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Kevin T Jacques, Baldwin-Wallace College
David Schirm, John Carroll University

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By

Kevin T. Jacques
Senior Financial Economist
Office of Financial Institutions Policy
Department of the Treasury
1500 Pennsylvania Avenue, N.W.
Washington, D.C. 20220
Phone: (202) 622-1219
Fax: (202) 622-0256
E-mail: kevin.jacques@do.treas.gov

and

David C. Schirm
Associate Professor of Finance
Department of Economics & Finance
John Carroll University
University Heights, OH 44118
Phone: (216) 397-4468
Fax: (216) 397-1728
E-mail: schirm@jcu.edu

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ABSTRACT

Currently, the Basel Committee on Banking Supervision is revising the risk-based capital standards to more accurately account for the credit risk in banks’ activities. Such changes raise the question of how the revised standards will influence the Federal Reserve’s ability to conduct monetary policy. Using a simple theoretical model, it is shown that the revised Basel Accord results in asymmetric differences in the effectiveness of monetary policy in changing bank lending. These differences are a function of a number of factors including whether banks are constrained by the risk-based capital standards, the credit quality of banks’ assets, the relative liquidity of banks’ balance sheets, and migrations in the credit ratings of borrowing entities.
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I. Introduction

In the late 1980s, U.S. bank regulators, as part of the international Basel Committee on Banking Regulation and Supervisory Practices, adopted the risk-based capital standards (the Basel Accord), the primary purpose of which was to make bank capital requirements responsive to the credit risk in banks’ portfolios of assets and off-balance sheet activities. While capital ratios rose significantly in the years following the implementation of risk-based capital, the standards, because of their simplified approach, were not without problems including that they failed to adequately differentiate between the credit risk of assets in general, and commercial loans in particular. Such weaknesses resulted in a variety of distortions, many of which were exacerbated by legal and financial engineering aimed at mitigating the requirements of the Accord, thus making regulatory capital ratios less reliable as an indicator of financial strength.¹

Efforts are currently underway to revise the 1988 Accord, with the revised standards to be applied to large, internationally-active banks in both the U.S. and abroad.² Recognizing that the risk-based capital standards need to evolve along with changes in financial markets, and improvements in recent years in banks’ risk measurement and management systems, one of the primary purposes of the revised Accord is to more closely align regulatory capital requirements with the underlying credit risk in banks’ activities, thereby reducing distortions existing in the

¹ Some of these distortions took the form of regulatory capital arbitrage. For a discussion of the problems of regulatory capital arbitrage as it pertains to the 1988 Accord see Jones (2000).
² Ferguson (2003a) notes that approximately twenty large U.S. banks are likely to adopt the revised Accord at the outset, and while the number of banks to which the revised Accord will be applied is small, because these banks will be the largest, most internationally-active banks in the U.S., they account for over two-thirds of all assets in the U.S. banking system.
current Accord.\(^3\) This is accomplished, in part, by incorporating credit ratings into the regulatory capital standards, and by allowing the risk-based capital requirements on certain assets to vary as the credit ratings of the underlying borrowing entities change. Given the proposed changes, Tanaka (2002), Van den Heuvel (2002\(^b\)), and Kopecky and Van Hoose (2003b) note that little existing research has addressed the issue of how the revised Basel Accord affects the monetary transmission mechanism.

Theory suggests a number of possible ways regulatory capital standards may alter bank lending behavior and the effectiveness of monetary policy, often with conflicting results. Models such as those by Chami and Cosimano (2001) and Van den Heuvel (2002\(^b\)) emphasize the relationship between monetary policy and bank capital, finding that changes in monetary policy alter bank profitability, which in turn changes bank capital and lending. Alternatively, under the bank lending channel hypothesis, monetary policy has a direct effect on the supply of bank loans as banks fund loans, at least in part, with reservable deposits. Van den Heuvel (2002\(^a\)) notes that a binding regulatory capital requirement limits the ability of capital-constrained banks to increase lending in response to an expansionary monetary policy, thus making monetary policy less potent. In contrast, Stein (1998) and Van den Heuvel (2002\(^a\)) note that bank capital may mitigate adverse selection problems. In the event of a contractionary monetary policy, capital-constrained banks are less likely to increase their issuance of reservable deposits and more likely to decrease lending, thus making monetary policy more potent if banks are capital-constrained. One possible explanation for these seemingly conflicting conclusions is that important cross-sectional differences exist in how banks respond to monetary policy shocks (Kashyap and Stein, 1994, Kishan and Opiela, 2000). However, common among all of these

\(^3\) The revised Accord includes not only changes in regulatory capital requirements (Pillar 1), but also standards for supervisory review (Pillar 2) and enhanced disclosure requirements (Pillar 3). For more detail, see Basel Committee.
theories is the notion that monetary policy affects, either directly or indirectly, the supply of bank
loans, and that the nature of this relationship can be influenced, at least in part, by regulatory
capital standards.

