Bank Balance Sheets, Deleveraging and the Transmission Mechanism

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- *The depletion of bank capital and the subsequent deleveraging by banks played an important role in the severity of the recent global financial crisis.*
- *The bank-capital channel—the endogenous response of bank capital to economic developments—can magnify and propagate monetary policy actions and other shocks. The strength of this amplification depends on the banking system's capitalization: the less capitalized the banking system is, the more bank lending, output and inflation respond to shocks.*
- *While effective capital regulation will increase the resilience of the banking sector to economic shocks, it will also affect the monetary policy transmission mechanism. In particular, the stabilization of an economy with a better-capitalized banking system will require less-aggressive movements in the policy rate. Moreover, achieving the stabilization benefits of countercyclical capital buffers requires proper coordination with monetary policy.*

The recent global financial crisis underscored the important role of banks and other financial institutions in transmitting and amplifying economic and financial shocks. The responses of banks, especially in the United States and Europe, to substantial decreases in their capital positions helped to turn the initial shock to the U.S. subprime-mortgage market into a global cataclysm.[1] These forces, which peaked after the failure of Lehman Brothers, are viewed as key determinants in the collapse of aggregate expenditure in the autumn of 2008 and the resulting large contraction in employment and output. Understanding these phenomena and their implications for public policy is important and requires the use of a macroeconomic framework in which financial intermediation matters for resource allocation.

This article investigates the influence of bank capital on economic fluctuations, using a macroeconomic framework that incorporates an explicit role for financial intermediation. The analysis focuses on the role of bank capital in the amplification and propagation of shocks and examines how weaker bank balance sheets can make an economy more vulnerable to adverse shocks. It also studies how new macroprudential initiatives such as countercyclical capital buffers—whose purpose is to make the banking sector more resilient to stress—will affect the transmission mechanism of monetary policy and other shocks to the real economy.

The first section of the article summarizes the macroeconomic models of Meh and Moran (2010) and Christensen, Meh and Moran (2010) that incorporate a banking sector. The second section shows how endogenous movements in bank capital—the bank-capital channel (see **Box**)—can amplify and

1 Note that the loss of liquidity in financial markets also contributed to the severity of the crisis.

propagate shocks to output and inflation. The third and fourth sections respectively examine how the transmission of shocks depends on the capitalization of the banking system and how financial shocks originating in the banking sector can substantially affect the real economy. The fifth section illustrates the important implications that countercyclical capital buffers could have for the transmission and the magnification of shocks.[2] The last section concludes by highlighting areas where further research is needed. Indeed, this article abstracts from elements, such as boom-bust dynamics and associated non-linearities that may be important in the discussion of the relationship between bank balance sheets and the transmission mechanism. The article should therefore be viewed as a useful first step in understanding the interaction between bank capital and the transmission mechanism, as well as the implications of countercyclical capital buffers for monetary policy.

A Macroeconomic Framework with Banking

This section outlines the macroeconomic framework with banking that is used to analyze the role of bank capital in economic fluctuations. This framework, based on Meh and Moran (2010) and Christensen, Meh and Moran (2010), is particularly suited to this exercise since the condition of bank balance sheets is determined endogenously through the important role of bank capital in mitigating asymmetric-information problems between bankers and their creditors.[3]

The model includes several nominal and real frictions, in the spirit of standard New Keynesian models (Christiano, Eichenbaum and Evans 2005).[4] Households choose their consumption and leisure to maximize expected lifetime utility and deposit their savings in banks.[5] Monopolistically competitive firms use capital and labour to produce differentiated intermediate goods and face sticky prices. These differentiated intermediate goods are then assembled by competitive firms to obtain the final good. Monetary policy is assumed to follow a Taylor rule with interest rate smoothing. Such a rule stipulates that the monetary authority adjusts the policy rate gradually in response to deviations of the inflation rate from the target and the output gap.

Entrepreneurs require external funds to make investments. As a result, banks intermediate funds between households (dispersed depositors, the ultimate lenders) and firms (entrepreneurs, the ultimate borrowers).[6] This intermediation process, however, is complicated by two sources of moral hazard. The first affects the relationship between banks and firms and arises because firms may choose to invest in risky projects that yield private benefits but have a low probability of success. The second source of moral hazard pertains to the relationship between banks and households, and stems from the fact that banks (to which households delegate the monitoring of firms) may not monitor appropriately, since monitoring is costly and not publicly observable.

The solution to the model involves an optimal configuration of financial contracts under asymmetric information, building on the seminal work of Holmstrom and Tirole (1997).[7] Banks spend resources to monitor the behaviour of firms and require that firms invest their own funds (net worth) in projects. In turn, a higher level of bank capital lessens the moral-hazard problem between banks and depositors, and thus the banking sector faces less-stringent conditions in its funding market. Since raising new bank capital is costly (see **Box**), bank capital is determined, in the short run, primarily by retained earnings (internal funds).

