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Abstract

Bank regulators are in the process of implementing revised regulatory capital standards. However, the macroeconomic effects of a revised Basel Accord are uncertain. Examining the various channels through which the revised Accord may influence economic output suggests that making the buffer stock of capital positively related to the business cycle is necessary to reduce procyclicality. This can be accomplished by bank regulators using either enhanced supervisory powers or increased financial disclosure.

Keywords: revised Basel Accord, risk-based capital standards, procyclicality

JEL Classifications: G21, G28

1. Introduction

Even without government regulation, cyclicality is an inherent part of macroeconomics, in general, and financial markets and institutions, in particular. Recognizing

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the importance of banks in the macroeconomic system, capital requirements are often
designed to reduce the risk of insolvency. Viewed as a means of providing a mini-
mum cushion of capital to protect against unexpected losses, the 1988 Basel Accord
explicitly linked the level of capital banks were required to hold with their perceived
level of credit risk.

While the purpose of risk-based capital standards is to more closely align bank
capital requirements with risk, research by Blum and Hellwig (1995), Furfine (2001),
Jacques (2008), and others suggest that regulatory capital standards based on risk may
accentuate fluctuations in the business cycle, a problem known as procyclicality. With
minimum capital requirements based on risk, banks are more likely to become capital
constrained during economic downturns as loan losses rise and capital is depleted.
Because risk-based capital standards explicitly link banks’ minimum required capital
to asset risk, and place higher capital requirements on loans than securities, capital-
constrained banks are likely to reduce lending thereby exacerbating the economic
downturn. Alternatively, authors such as Jokivuolle and Kauko (2001) argue that
more risk-sensitive capital requirements could make the economy more resilient to
shocks by improving banks’ efficiency.

While capital levels in the banking system rose following implementation of the
1988 Basel Accord, the standards were not without problems, as continued advances
in the area of risk measurement and management systems made the standards too
simplistic to adequately address the activities of complex financial institutions (Fer-
guson, 2003). As a result, over the last decade, the international Basel Committee on
Banking Regulation and Supervisory Practices has been developing and implement-
ing a revised Basel Accord. The purpose of the revisions is to more closely align the
regulatory capital requirements of internationally active banks with the underlying
risks in their on- and off-balance sheet activities.

As developed by the Basel Committee (2006), improvements in the revised Ac-
cord take a number of forms including changes in regulatory capital requirements
(Pillar 1), enhanced supervisory review (Pillar 2), and increased disclosure require-
ments (Pillar 3). Two of the most important changes include the explicit incorporation
of credit ratings and the fact that regulatory capital requirements on commercial loans
vary as the credit ratings of the underlying corporate entities change. Under the re-
vised Accord, two general methods exist for calculating banks’ regulatory capital
requirements, the standardized approach based on external credit ratings and an in-
ternal ratings-based approach which utilizes banks’ internal credit risk models. The
standardized approach maintains the current reliance on risk weights, but proposes
modifications including increasing the granularity of the standards by using external
credit ratings and increasing the number of risk-weight categories.1 Furthermore, if

1 Under the revised standards, a mapping of external credit ratings to risk weights is defined such that
loans to corporate entities rated AAA to AA− receive the 20% risk weight, loans to entities rated A+ to
A− receive the 50% risk weight, and the 100% risk weight is assigned to corporate loans rated BBB+ to
BB− and those loans that are unrated. Finally, loans rated below BB- receive the new 150% risk weight.
the credit rating of a corporate borrower migrates over time, then banks must slot the loan in the risk-weight category corresponding to the new rating, thereby changing the regulatory capital requirement.

These changes to the 1988 Accord raise a number of policy questions including how macroeconomic activity is likely to respond to the revised capital standards. As discussed by Goodhart (2004), the primary focus of supervision and regulation is often on the individual bank, and as a result, the revised Accord may have unintended consequences for the economy. The potential for the revised Accord to amplify business cycles has generated considerable interest among academics and policy makers, both in the United States and abroad (U.S. House Financial Services Committee, 2003; Caruana, 2005). However, Lowe (2002) and Heid (2007) suggest that while procyclicality is the subject of considerable policy debate, the existing research is of limited help in resolving this issue. This limitation occurs for two reasons. First, while the existing research and policy discussion provide a variety of channels for the revised standards to potentially influence output, most existing studies focus on only a single channel of the transmission process. For example, if regulatory capital requirements change as the credit quality of the underlying loans change, then deteriorating credit ratings during a recession could cause minimum regulatory capital requirements to increase. This has the potential to decrease business lending and dampen economic activity. Consistent with this ratings-migration hypothesis, Jokivuolle and Peura (2001) conclude that ratings-sensitive capital requirements increase the volatility of capital standards.

Alternatively, during a recession banks may experience an increase in troubled loans as corporate borrowers are less able to service their debt. This could result in additional bank chargeoffs and provisions to loan loss reserves, thereby leading to decreasing bank capital ratios. As a consequence, banks have an incentive to reallocate their portfolios away from high-risk assets such as commercial loans or to reduce lending, thereby tightening credit conditions and exacerbating the decrease in output. With respect to the 1988 Accord, this is the debt-service hypothesis put forth in Blum and Hellwig (1995).