An alternative way to address the issue of how regulatory capital standards influence
bank lending and monetary policy is to examine empirical studies of the 1988 Accord. Studies
such as those by Hall (1993), Haubrich and Wachtel (1993), Jackson et al. (1999), Furfine
(2000), and Aggarwal and Jacques (2001) suggest that banks altered the composition of their
balance sheets in response to the 1988 risk-based capital standards, generally substituting low
credit risk assets, such as securities, for assets with higher credit risk, such as commercial loans.
If the composition of banks’ assets has an influence on the effectiveness of monetary policy, as is
true under the credit view of monetary policy, then asset substitution resulting from a revised
Accord may impact the transmission mechanism. Other studies, such as those by Kashyap and
Stein (1994) and Thakor (1996) have shown that risk-based capital standards alter the
relationship between money and bank lending, with implications for the effectiveness of
monetary policy. In addition, Berger and Udell (1994), Hancock and Wilcox (1994), Brinkmann
and Horvitz (1995), and Peek and Rosengren (1995b) have examined what role the standards
played in the 1990 credit crunch, often with conflicting results. While prior research may
suggest that the 1988 risk-based capital standards had a significant influence on bank portfolio
composition and monetary policy, the existing research is limited in its applicability to the
revised Accord as some key elements of the forthcoming revised standards differ significantly
from the 1988 Accord.

This study contributes to the literature on bank capital regulation by examining how the
forthcoming revisions to the risk-based capital standards may alter bank lending and the
effectiveness of monetary policy. Modifying recent work by Peek and Rosengren (1995a) and Kishan and Opiela (2000), an asymmetric response is shown in how banks react to monetary policy under the revised Accord. Specifically, asymmetric differences exist in the effectiveness of monetary policy depending not only on whether banks are constrained by the revised risk-based capital standards, but also the credit quality and relative liquidity of the assets held in the portfolios of capital-constrained banks. In addition, it is shown that under a revised Basel Accord, migrations in credit ratings also influence the effectiveness of monetary policy.

2. Risk-Based Capital

In June 1999, the Basel Committee issued a consultative paper that emphasized revising the 1988 Accord to more closely align the risk-based capital standards with the actual risk in banks’ activities and to provide an incentive for banks to enhance their risk measurement and management systems. Under the proposed revisions, two general methods exist for calculating banks’ regulatory capital requirements, one based on external credit ratings and the other based on the use of banks’ internal credit risk models.  

Under the external ratings approach, the current reliance on risk weights and buckets is maintained, with modifications being made to remedy some of the existing Accord’s flaws. In contrast to the 1988 Accord which slotted assets and off-balance sheet activities into one of four risk-weight categories based on the type and credit risk of the underlying asset, one of the major revisions to the Accord involves slotting bank claims and credit exposures, including commercial

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4 Under Pillar 1 of the revised Accord, the external credit ratings approach is also known as the standardized approach, while there are two internal ratings-based (IRB) approaches, the foundation IRB and the advanced IRB (A-IRB). The proposed changes to capital requirements under the revised Accord also incorporate capital charges for market and operational risk. Because the focus of this paper is on how changes to the credit risk portion of risk-based capital will influence bank lending and monetary policy, the issues of market and operational risk are not explored. For more information on capital charges under the revised Accord, see Basel Committee (2003).
loans, into risk-weight categories on the basis of external credit agency ratings, and increasing the number of risk buckets to include a 150 percent risk-weight category.\textsuperscript{5} As under the 1988 Accord, banks calculate their total risk-weighted assets as the sum of the dollar value of each asset or off-balance sheet activity multiplied by its corresponding risk weight. In order to meet minimum regulatory capital requirements, banks must hold Tier 1 capital equal to at least 4\% and total capital (Tier 1 + Tier 2) equal to at least 8\% of its total risk-weighted assets.\textsuperscript{6}

A second significant change in the revised standards is that a migration over time in the credit rating of a corporate borrower causes a loan to that borrower to be placed in a different risk-weight category. Under the proposed revisions, risk-based capital requirements on existing business loans are no longer invariant to changes in credit ratings. Rather, if the credit rating of the corporate borrowing entity deteriorates, the regulatory capital requirement on the loan increases. While the Basel Committee has proposed numerous changes to the original Basel Accord, none may be more important for bank portfolio composition and the effectiveness of monetary policy because migrating credit ratings introduce the possibility of increasing variability in regulatory capital requirements (Jokivoulle and Peura, 2001) and to the degree that credit ratings tend to be downgraded during recessions (Nickell et al., 2000; Bangia et al., 2002), regulatory capital standards may become increasingly procyclical (Lowe, 2002). This is in sharp contrast to the 1988 Accord where all commercial loans, regardless of credit rating, were slotted in the 100 percent risk-weight category. Given the existing research on the link between the stringency of regulatory capital requirements and monetary policy, the fact that credit ratings

\textsuperscript{5} For corporate loans rated AAA to AA\textsuperscript{-} the 20 percent risk weight is applied. The 50 percent risk weight is applied to those loans rated A\textsuperscript{+} to A\textsuperscript{-}, while the 100 percent risk weight is assigned to loans rated BBB\textsuperscript{+} to BB\textsuperscript{-} and those loans that are unrated. Finally, corporate loans below BB\textsuperscript{-} are assigned a 150\% risk weight.