In Meh and Moran (2010), the capital-asset ratio necessary to mitigate the asymmetric-information problems is determined solely through market discipline. In contrast, Christensen, Meh and Moran (2010) allow for an exogenous regulatory capital requirement that can be time varying to increase the resilience of the banking system. The model can therefore accommodate countercyclical capital buffers (such as those in Basel III) whereby banks are required to maintain a higher capital-asset ratio in good times than in bad times. Under such a rule, banks can draw down their

2 Boivin, Kiley and Mishkin (2010) examine the evolution of the monetary policy transmission mechanism over time.

3 This model was used to contribute to policy debate at the Bank for International Settlements (BIS 2010) and the Bank of Canada (Bank of Canada 2010).

4 Following the crisis, many papers emerged to take into account the balance sheets of banks in New Keynesian models. See, for example, Dib (2010); Van den Heuvel (2008); Angelini, Neri and Panetta (2011); and Gertler and Karadi (2011). Also see de Resende and Lalonde (this issue) for the use of the Bank of Canada Global Economic Model augmented with banking (BoC-GEM-Fin) and Aikman and Vlieghe (2004).

5 In the model, households do not face financial frictions. Examples of models where households face collateral constraints include Iacoviello (2005) and Christensen (this issue). Building models that feature both bank capital and household balance sheets is left for future research.

6 The present framework focuses on the traditional loan book and not on capital-market activities.

7 This optimal financial contract stems from a principal-agent problem featuring a moral-hazard issue, in that bank actions are not publicly observable. Because of this asymmetric information, the Modigliani-Miller theory does not hold in the model.

The Bank-Capital Channel: An Illustration

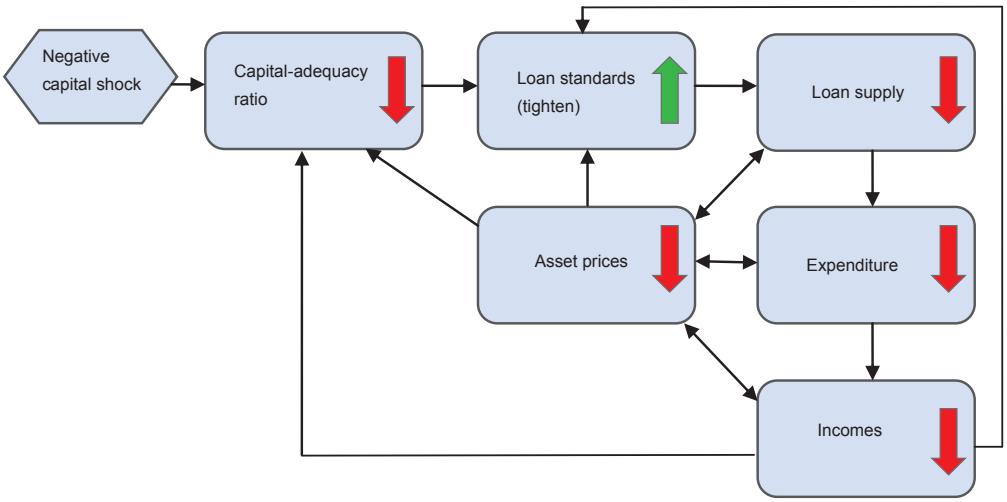
The bank-capital channel is the channel through which monetary policy actions or other shocks affect bank lending by their impact on bank capital. Van den Heuvel (2007a) was one of the first authors to highlight this channel in the context of the monetary policy transmission mechanism. Shocks to aggregate demand and supply, as well as conditions in real estate markets, may influence loan losses (or loan values) and, if not buffered by profits, can affect the level of bank capital. Adverse (favourable) shocks to the balance sheets of banks or financial institutions can entail sharp contractions (expansions) in credit, which can in turn magnify the effects of such shocks on output and inflation (**Figure A**). For example, after negative shocks, banks deleverage by reducing bank lending, which is achieved by tightening their loan standards and increasing credit spreads.

Two broad factors contribute to the strength of this channel. First, some borrowers are highly dependent on banks or financial institutions for credit. This dependence implies that if the supply of bank loans is severely disrupted, these borrowers face sizable difficulties and costs in finding and forming relationships with new lenders, and must therefore curtail their expenditures. The second factor is the difficulty that banks face in trying to fully insulate their supply of lending in response to such shocks, given the difficulty of raising capital, especially in times of financial stress. The costs of raising capital can come, for example, from adverse-selection problems and possible pecuniary costs associated with share purchases and equity issuances (Jermann and Quadrini forthcoming).

The bank-capital channel resembles the theory of the financial-accelerator mechanism (Bernanke, Gertler and Gilchrist 1999; Kiyotaki and Moore 1997). But they are inherently different: the bank-capital channel focuses on how the balance sheets of banks constrain the supply of credit, while the financial-accelerator mechanism focuses on how the balance sheets of the ultimate borrowers constrain the amount they are able to borrow.

Although this article does not aim to explain the recent subprime-mortgage market crisis, it is interesting to observe that the bank-capital channel studied here can qualitatively replicate some of the broad dynamics of the recent crisis. For example, the fall in the perceived quality of banks causes a prolonged deterioration in bank capital, a tightening of loan standards, a rise in credit spreads, a fall in bank lending, and a subsequent persistent drop in output. The model, however, is silent on the role of liquidity problems in the severity of the crisis.

