



The role of bank capital in the propagation of shocks

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ABSTRACT

The recent financial turmoil has underlined the importance of analyzing the link between banks' balance sheets and economic activity. We develop a dynamic stochastic general equilibrium model in which bank capital mitigates an agency problem between banks and their creditors. As a result, the capital position of banks affects their ability to attract loanable funds and therefore influences the business cycle through a bank capital channel of transmission. We find that the bank capital channel greatly amplifies and propagates the effects of technology shocks on output, investment and inflation. Moreover, bank capital shocks create sizeable declines in output and investment.

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1. Introduction

The balance sheets of banks worldwide have recently come under stress, as significant asset writedowns led to sizeable reductions in bank capital. These events have generated a 'credit crunch', in which banks cut back on lending and firms found it harder to obtain external financing. Concerns have been raised that these adverse financial conditions will continue to undermine economic activity, much like shortages in bank capital slowed down recovery from the 1990 to 1991 recession (Bernanke and Lown, 1991). This has sustained interest for quantitative business cycle models that can analyze the interactions between bank capital dynamics and the business cycle.

However, the balance sheets of banks and bank capital are absent from most of the recent contributions in developing dynamic stochastic general equilibrium (DSGE) models with financial frictions (Bernanke et al., 1999; Christiano et al., 2008; Iacoviello, 2005; Kiyotaki and Moore, 1997). As a result, these models imply that lending by banks is unaffected by their capital position. This constitutes a limitation of current quantitative models of financial frictions and is in contradiction with an important body of evidence suggesting that bank capital affects bank lending and economic activity.¹

Our paper develops a DSGE model with a banking sector in which bank capital emerges endogenously to solve an asymmetric information problem between bankers and their creditors. Because of this problem, the capital position of a

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¹ For example, Peek and Rosengren (1997, 2000) show that decreases in the capitalization of Japanese banks in the late 1980s had adverse effects on economic activity in regions where these banks had a major presence. Moreover, bank-level data (Kishan and Opiela, 2000; Van den Heuvel, 2007) indicate that poorly capitalized banks reduce lending more significantly following monetary policy contractions. Finally, Van den Heuvel (2002) shows that U.S. states whose banking systems are less capitalized are more sensitive to monetary policy shocks.

bank affects its ability to attract loanable funds and, as a result, bank capital influences the business cycle through a *bank capital channel* of transmission. We incorporate this channel of transmission in a medium-scale version of the New Keynesian paradigm, in the spirit of Christiano et al. (2005) and Smets and Wouters (2007). Our paper thus enables this type of modeling, widely used for monetary policy analysis, to account for the role of bank capital in the propagation of shocks.

In the model, investors lack the ability to monitor the economy's entrepreneurs and thus do not lend directly. Instead, they deposit funds at banks, to whom they delegate the task of monitoring entrepreneurs. However, banks may not monitor adequately, since doing so is costly and not publicly observable, and any resulting risk in their loan portfolio would be mostly borne by investors. This moral hazard problem is mitigated when banks invest their own net worth (their capital) in entrepreneurial projects, so that they also have a lot to lose from loan default.² In our model, therefore, the capital position of banks affects their ability to attract loanable funds, finance entrepreneurs and sustain economic activity. A second source of moral hazard, affecting the relationship between banks and entrepreneurs, is present in the model and implies that the dynamics of entrepreneurial net worth also influence the economy. This double moral hazard framework, introduced in Holmstrom and Tirole (1997) and Chen (2001), thus allows for a rich set of interactions between bank capital, entrepreneurial net worth, and economic activity.

The bank capital channel propagates shocks as follows. A negative technology shock, for example, reduces the profitability of bank lending, making it harder for banks to attract loanable funds. Banks must therefore finance a larger share of entrepreneur projects from their own net worth (their capital), which requires an increase in their capital-to-loan (or capital adequacy) ratio. Since bank capital mostly consists of retained earnings, it cannot adjust immediately and bank lending falls, along with aggregate investment. These initial declines propagate the shock to future periods, because lower investment depresses bank earnings, which translates into lower bank capital in future periods and thus further decreases in aggregate investment.³

The main findings of our paper are as follows. First, impulse response functions show that the presence of an active bank capital channel amplifies and propagates the effects of shocks on output, investment and inflation. The strength of this effect depends on the nature of the shock: it is stronger for technology shocks (i.e. supply shocks) and more limited for monetary policy shocks (i.e. demand shocks). We also show that when the bank capital channel is active, an economy with more bank capital is better able to absorb negative shocks than an economy with less bank capital. Since our model contains several features in addition to financial frictions, such as habit formation in household consumption, price and wage rigidities, and variable capital utilization in production, these results indicate that accounting for the role of bank capital is important when building medium-scale models for business cycle and monetary policy analysis.

Our second finding is that a financial shock, which causes exogenous decreases in bank capital, leads to sizeable declines in bank lending, investment and output. This shows that banks can not only amplify and propagate shocks, but can also be an independent source of shocks with important consequences for real economic activity.

Our third finding is that the cyclical properties of the model are broadly similar to those of the data over key aspects. More specifically, the influence of the bank capital channel manifests itself in counter-cyclical patterns in the capital adequacy ratios, and we document that these patterns match those in the data, providing an important validation of our framework.

An independent work that is closely related to our paper is from Aikman and Paustian (2006), who also use the double moral hazard framework of Holmstrom and Tirole (1997) and Chen (2001). Our paper and the one by Aikman and Paustian are different, however, and make complementary contributions. We differ in terms of modeling and also in terms of the question. On the modeling side, the papers differ in two important aspects. First, we introduce financial frictions (i.e. the double moral hazard problem) in the sector producing capital goods, which can increase the impact of the frictions on the economy because it makes them interact with intertemporal saving decisions (Carlstrom and Fuerst, 1998). Second, we combine the double moral hazard problem with a medium-scale model, consistent with recent literature on New Keynesian models (Christiano et al., 2005), to verify that it remains an important channel of propagation even in larger models. Our paper and the one by Aikman and Paustian are also different in terms of the question. As discussed above, our findings single out the specific role played by the bank capital channel in the transmission of shocks, while Aikman and Paustian's objective is to characterize optimal monetary policy in a New Keynesian model with bank capital.

Other related work includes Van den Heuvel (2008), in which the dynamics of bank capital also influence bank lending and economic activity, but where bank capital is motivated by regulatory requirements⁴; Meh and Moran (2004), in which monetary non-neutralities arise from limited participation rather than nominal rigidities, and Markovic (2006), in which financial frictions arise within a costly state verification framework. Finally, recent papers by Goodfriend and McCallum (2007), Christiano et al. (2008) and Cúrdia and Woodford (2008) analyze banking in dynamic models but do not emphasize bank capital.

The remainder of this paper is organized as follows. Section 2 describes the model and Section 3 discusses the model's calibration. Section 4 presents our main findings and Section 5 provides a sensitivity analysis. Section 6 concludes.

² Throughout, we use the terms 'bank net worth', 'bank capital', or 'bank equity' interchangeably.

³ The dynamics of entrepreneurial net worth reinforce the bank capital channel by creating the 'financial accelerator' discussed in the literature (Carlstrom and Fuerst, 1997; Bernanke et al., 1999).

⁴ Recent papers by Dib (2009) and Gerali et al. (2009) also motivate bank capital from exogenous regulatory requirements.

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