\textsuperscript{6} Under the risk-based capital standards, capital has two definitions. Tier 1 capital is comprised mainly of common equity, while Tier 2 capital includes cumulative perpetual preferred stock, term subordinated debt, and the allowance for loan and lease losses.
may migrate under the proposed standards raises additional issues as to the effectiveness of monetary policy under a revised Basel Accord.

3. The Model

The preceding sections raise the issue of how the imposition of a revised risk-based capital standard, one where capital requirements are based on credit ratings and can migrate as the credit ratings on assets change, will influence bank lending and the transmission of monetary policy. To examine this issue, the one-period theoretical model of representative banks developed by Peek and Rosengren (1995a) and Kishan and Opiela (2000) is modified to incorporate the revised standards.⁷ Specifically, banks are assumed to hold three assets, reserves (R), securities (S), and loans (L), two types of liabilities, demand deposits (DD) and large uninsured time deposits (TD), and capital (K), and as such, are subject to the traditional balance sheet constraint:

\[ R + S + L = DD + TD + K \quad (1) \]

On the liability of the balance sheet, bank capital is assumed to be fixed in the short run, as theoretical (Stein, 1998) and empirical evidence (Cornett and Tehranian, 1994) suggests that raising capital is very costly, particularly for banks constrained by risk-based capital standards (Jacques and Nigro, 1997). Demand deposits are assumed to be inversely related to the federal funds rate, and the amount of time deposits depends on the spread between the rate banks pay on

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⁷ The one-period nature of the theoretical model is reflective of the short-run adjustment of banks to changes in monetary policy. Recent work by Kopecky and VanHoose (2003a,b) uses a multi-period model that differentiates between short-run and long-run effects of regulatory capital requirements, thus recognizing the endogeneity of capital.
deposits \( (r_{TD}) \) and the mean rate on time deposits in the market \( (r_{TDM}) \), with \( a_0, a_1, f_0 \) and \( f_1 \) expected to be positive. Thus:

\[
\begin{align*}
DD &= a_0 - a_1 r_{FF} \\
TD &= f_0 + f_1 (r_{TD} - r_{TDM})
\end{align*}
\]

where \( r_{FF} \) is the federal funds rate.\(^8\)

On the asset side of the balance sheet, banks hold reserves, securities, and commercial and industrial loans. Given the level of demand deposits, banks are required to hold reserves such that:

\[
R = \alpha DD
\]

with \( \alpha \) being the reserve requirement ratio as set by the Federal Reserve, and banks being assumed to hold no excess reserves. In addition, banks are assumed to hold securities in fixed proportion to the level of demand deposits \( (h_1) \) net of reserves such that:

\[
S = h_0 + h_1 DD - R
\]

with \( h_0 \) and \( h_1 \) expected to be positive. In this model, securities serve as a buffer against liquidity problems arising from large withdrawals of transaction deposits.

\(^8\) For a discussion of using the federal funds rate as an indicator of the Federal Reserve’s monetary policy, see Bernanke and Blinder (1992).
Furthermore, bank loan markets are assumed to be imperfectly competitive, with banks possessing some market power. Thus, banks’ loans are influenced by the interest rate offered ($r_L$) relative to the mean rate in the market ($r_{LM}$) such that:

$$L = g_0 - g_1(r_L - r_{LM})$$  \hspace{1cm} (6)

The higher the interest rate a bank sets on its loans, relative to the market, the more loans decrease, with both $g_0$ and $g_1$ expected to be positive.

Finally, market interest rates on time deposits, loans, and securities are assumed to be related to the federal funds rate such that:

$$r_{TDM} = b_0 + \varphi r_{FF}$$  \hspace{1cm} (7)

$$r_{LM} = c_0 + \varphi r_{FF}$$  \hspace{1cm} (8)

$$r_S = e_0 + \varphi r_{FF}$$  \hspace{1cm} (9)

For simplicity, Peek and Rosengren (1995a) and Kishan and Opiela (2000) make the assumption that all three interest rates respond equally to a change in the federal funds rate.

Given equations (1) through (9), banks are assumed to maximize profits ($\pi$) such that:

$$\pi = (r_L - \theta)L + r_S S - r_{DD} D - r_{TD} TD$$  \hspace{1cm} (10)

where $r_L$ is the interest income on loans, $\theta L$ equals loan losses, $r_S S$ is the interest income on securities, and $r_{DD} D$ and $r_{TD} TD$ are the interest cost of demand and large time deposits.
respectively. In attempting to maximize profits, banks face a potential regulatory capital
constraint such that:

\[ K \geq \gamma_S S + \gamma_L L \]  \hspace{1cm} (11)