Figure A: Illustration of how a shock to bank capital affects the economy



Source: Adapted from Bayoumi and Melander (2008)

capital when negative shocks arise and continue operating with less pressure to reduce assets. In the exercises that follow, the time-varying capital requirement is adjusted in response to the credit gap (deviation of private credit-to-GDP ratio from its long-run trend). The Basel Committee on Banking Supervision recently advocated the credit gap as a useful indicator of financial vulnerability.[8]

The Importance of the Bank-Capital Channel in the Amplification and Propagation of Shocks

To isolate the role of bank capital in the transmission of shocks we conduct a hypothetical policy experiment, comparing the economic responses following adverse economic shocks under two scenarios. The first scenario features an active bank-capital channel, where endogenous movements in bank capital affect the amount of loans made.[9] The second scenario is similar to the first, except that the bank-capital channel is turned off by removing the asymmetric-information problem between bankers and their creditors. In this experiment, the capital requirement is market determined (Meh and Moran 2010). The results of this policy experiment are illustrated in **Chart 1**, which presents the effects of a one-standard-deviation adverse shock to productivity.[10]

Based on a reasonable calibration, the key result is that the bank-capital channel amplifies and propagates the effect of shocks on output, investment, bank lending and inflation. Indeed, when the bank-capital channel is active, the peak decline in bank lending is twice as large, and the decline in output is much more pronounced. Further, the adverse productivity shock has longer-lasting effects on the economy: under an active bank-capital channel, it takes about 13 quarters for the impact of the shock on bank lending and output to bottom out, as opposed to 8 quarters otherwise. Moreover, the upward pressure on inflation that typically results from an adverse productivity shock is markedly higher when the bank-capital channel is present than when it is not. This is because the decrease in bank lending is greater in the presence of the bank-capital channel, and this in turn compounds the effects on output and inflation. These results are broadly consistent with empirical evidence.[11]

The bank-capital channel amplifies and propagates the effect of shocks on output, investment, bank lending and inflation

The amplification of shocks through the bank-capital channel results primarily from the emergence of feedback effects. After a disturbance that causes a decrease in economic performance, such as a productivity shock, an adverse feedback loop emerges, where falling profitability and asset values lead to increased loan losses in the banking sector. The loan losses cause a decline in bank capital, leading the banking sector to face more-stringent conditions in its own funding markets. This disruption in financial intermediation leads to a further drop in output, investment and asset prices.

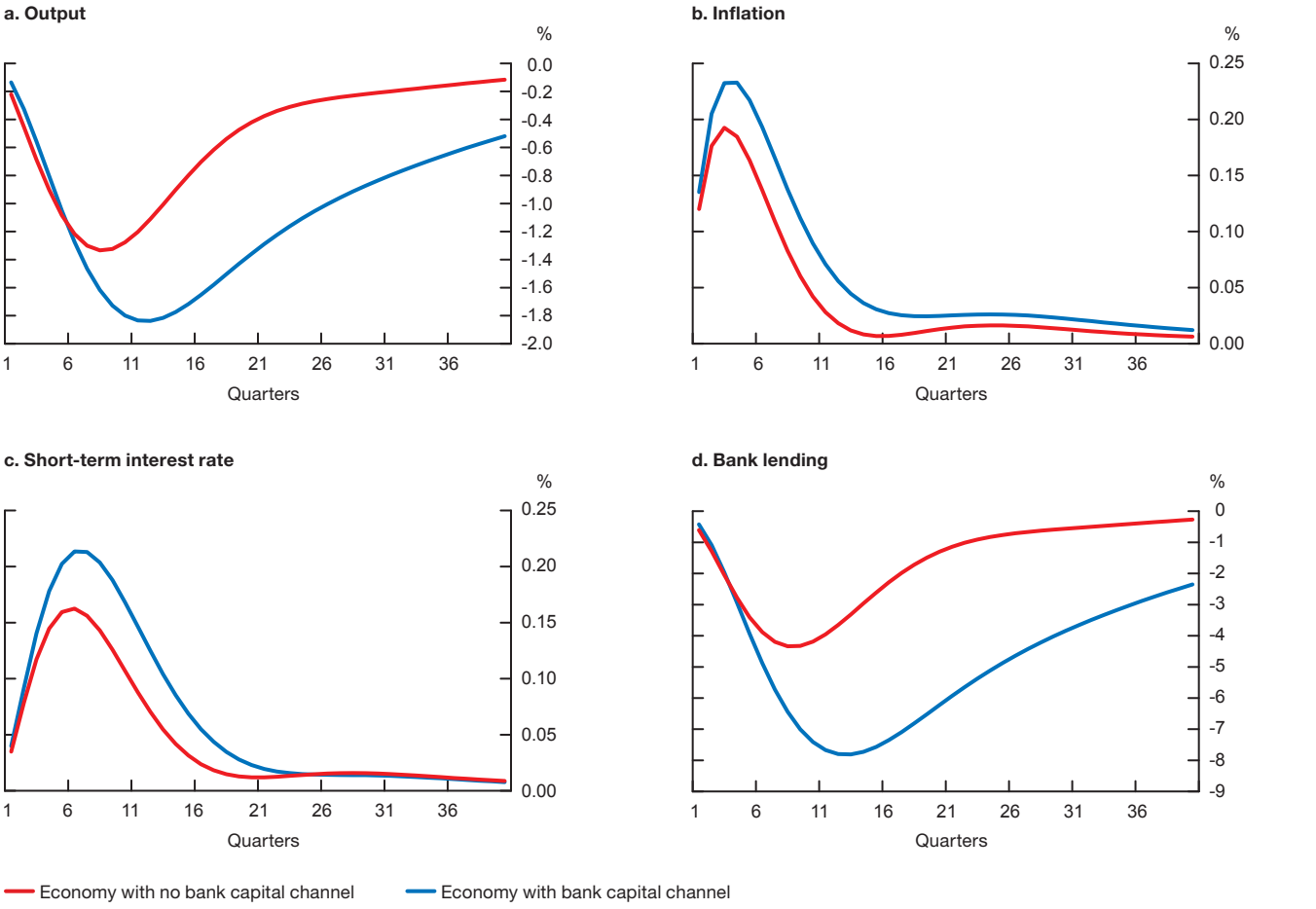
8 For simplicity, the countercyclical capital buffers in the model depend only on the credit gap. In practice, they may depend on other variables, such as asset prices and credit spreads, and be activated only occasionally (Chen and Christensen 2010).

