanke, B. S., M. Gertler, and S. Gilchrist (1999). The financial accelerator in a quantitative business cycle framework. Volume 1, Part C of *Handbook of Macroeconomics*, Chapter 21, pp. 1341–1393. Elsevier.

Brock, W. and L. Mirman (1972). Optimal economic growth and uncertainty: The discounted case. *Journal of Economic Theory 4*(3), 479–513.

Brunnermeier, M. K., T. Eisenbach, and Y. Sannikov (2013). Macroeconomics with financial frictions: A survey. In *Advances in Economics and Econometrics: Tenth World Congress*, Volume 2. New York: Cambridge University Press.

Candian, G. and M. I. Dmitriev (2015). Risk aversion and the financial accelerator. *Unpublished manuscript*.

Carlstrom, C. T., T. S. Fuerst, and M. Paustian (2010). Optimal monetary policy in a model with agency costs. *Journal of Money, Credit and Banking 42*, 37–70.

Carlstrom, C. T., T. S. Fuerst, and M. Paustian (2016). Optimal contracts, aggregate risk, and the financial accelerator. *American Economic Journal: Macroeconomics 8*(1), 119–47.

Chari, V. V., P. J. Kehoe, and E. R. McGrattan (2007). Business cycle accounting. *Econometrica 75*(3), 781–836.

Christiano, L. J. and D. Ikeda (2012). Government policy, credit markets and economic activity. *Unpublished manuscript*.

Christiano, L. J. and D. Ikeda (2013). Leverage restrictions in a business cycle model. *Unpublished manuscript*.

Christiano, L. J., R. Motto, and M. Rostagno (2014). Risk shocks. *American Economic Review 104*(1), 27–65.

de Groot, O. (2010). Coordination failure and the financial accelerator. *Unpublished manuscript*.

de Groot, O. (2014). The risk channel of monetary policy. *International Journal of Central Banking 10*(2), 115–160.

De Paoli, B. and M. Paustian (2013). Coordinating monetary and macroprudential policies. *Unpublished manuscript*.

Dmitriev, M. and J. Hoddenbagh (2014). The financial accelerator and the optimal lending contract. *Unpublished manuscript*.

Fiore, F. D. and O. Tristani (2013). Optimal monetary policy in a model of the credit channel. *The Economic Journal 123*(571), 906–931.

Fisher, I. (1933). The debt-deflation theory of great depressions. *Econometrica 1*(4), 337–357.

Gertler, M. (2013). Comment on "Which financial frictions? Parsing the evidence from the financial crisis of 2007 to 2009". *NBER Macroeconomics Annual 27*(1), 215–223.

Gertler, M. and P. Karadi (2011). A model of unconventional monetary policy. *Journal of Monetary Economics 58*(1), 17–34.

Gertler, M. and N. Kiyotaki (2010). Financial intermediation and credit policy in business cycle analysis. Volume 3 of *Handbook of Monetary Economics*, Chapter 11, pp. 547–599. Elsevier.

Gertler, M., N. Kiyotaki, and A. Queralto (2012). Financial crises, bank risk exposure and government financial policy. *Journal of Monetary Economics 59, Supplement*, 17–34.

Goldstein, I. and A. Pauzner (2005). Demand–deposit contracts and the probability of bank runs. *Journal of Finance 60*(3), 1293–1327.

Hart, O. and J. Moore (1994). A theory of debt based on the inalienability of human capital. *Quarterly Journal of Economics 109*(4), 841–79.

Iacoviello, M. (2005). House prices, borrowing constraints, and monetary policy in the business cycle. *The American Economic Review 95*(3), pp. 739–764.

Jermann, U. and V. Quadrini (2012). Macroeconomic effects of financial shocks. *The American Economic Review 102*(1), 238–271.

Keynes, J. M. (1936). *General theory of employment, interest and money*. London: Macmillan.

Kindleberger, C. P. (1978). *Manias, panics and crashes: a history of financial crises*. New York: Basic Books.

Kiyotaki, N. and J. Moore (1997). Credit cycles. *Journal of Political Economy 105*(2), 211–248.

Minsky, H. P. (1992). The financial instability hypothesis. *Unpublished manuscript*.

Modigliani, F. and M. Miller (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review 48*(3), 261–297.

Quadrini, V. (2011). Financial frictions in macroeconomic fluctuations. *FRB Richmond Economic Quarterly 97*(3), 209–254.

Townsend, R. (1979). Optimal contracts and competitive markets with costly state verification. *Journal of Economic Theory 21*(2), 265–93.

Vlcek, M. J. and M. S. Roger (2012). Macrofinancial modeling at central banks: Recent developments and future directions. *Unpublished manuscript*.