Equation (11) recognizes that banks are subject to risk-based capital requirements, where \( \gamma_S \) and
\( \gamma_L \) measure the risk-based capital requirement for securities and loans, respectively.\(^9\) To
explicitly incorporate external credit ratings into the model, the risk-based capital requirement
for banks’ loans and securities can be rewritten:

\[ \gamma_L = \tilde{\Omega}_L \]  \hspace{1cm} (12a)

\[ \gamma_S = \tilde{\Omega}_S \]  \hspace{1cm} (12b)

where the risk weights on loans and securities, \( \tilde{\Omega}_L \) and \( \tilde{\Omega}_S \), are both variable and a function of
the credit risk of the underlying entity such that:

\[ \tilde{\Omega}_L = \tilde{\Omega}_L(c_L) \hspace{1cm} \frac{d\tilde{\Omega}_L}{dc_L} < 0 \]  \hspace{1cm} (12c)

\(^9\) Currently, banks are subject to both a leverage ratio requirement and a risk-based capital requirement. Including a
leverage ratio requirement in this study would result in some banks being constrained by that requirement, but does
not change the results for banks constrained by only the revised risk-based capital standards. Because the focus of
this research is on how banks will respond to the revised Basel Accord, the question of the leverage ratio is ignored.
In equations (12a) through (12d), $\rho$ is the specified regulatory minimum capital ratio, currently fixed at 8% by the Basel Committee. Furthermore, under the external ratings approach, $\tilde{\Omega}_L$ varies inversely with the credit rating of the borrowing entity in the loan contract, $c_L$, and $\tilde{\Omega}_S$ varies inversely with the credit rating of the borrowing entity underlying the security, $c_S$, thus making $d\tilde{\Omega}_L/dc_L$ and $d\tilde{\Omega}_S/dc_S$ less than 0.\(^{10}\)

By way of comparison, under the 1988 Accord, the risk-based capital requirements on loans and securities are invariant with respect to changes in credit ratings. In this case, equations (12a) and (12b) can be rewritten as:

\[
\gamma_L = \rho\tilde{\Omega}_L \quad \text{where} \quad \frac{d\tilde{\Omega}_L}{dc_L} = 0 \tag{13a}
\]

\[
\gamma_S = \rho\tilde{\Omega}_S \quad \text{where} \quad \frac{d\tilde{\Omega}_S}{dc_S} = 0 \tag{13b}
\]

where not only is $\rho$ fixed, but because $\tilde{\Omega}_L$ and $\tilde{\Omega}_S$ are effectively independent of changes in credit risk, they too are fixed thus making $\gamma_L$ and $\gamma_S$ fixed.

\(^{10}\) For commercial loans, $\tilde{\Omega}_L$ ranges between 20% and 150%, with the capital requirement, at the margin, on AAA rated loans equal to 1.6 percent (.08 *20%) and for loans rated BB- or lower equal to 12 percent (.08 *150%). This occurs because, under the external ratings approach, while $\rho$ remains fixed at 8%, $\tilde{\Omega}_L$ varies inversely with the external credit rating of the borrowing entity, with $\tilde{\Omega}_L$ equaling 20%, 50%, 100%, or 150%.
The model formed by equations (1) through (10) is identical to Peek and Rosengren (1995a) and Kishan and Opiela (2000) with one significant exception. This study explicitly recognizes that banks are subject to a risk-based capital requirement, and as such adds equations (11) and (12a–12d). Peek and Rosengren (1995a) examine the model under the assumption that the leverage ratio is binding, with no role for risk-based capital, while Kishan and Opiela (2000) assume that regulatory capital standards are not binding. Comparisons with the Peek and Rosengren leverage ratio results and 1988 Basel Accord equations in (13a) and (13b) provide useful results for comparison purposes. But given the significant changes introduced by the revised Basel Accord, the results from those capital requirements provide limited insight into how monetary policy might be influenced by the revised Accord.

4. Unconstrained and Constrained Banks

Substituting equations (12a) through (12d) into (11), and using equations (1) through (9) to eliminate R, DD, TD, S, r_{TD}, r_L, r_{TDM}, r_S, and r_{LM}, the Lagrangian was formed and maximized with respect to loans. The first-order conditions were used to solve for L in the unconstrained case; by a similar method, other key variables, such as time deposits, were solved for.

Ceteris paribus, implementation of the revised Basel Accord may influence bank behavior in that some banks that were not constrained under the 1988 standards may become constrained under the revised standards. The opposite result is also possible. Given the existing research suggesting that bank behavior may differ depending on whether or not regulatory capital standards are binding, such an argument suggests the need to differentiate between unconstrained and constrained banks in examining the revised Accord.
4.1 Unconstrained banks