9 This is the baseline economy in Meh and Moran (2010). The monitoring cost, which dictates the degree of asymmetric information between bankers and their creditors, is calibrated to be in the range of the estimate of the ratio of bank operating costs to bank assets for developed economies (Erosa 2001). For further details on the calibration, see Meh and Moran (2010).

10 The size of the shock measured in percentage points is the same under the two scenarios. The monetary policy rule is assumed to remain the same under the two scenarios.

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

Chart 1: Economic response to an adverse productivity shock in the presence of the bank-capital channel
Deviation from steady state



Source: Adapted from Meh and Moran (2010)

The Impact of a Shock to Bank Capital on Economic Activity

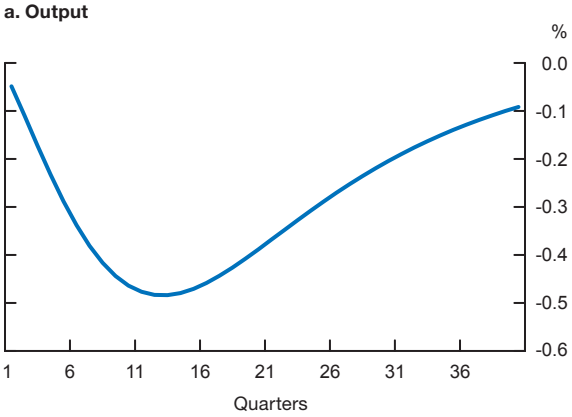
We now consider the effects of a financial shock that decreases the net worth of banks. Such a shock could result from a fall in the perceived quality of their assets (Gertler and Karadi 2011). In the following experiment, the size of the shock is a 5 per cent decline in asset quality to roughly match the broad dynamics of the U.S. subprime-mortgage shock. The results are displayed in **Chart 2**.

The key finding from this policy experiment is that shocks originating in the banking sector can have significant and long-lasting macroeconomic effects. As illustrated in **Chart 2**, the sudden deterioration of bank capital causes a decline in banks' capital-asset ratios. To restore these ratios to their targeted levels, banks endogenously deleverage by tightening loan standards, which leads to a decrease in lending.

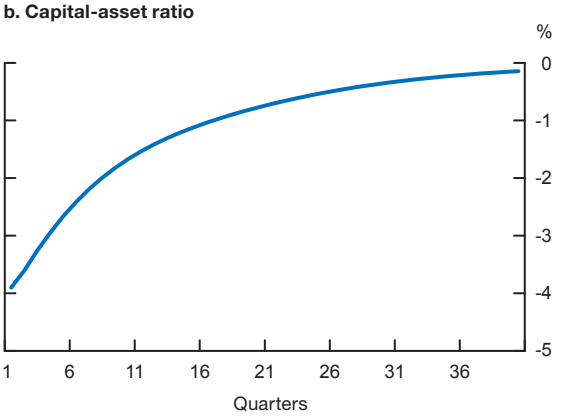
The resulting "credit crunch" directly affects investment expenditure within the economy, and asset prices come under pressure. The reduction in investment spending and asset prices leads to a reduction in incomes (household income, aggregate output and business profits) through standard economic multiplier effects and wealth effects. These negative impacts then affect loan values and bank capital, sparking a further round of deleveraging. Thus, because of this adverse feedback loop, the final effect of a negative shock to banks' balance sheets on aggregate economic activity can be significantly and persistently larger than the initial direct effect.

Chart 2: Economic response to a negative shock to bank capital
Deviation from steady state

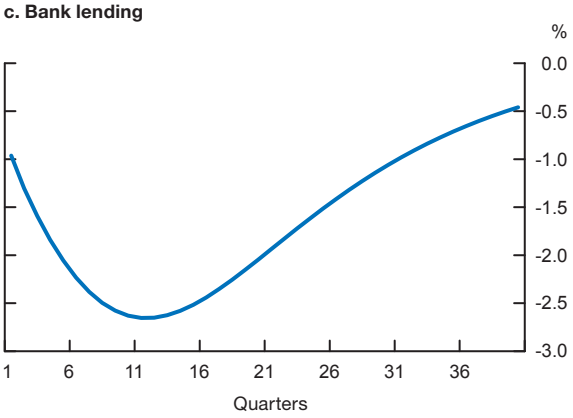
a. Output



b. Capital-asset ratio



c. Bank lending



Source: Adapted from Meh and Moran (2010)

Economic Response to Shocks and the Capitalization of the Banking System

The previous sections show that endogenous movements in bank capital amplify and prolong the adverse effects of shocks on the economy. The following question then emerges: Can a high level of bank capital mitigate this amplification mechanism when the bank-capital channel is active?

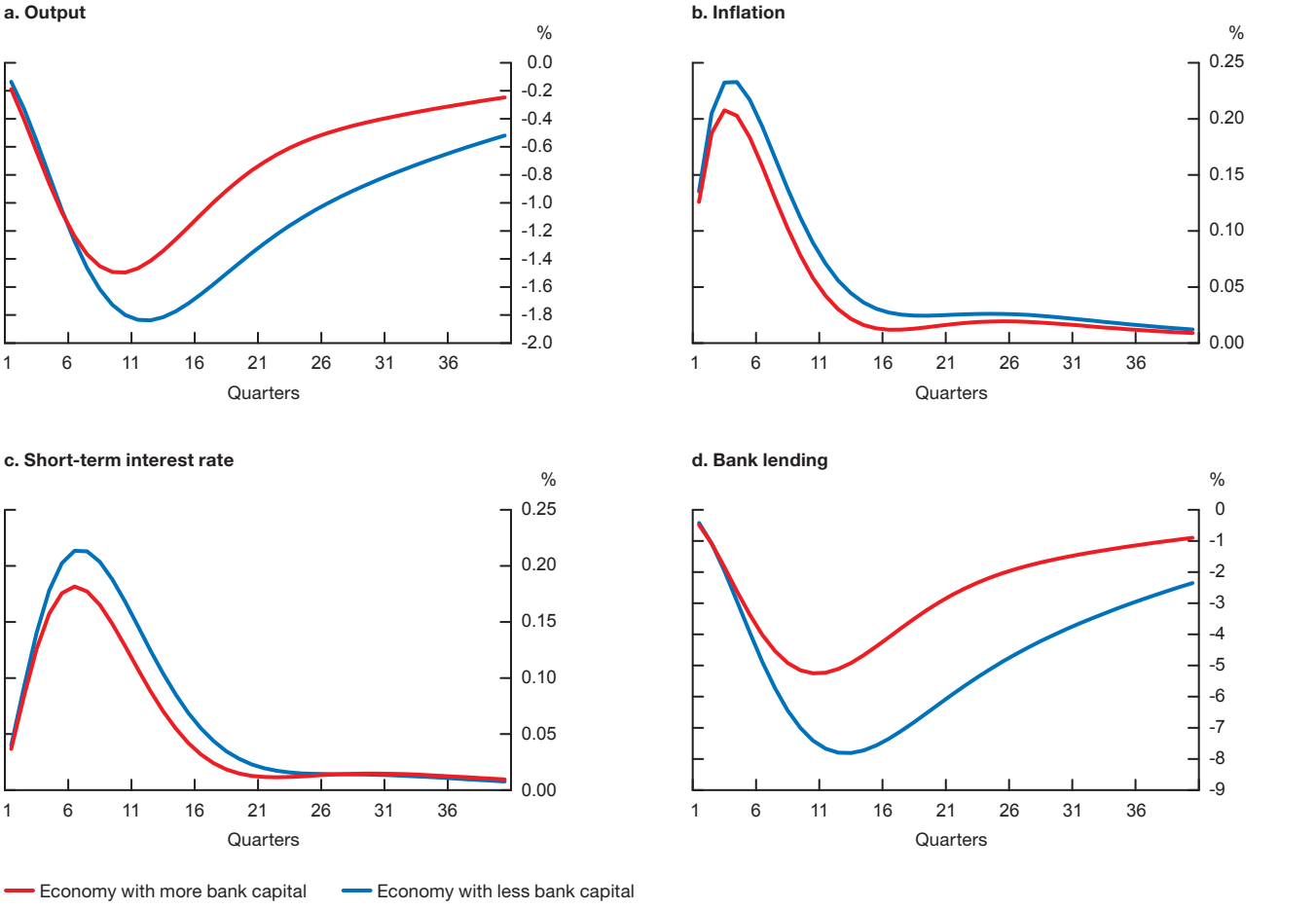
To examine this question, we conduct a third policy experiment, contrasting the responses to shocks when the banking sector has more capital with those when the banking sector has less capital (baseline in the previous sections). The capital-asset ratio in the banking sector with more capital is set exogenously to be twice as large as that in the banking sector with lower capital.[12] The monetary policy rule is still assumed to be the same for both scenarios. From the results reported in **Chart 3**, the outcome is clear: an economy with a banking system that has more capital is better able to absorb the adverse effects of shocks on bank lending, output and inflation. As illustrated in **Chart 3**, this is because the drop in bank lending after the shock is much smaller in the economy with abundant bank capital. When the banking system has more capital, bank lending and output tend to fall by about 5.2 per cent and 1.5 per cent, respectively, while the fall in bank lending is about one and a half times greater and the decline in output increases to about 1.8 per cent when the banking system is less capitalized.