Assuming banks are not constrained by the risk-based capital standards, a change in the federal funds rate can be shown to influence banks’ portfolio composition such that:

\[
\frac{dL}{dr_{FF}} = -\frac{g_1 a_t (1-h_t)}{f_1 + g_1} < 0 \quad \text{assuming} \quad h_t < 1 \quad (14)
\]

\[
\frac{dS}{dr_{FF}} = -a_t (h_t - \alpha) \leq 0
\]

\[
\frac{dR}{dr_{FF}} = -a_t \alpha < 0 \quad (15)
\]

\[
\frac{dTD}{dr_{FF}} = \frac{f_1 a_t (1-h_t)}{f_1 + g_1} > 0 \quad \text{assuming} \quad h_t < 1 \quad (17)
\]

\[
\frac{dDD}{dr_{FF}} = -a_t < 0 \quad (18)
\]

\[
\frac{d(deposits)}{dr_{FF}} = -a_t \left( g_1 + f_1 h_t \right) \left( f_1 + g_1 \right) \leq 0 \quad (19)
\]

The results of equations (14) through (19) show that an increase in the federal funds rate will increase banks’ issuance of time deposits, as banks seek to replace funds lost as a result of a decrease in demand deposits, with equation (19) showing that collectively the decrease in
demand deposits is not fully offset by increasing time deposits, thus leading to a decrease in total deposits.\textsuperscript{11} Given the contraction of liabilities, banks will reduce assets in response to the increase in the federal funds rate. Specifically, the decrease in demand deposits will lead to a contraction in reserves, with the impact on securities being uncertain. Kishan and Opiela (2000) argue that for banks that are unconstrained by regulatory capital standards or hold a large portfolio of securities relative to reserves, \((h_1 - \alpha)\) will be greater than zero, resulting in a decline in securities in response to an increase in the federal funds rate. Despite the change in securities, and the increase in time deposits, banks will reduce loans in response to a contractionary monetary policy, the magnitude of the decrease being determined by not only \(h_1\), but also the interest rate sensitivities of demand deposits \((a_1)\), time deposits \((f_1)\), and loans \((g_1)\). For the purposes of this study, what is important to note is that for banks not constrained by the risk-based capital standards, the risk-based capital requirements on loans and securities, \(\rho\tilde{\Omega}_2\) and \(\rho\tilde{\Omega}_3\), do not influence either banks’ portfolio composition or the response of their assets and liabilities to a change in the federal funds rate.\textsuperscript{12}

\begin{itemize}
  \item Alternatively, banks may be constrained by the revised risk-based capital standards.

\end{itemize}

Under this condition, differentiating the Lagrangian and using the first-order conditions to solve for key results yields:

\textsuperscript{11} Because banks are not constrained by risk-based capital, the results of equations (14) through (19) are the same as those in Peek and Rosengren (1995a) and Kishan and Opiela (2000).

\textsuperscript{12} As noted by Jacques and Nigro (1997), even banks that are not explicitly constrained by the risk-based capital standards may act as if the standards are binding. This may occur because banks desire to hold a buffer stock of capital above the regulatory minimum as insulation against a shock that would otherwise result in the bank

\textsuperscript{13}
These results are fundamentally different from the unconstrained case in that the risk-based capital requirements on both loans and securities play a critical role in how assets and liabilities respond to changes in monetary policy. Specifically, not only do $\rho_{\Omega, \Omega}$ and $\rho_{\Omega, \Omega}$ influence how becoming capital constrained, or because by holding capital above the regulatory minimum, banks may signal to the market and regulators that they are in compliance with the standards, thus leading to a reduction in costs.
loans, time deposits, and total deposits change as monetary policy changes, but the relative magnitude of the risk weights \( \frac{\hat{\Omega}_{x}}{\hat{\Omega}_{L}} \) is also an important factor.

As a point of comparison between the 1988 and revised Accords, recall from equations (13a) and (13b) that the capital requirements on loans and securities under the 1988 Accord are fixed. If banks are assumed to have a portfolio of assets comprised of securities slotted in the 20 percent risk-weight category \( (\Omega_{x} = 0.2) \) and commercial loans \((\Omega_{L} = 1.0)\), then under the 1988 Accord \( \frac{\hat{\Omega}_{x}}{\hat{\Omega}_{L}} = 0.2 \). In contrast, under the revised Accord, because of the dependence of the risk weights on credit ratings, \( \frac{\hat{\Omega}_{x}}{\hat{\Omega}_{L}} \) varies according to the credit ratings on the underlying assets. Assuming that the credit rating of securities is such that the risk weight remains at 20 percent, then because not all commercial loans are slotted in the 100 percent risk-weight category under the revised Accord, but are instead weighted according to their credit rating, \( \frac{\hat{\Omega}_{x}}{\hat{\Omega}_{L}} \) will vary ranging between 0.13 and 1.0.\(^{13}\) Given the greater granularity in risk weighting of commercial loans under the revised Accord, the effectiveness of monetary policy to change lending will differ depending on the credit quality of the borrowing entities. Assuming

\[^{13}\] To see this note that if all loans are rated below BB: \( \frac{\hat{\Omega}_{x}}{\hat{\Omega}_{L}} = \frac{0.08 * 0.20}{0.08 * 1.50} = 0.13 \). For a portfolio comprised of commercial loans rated AA- or better \( \frac{\hat{\Omega}_{x}}{\hat{\Omega}_{L}} = \frac{0.08 * 0.20}{0.08 * 0.20} = 1.0 \).
(h1–α) < 0, if \( \frac{\rho \Omega_X}{\rho \Omega_L} = 0.13 \), as would occur if banks had portfolios comprised of commercial loans rated below BB–, then monetary policy would be less effective under the revised Accord than under the 1988 Accord. In this case, an increase in the federal funds rate would lead to a decrease in loans that is only 65 percent of the decrease that would have occurred under the 1988 Accord. Alternatively, if \( \frac{\rho \Omega_X}{\rho \Omega_L} = 1.0 \), as would occur if the portfolio is comprised of loans rated AA– or better, then monetary policy would be more effective under the revised Accord than under the 1988 Accord. In this case, the decrease in lending in response to an increase in the federal funds rate would be five times greater than under the 1988 Accord.

From the preceding example, and the results of equations (20) through (25), it can be seen that (h1 – α) also differentiates the response of capital-constrained banks to changes in the federal funds rate. As such, three cases merit examination. One possibility is that banks have a large securities portfolio relative to their holdings of reserves, (h1 – α) > 0. This may be the case if securities are a substitute for external debt financing, and in the event of a contractionary monetary policy, banks can not frictionlessly switch between demand deposits and large uninsured time deposits, thus making external debt financing costly (Kashyap and Stein, 1997, James, 1995). These banks may be thought of as holding more liquid balance sheets. If (h1 – α) > 0, an increase in the federal funds rate increases time deposits but decreases demand deposits, thus leading to a decrease in total deposits. The fact that the change in total deposits is not equal to zero is in contrast to the findings of Peek and Rosengren (1995a) for banks constrained by the leverage ratio, but is consistent with the lending view of monetary policy in that banks do not fully insulate their lending activities from shocks by switching between types of deposits (Kashyap and Stein, 1994). The decrease in demand deposits results in a decrease in
reserves with an accompanying decrease in securities. And given the fact that banks have
decreased reserves and securities, similar to Peek and Rosengren (1995a), banks increase loans.

While seemingly counterintuitive, this result is consistent with the empirical findings of Kashyap
and Stein (1994) that contractionary monetary policy causes commercial lending at large banks
to increase in the short run, as well as findings by Morgan (1998) that contractionary monetary
policy causes loans under commitment to increase. More importantly, the fact that loans
increase in response to a contractionary monetary policy means that if some significant subset of
large banks are capital-constrained banks but possess more liquid balance sheets, monetary
policy will be less potent.

A second case is where banks do not hold a large securities portfolio relative to their
holdings of reserves, \((h_1 - \alpha) < 0\), thus implying less liquid balance sheets. In this case, the
impact of a monetary policy shock on time deposits is indeterminate and depends on the relative
magnitude of the parameters \(h_1, \rho_\theta_\gamma, \rho_\theta_\delta, \) and \(\alpha\). In the event of a contractionary monetary
policy, while the sign of \(dTD/dr_{FF}\) is uncertain, the decrease in total deposits is greater and
deposits are less available to support loans than in the preceding case of the more liquid bank,
and consistent with the bank lending channel, the decrease in demand deposits is not fully offset
by a change in time deposits. With liabilities again shrinking, total assets will also decrease. But
unlike the case where banks have more liquid balance sheets, in this case loans decrease and
securities increase. Given the fact that these banks are constrained by the risk-based capital
standards, and that the securities portfolio is relatively small, banks respond to the decline in
total deposits by liquidating some loans. Because the risk-based capital standards place a capital
requirement on both loans and securities, liquidating loans frees up some capital which banks
can use to acquire interest-bearing securities. To the degree that large U.S. banks emphasize
liability management in the management of their balance sheets in general (Gardner, Mills, and Cooperman, 2000), and can more easily access markets for uninsured liabilities in particular, this case may be more reflective of how U.S. banks that are likely to apply the revised Basel Accord will react. And in contrast to the preceding case, under these conditions monetary policy is effective, as capital-constrained banks, like their unconstrained counterparts, decrease lending in response to a contractionary monetary policy.

Finally, the previous examples apply in cases where banks hold securities that carry non-zero risk weights under the risk-based capital standards. But as noted earlier, under the revised risk-based capital standards different amounts of capital are required against different types of assets based primarily on the credit rating of the underlying borrowers. With respect to securities, risk weights on AAA-rated sovereign securities, such as U.S. Treasury bonds, carry a 0 percent risk-based capital requirement at the margin, while the risk weights on other types of securities under the revised Accord may range between 20 and 150 percent, thus leading to capital requirements between 1.6 percent and 12 percent.\footnote{Claims on sovereigns and their central banks carry a 0 percent risk weight if rated AAA to AA-. See Basel Committee (2003) for additional details.} Examining the earlier results in this section, it can be seen that the effectiveness of monetary policy also depends on the credit rating of the securities in banks’ portfolio. Equations (20) through (25) provide an analysis of the impact of changes in the federal funds rate on various components of the banks’ balance sheets under the assumption that banks hold securities with a non-zero risk weight. Alternatively, if all the securities in a banks’ portfolios fall into the 0 percent risk-weight category (\(\bar{\Omega}_2 = 0\)), the results for time deposits, total deposits, and loans change significantly.\footnote{A number of theoretical studies of the risk-based capital standards make this assumption including Kashyap and Stein (1994) and Blum and Hellwig (1995).} To see this, note that an expansionary monetary policy would lead to an increase in total deposits. On the asset side of...
the balance sheet, part of the increase in deposits would result in an increase in reserves, and depending on the sign of \((h_1 - \alpha)\) securities may increase or decrease. But regardless of what happens to securities, banks will make no change in loans. This is the Kashyap and Stein (1994) and Kopecky and VanHoose (2003a) result, in that monetary policy is completely ineffective in changing bank lending. In the case where \((h_1 > \alpha)\), banks choose to increase their securities and not their loans because, at the margin, an increase in loans would require already capital-constrained banks to add additional capital, while increasing AAA-rated government securities, because of the 0 percent risk weight, requires no additional capital, yet allows banks to increase profits.