An economy with a banking system that has more capital is better able to absorb the adverse effects of shocks on bank lending, output and inflation

This finding suggests that higher capital makes the banking sector more resilient to stress and helps dampen the inherent procyclicality of the banking system and broader economic cycles.

12 In this hypothetical case, the banking system is exogenously given capital for a given degree of asymmetric information between banks and their creditors. See Meh and Moran (2010) for a description of this experiment.

Chart 3: Effects of bank capital on the economic response to an adverse productivity shock
Deviation from steady state



Source: Adapted from Meh and Moran (2010)

Countercyclical Capital Buffers and the Transmission Mechanism of Monetary Policy and Other Shocks

The experiments discussed above illustrate that the amplification and propagation effects of the bank-capital channel can be mitigated when the banking system is better capitalized. These results are interesting, since the countercyclical capital buffers approved under Basel III are intended to reduce the procyclicality of the banking system. In doing so, however, countercyclical capital buffers will undoubtedly affect the behaviour of the financial system and, hence, alter the monetary transmission mechanism as well.[13] This section analyzes how countercyclical capital buffers are likely to affect the transmission mechanism of shocks.[14]

In principle, countercyclical capital buffers can have two benefits. First and foremost, they can make financial crises less frequent and less severe if they do occur (BCBS 2010a; Bank of Canada 2010). Second, they can help dampen economic cycles.[15] Since Christensen, Meh and Moran (2010) abstract from modelling the endogenous occurrence of crises, this article focuses only on the second benefit. In the experiments that follow, we

13 Caruana (2011) discusses the conduct of monetary policy in a world with macroprudential policy.
14 Boivin, Lane and Meh (2010) use the same model to examine whether monetary policy should be used to lean against the buildup of imbalances.
15 Carney (2011) reviews the benefits of countercyclical capital buffers and Basel III.

assume that countercyclical capital requirements can range within plus or minus 2 percentage points around a steady-state capital-asset ratio equal to 10 per cent.[16] Then, holding the monetary policy rule unchanged, we compare outcomes in an economy with and without countercyclical capital buffers.

Results suggest that the extent to which countercyclical capital buffers affect the transmission mechanism depends on the nature of the shocks hitting the economy

Results from our model-based simulations suggest that the extent to which countercyclical capital buffers affect the transmission mechanism depends on the nature of the shocks hitting the economy. Consider, for instance, (demand-type) financial shocks that generate simultaneous downward pressures on inflation and credit contractions. An example of such a shock is the exogenous negative shock to bank capital discussed earlier. In this case, countercyclical capital buffers and monetary policy reinforce each other to simultaneously achieve macroeconomic and banking stability. This is illustrated in **Chart 4**. Countercyclical capital buffers help to dampen the decline in bank lending; therefore, a smaller decrease in the interest rate is needed to stabilize inflation and output than in the case with no countercyclical capital buffers. This arises since bank lending, output and inflation all move in the same direction in response to the financial shock. As a result, the policy actions required to stabilize the economy are associated with a loosening of both the countercyclical capital buffer and monetary policy. There is thus no inherent trade-off between countercyclical capital buffers and monetary policy when the underlying financial shocks act like demand-type shocks.

However, when the underlying shocks affecting the economy are (supply-type) financial shocks that cause credit contractions and upward inflation pressures, the effort to stabilize the banking system through countercyclical capital buffers may pose some challenges to the price-stability objective. For instance, excessive pessimism about future productivity could lead to credit contractions while, at the same time, putting upward pressures on inflation (Lorenzoni 2008). This is illustrated in **Chart 5**. Stabilizing credit growth after an adverse productivity shock therefore calls for a looser countercyclical capital buffer. But loosening the countercyclical buffer puts additional upward pressure on inflation, making it even harder for monetary policy to control inflation.[17] Indeed, in this case, **Chart 5** shows that, in the presence of countercyclical buffers, the interest rate must be increased more aggressively to combat inflation than in a world without countercyclical capital buffers.

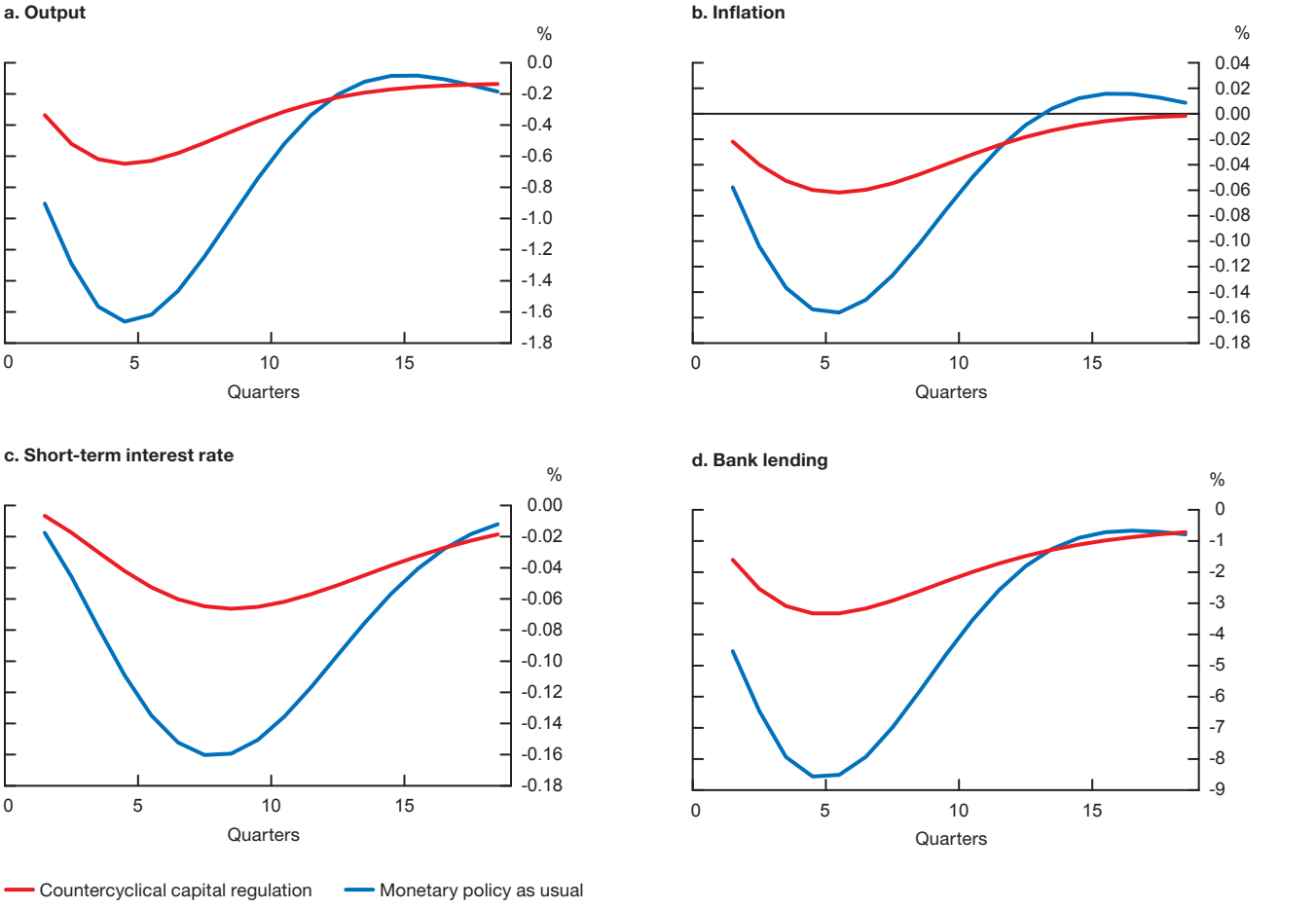
Overall, these results suggest that the impact of countercyclical capital buffers on the transmission mechanism of monetary policy and, consequently, the nature of the coordination between these two tools, depend on the nature of the shocks experienced by the economy. Demand-type financial shocks pose no inherent trade-offs between stabilizing credit and achieving price stability. In this case, the use of countercyclical capital buffers eases the pressure on monetary policy, and less-aggressive movements in the interest rate would be required to achieve economic stability. Supply-type financial shocks, however, can generate a tension between stabilizing credit and price stability. In this case, activating countercyclical capital buffers could make it harder to stabilize inflation, and more-aggressive movements in the interest rate would be required. Under such circumstances, proper coordination between the two policy instruments will lead to a better policy outcome.[18]

16 This range is broadly in line with the range of 0 to 2.5 per cent for the countercyclical capital buffer recently announced by the regulators (BCBS 2010b).

17 Loosening the countercyclical capital buffer can cause additional inflation because such loosening increases credit, which, in turn, leads to a rise in aggregate demand, causing a further rise in inflation.

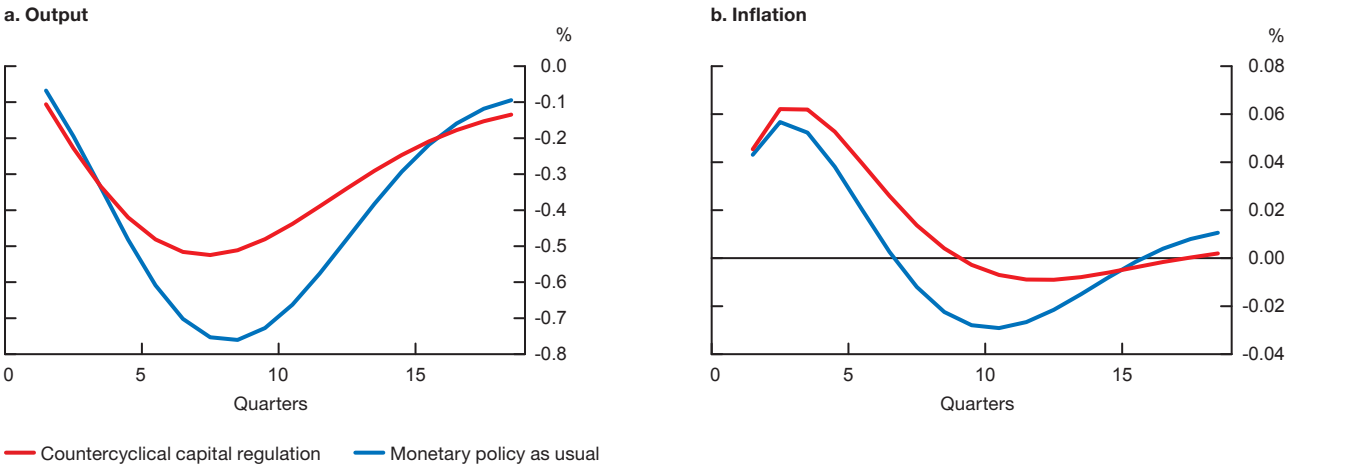
18 Countercyclical capital buffers should be considered neither a substitute for monetary policy nor an all-purpose stabilization instrument. Rather, they should be viewed as a useful complement to monetary policy in a world in which financial shocks have become an important source of economic fluctuations.