Collectively, the results for banks constrained by the forthcoming revised Accord concur with Kishan and Opiela (2000) in finding that bank capitalization is critical to explaining cross-sectional differences in the response of banks to changes in monetary policy. But by explicitly incorporating the revised risk-based capital standards into the model, it can be seen that the response of bank lending to monetary policy is asymmetric in that the relative liquidity of constrained banks’ balance sheets and the credit quality of the banks’ loans and securities are also critical components to understanding how banks respond to changes in monetary policy.

5. Monetary Policy and Credit Ratings Migration

As noted earlier, two of the distinguishing features of the revised Basel Accord are the incorporation of credit ratings into the regulatory capital requirement and the possibility of capital requirements on certain assets changing as underlying credit ratings change. The previous section highlights the importance of the first of these two changes. To see the importance of credit ratings migration on the effectiveness of monetary policy, recall from
equations (12a) through (12d) that, unlike the 1988 Accord, under the revised Accord the risk-based capital requirements on loans and securities are a function of the credit ratings of the entities to which banks have credit exposures. The fact that loans migrate across risk-weight categories as credit ratings change, and that \( \frac{d\bar{\Omega}_L}{dc_L} < 0 \), means that the banks’ risk-based capital requirements change in response to fluctuations in credit ratings.\(^{16}\)

In effect, changes in credit ratings can alter the effectiveness of monetary policy in two ways. First, a credit shock may cause banks to move between the unconstrained and risk-based capital constrained states. For example, if corporate credit ratings are positively correlated and change due to market-specific factors such as a recession (Saunders, 2000), then banks that were previously unconstrained may experience a significant number of credit rating downgrades in their portfolio of commercial loans, and as such, become constrained by risk-based capital. And as the preceding sections shows, the potency of monetary policy differs significantly depending on not only whether banks are constrained by the revised risk-based capital standards, but also other characteristics of banks’ assets.

Second, using equations (20) through (25), changes in credit ratings will alter the responsiveness of the banks’ assets and liabilities to changes in monetary policy. More specifically, the critical results for capital-constrained banks are:

\[
\frac{d\left(\frac{dL}{dr_{fr}}\right)}{dc_L} = \frac{d\left(\frac{dT_D}{dr_{fr}}\right)}{dc_L} = -\alpha (h_i - \alpha) \bar{\Omega}_L \frac{d\bar{\Omega}_L}{dc_L} < 0 \quad (26)
\]

\(^{16}\) Because the focus of much of the current discussion of the revised Accord involves changes in credit ratings on commercial loans, a simplifying assumption has been made that the loans and securities in banks’ portfolios are from different corporate entities and that the credit rating of borrowing entities has been downgraded.
Equation (26) is important in that it establishes that the transmission of monetary policy depends not only on the credit quality of the loans and securities comprising banks’ assets, but also how banks’ deposits and lending respond as credit ratings migrate. In contrast, under the 1988 Accord \((d\Omega_l / dc_l) = 0\), thus making monetary policy effectively independent of migrations in the credit rating on banks’ existing commercial loans. With regard to the revised Accord, as the credit rating of the borrowing entities deteriorates the risk weight assigned to the loans increases with a corresponding increase in required capital on already capital-constrained banks. Ceteris paribus, given that the risk weight on loans is now greater in both an absolute sense and relative to the risk weight on securities, banks face a reconfigured profit maximization problem with a resulting change in how its loans and time deposits respond to monetary policy changes.

For banks with more liquid balance sheets \((h_1 > \alpha)\), the change in the responsiveness of time deposits and loans to changes in the federal funds rate is positively related to changes in the credit rating of the underlying borrowing entity. Recognizing from equations (20) and (24) that \(dTD/dr_{FF} > 0\) and \(dL/dr_{FF} > 0\) when \((h_1 > \alpha)\), the results suggest that as the credit ratings of the borrowing entities deteriorates, the responsiveness of loans and time deposits to changes in the federal funds rate becomes less positive (decreases). In effect, the higher risk weight means that the already capital-constrained banks face not only higher credit risk in their existing portfolios of loans, but also increasingly stringent risk-based capital standards. As a result, raising external financing may become even more difficult, thus resulting in even less need for large time deposits and an even smaller increase in loans, with monetary policy becoming more effective in that the response of this cross-section of banks is less positive than would otherwise be the case.