Chart 4: Effects of countercyclical capital requirements following a negative shock to bank capital
Deviation from steady state



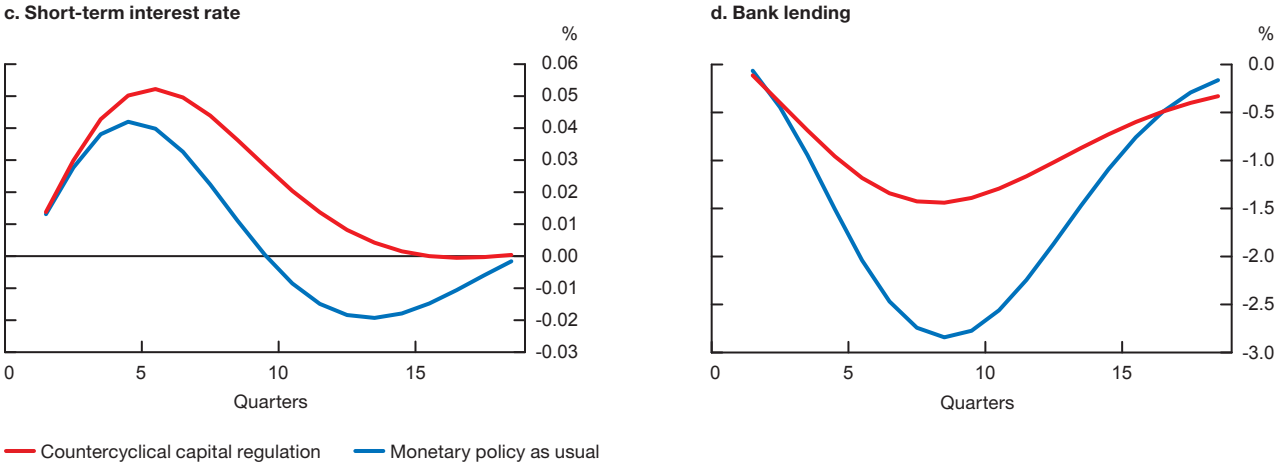
Source: Adapted from Christensen, Meh and Moran (2010)

Chart 5: Effects of countercyclical capital requirements following an adverse productivity shock
Deviation from steady state



Source: Adapted from Christensen, Meh and Moran (2010)

Chart 5: Effects of countercyclical capital requirements following an adverse productivity shock (cont'd)
Deviation from steady state



Source: Adapted from Christensen, Meh and Moran (2010)

Conclusion

The depletion of bank capital and the subsequent deleveraging by banks played an important role in the severity of the recent global financial crisis. To understand the mechanism behind these phenomena, this article presents a simple macroeconomic framework in which bank capital emerges as the solution to an asymmetric-information problem between banks and their creditors. One finding is that a more-capitalized banking system is better able to absorb the effects of shocks on bank lending and the economy. Furthermore, countercyclical capital buffers can increase the resilience of the banking system to adverse shocks, but, in doing so, they also alter the transmission mechanism of shocks and monetary policy to the broader economy.

Although the research discussed in the article provides important policy insights, it also abstracts from elements that can be important in understanding the role of bank capital in the transmission mechanism, as well as the implications of countercyclical capital buffers for monetary policy. Further research will be needed to improve our understanding of these issues. For example, more work is required on introducing crisis dynamics and the resulting non-linearities in macroeconomic models.[19] Another area that needs further work is the interaction between various macroprudential tools and their implications for monetary policy and the transmission mechanism. For instance, what are the interactions between countercyclical capital buffers and more-targeted macroprudential instruments, such as the loan-to-value ratio for mortgages? And what are the implications of such interactions for monetary policy? Finally, another important area of future research will be to improve our understanding of the determinants of liquidity and of the interaction between liquidity and the capital positions of financial intermediaries.

19 Woodford (2010) took an interesting first step by introducing an endogenous probability of crisis in standard macroeconomic models. This reduced-form probability of crisis depends on leverage. See also Brunnermeier and Sannikov (2011) who examine endogenous risk taking in a macroeconomic model with banking.

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