In contrast, for banks not holding a relatively large volume of securities \((h_1 < \alpha)\), the responsiveness of time deposits and loans to changes in the federal funds rate is negatively
related to the credit ratings of the borrowing entities. Thus, a deterioration in the credit ratings of borrowing entities causes the risk-based capital requirement on commercial loans to increase, with $dL/dr_F$ increasing (becoming less negative). For this group of banks, the results suggest that under the revised Accord monetary policy will be less effective in the face of deteriorating credit ratings than when credit ratings are improving. Combined with the findings for banks with more liquid balance sheets, the results provide further evidence of the asymmetric effectiveness of monetary policy under the revised Basel Accord.

6. Risk Based Capital and Internal Credit Risk Models

Using a modification of the theoretical approach of Peek and Rosengren (1995a) and Kishan and Opiela (2000), we have compared the implications of the revised Basel capital standards on the effectiveness of monetary policy to influence bank lending. While our analysis assumes that banks’ regulatory capital requirements are based on the external credit rating approach, as described in footnotes 4 and 5, the revised Accord also allows for the use of internal credit risk models to determine banks’ credit risk exposure. In his recent Congressional testimony, Ferguson (2003b) notes that the twenty largest U.S. banking organizations most immediately impacted by the revised Accord will not use the external ratings approach, but instead will be required to implement the Advanced Internal Ratings-Based (A-IRB) approach and provide the critical inputs for supervisors to determine appropriate capital requirements, these inputs being the probability of default (PD), loss given default (LGD), and exposure at default (EAD). These inputs are then used in supervisory formulas to determine the minimum risk-based capital that must be held by banks. It is noteworthy that the inputs required by bank supervisors to determine the risk-based capital requirements under the revised Accord using the

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A-IRB approach are not unlike the inputs used by external credit rating agencies to evaluate default risk.

We hypothesize that our general conclusions about the effectiveness of Federal Reserve monetary policy to influence banks’ lending behavior, using a modified version of our theoretical model to include the A-IRB approach, would be very similar to the conclusions drawn from our theoretical model using the external credit rating approach. Such further modification of our theoretical model could be accomplished by rewriting the risk-based capital requirement on banks’ loans \( \rho \tilde{\Omega}_l \) in equation (12a) as a function of PD, LGD, and EAD and incorporating the supervisory formulas as found in Basel Committee (2003). This is a topic for future research. Alternatively, recognizing that banks in many foreign countries will apply the external ratings approach rather than the A-IRB, substituting the relevant central bank interest rate for the federal funds rate in our model provides insights as to the effectiveness of monetary policy in those economies.

7. Conclusions

Existing research on the Basel Accord has raised the question of how revisions to the Accord are likely to influence the effectiveness of Federal Reserve monetary policy. In contrast to the 1988 Accord, the revised risk-based capital standards allow banks’ capital requirements to be determined by credit ratings. Modifying recent work by Peek and Rosengren (1995a) and Kishan and Opiela (2000), this study finds that the effectiveness of monetary policy to influence bank lending differs depending on the whether or not banks are constrained by the risk-based capital standards. In addition, the effectiveness of monetary policy to influence lending is also shown to depend on the credit quality of banks’ loans and securities and the liquidity of banks’
balance sheets. As such, the results are consistent with Kishan and Opiela (2000) in finding that differences in the response of banks’ assets and liabilities to monetary policy depend on the capitalization of banks. But this study extends their results by also noting asymmetrical differences in the effectiveness of monetary policy to influence both the direction and magnitude of bank lending depending on banks’ balance sheet liquidity and the credit quality of their assets.

In contrast to the 1988 Accord, currently proposed revisions also allow regulatory capital requirements to migrate as the credit rating of the borrowing entity changes. The results of this study have also shown that the effectiveness of monetary policy is not invariant to migrating credit ratings. Rather, changes in the credit ratings of borrowing entities lead banks to have an asymmetric response to monetary policy changes depending on the relative liquidity of banks’ balance sheets.

The results of this study have implications for the Federal Reserve’s conduct of monetary policy, showing that whether monetary policy is made more or less effective in changing bank lending depends on more than just whether or not banks are constrained by the revised Basel Accord. Rather, if credit ratings change over business cycles, this study has shown the critical financial characteristics of banks and their assets that will determine the ability of monetary policy to influence both the direction and magnitude of bank commercial lending. The responsiveness of banks to monetary policy changes is asymmetric in that some characteristics will make monetary policy more potent, while others will make monetary policy less effective.

But from a macroeconomic policy perspective, consistent with Bliss and Kaufman (2002), the implications of this study are that if the goal of the Federal Reserve is to simultaneously provide credit to the economy and manage interest rates, then the revised Basel Accord may complicate monetary policy.
REFERENCES


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