In contrast, theory also suggests how the revised Accord could decrease the procyclical nature of regulatory capital standards. Segoviano and Lowe (2002) and Lowe (2002) suggest that under a regulatory system where capital requirements increase as credit ratings deteriorate, banks may choose to hold, or markets may require of them, larger buffer stocks of capital when economic conditions are good. Similarly, Greenspan (2002) argues that the enhanced supervisory review standards of the revised Accord (Pillar 2) are designed to urge banks to increase their capital buffers during economic expansions. This buffer-stock hypothesis suggests that the procyclical effects of a revised Accord may be less than anticipated.

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2 In the academic literature, see Borio, Furfine, and Lowe (2000), Haldane, Hoggarth, and Saporta (2001), and Altman and Saunders (2001), Kashyap and Stein (2004), and Gordy and Howells (2006).
Whether put forth by policy makers or researchers, individually each of these hypotheses appears to have merit. But while the individual theories may be valid, much of the existing research and policy discussion operates as if the hypotheses exist in a vacuum. But failure to recognize the multitude of channels through which capital regulations could influence economic activity creates a bias in understanding the link between banking and business cycles.

A second limitation of the existing research on the revised Accord, as discussed by Saidenberg and Schuermann (2004) and Heid (2007), is that it estimates the impact of the revised capital requirements using analyses conducted on the 1988 standards. Given the significant changes in bank behavior following the introduction of the 1988 standards, and that the revised Accord offers changes to the 1988 standards, many existing studies fail to recognize the Lucas critique as it applies to the effect of regulatory capital standards on banks’ asset portfolios.

In contrast, this paper contributes to the literature by showing, in the context of a more complete theoretical model, a number of distinct channels through which the revised Accord could influence procyclicality. In that sense, the model developed in this study applies to both the standardized and internal ratings-based approaches. The analysis of the quantitative impact of the revised risk-based standards focuses on the standardized model incorporated into Basel II because the internal ratings come from bank proprietary models. Furthermore, in recognition of the Lucas critique, no attempt is made to empirically estimate the model. Rather, depending on the interaction of these channels, procyclicality may increase or decrease relative to the 1988 standards.

2. The model

The preceding section raises the issue of how a revised risk-based capital standard could influence macroeconomic activity. To examine this issue, the single-period Blum and Hellwig (1995) model is extended to incorporate the revised Accord. In the Blum-Hellwig model, a goods market equilibrium exists where aggregate supply \( y_S \) equals aggregate demand \( y_d \) with \( y_S \) being a function of output price \( p \) and the wage rate \( w \), while \( y_d \) equals the sum of consumption demand \( x_d \), business investment demand \( i_d \), government demand \( g_d \), and a disturbance term \( \epsilon \). Recognizing the effect of a shock on output

\[
\frac{dy}{d\epsilon} = \frac{\partial y_S}{\partial p} \frac{\partial y_d}{\partial \epsilon} - \frac{\partial y_S}{\partial p} \frac{\partial y_d}{\partial p}.
\]

(1)

Assuming aggregate supply increases and aggregate demand decreases in price, from Equation (1) a shock to the economy has a larger impact on output the larger
is \( \frac{\partial y^d}{\partial \varepsilon} \) and the smaller is \(-\frac{\partial y^d}{\partial p}\). Therefore, the traditional aggregate demand multiplier becomes

\[
\frac{\partial y^d}{\partial \varepsilon} = \left[ 1 - \frac{\partial x^d}{\partial y} - \frac{\partial i^d}{\partial y} - \left( \frac{\partial x^d}{\partial r} + \frac{\partial i^d}{\partial r} \right) \left( \frac{dr}{dy} \right) \bigg|_{LM} \right]^{-1},
\]

(2)

where \( r \) is the interest rate on government bonds.

The Blum-Hellwig model emphasizes the relationship between bank business lending and investment, with output being a function of investment. As a result, the investment demand function is specified as

\[
i^d = f(p, r, py - wl(y) - \delta, LS).
\]

(3)

The third element of Equation (3), \( py - wl(y) - \delta \), represents retained earnings, where \( wl(y) \) is the labor cost of output and \( \delta \) is the aggregate debt service. Furthermore, aggregate debt service is assumed to be a function of market conditions such that

\[
\delta = \delta(p, y, w, L_0),
\]

(4)

where \( L_0 \) is loans outstanding. The fourth element of the Equation (3), \( LS \), is the loan supply function of banks, and its inclusion in Equation (3) denotes the special nature of bank loans in financing corporate investment as discussed by Benston (2004). As a result, investment demand is positively related to the loan supply such that

\[
\frac{\partial i^d}{\partial LS} > 0.
\]

On their balance sheets, banks are assumed to hold three kinds of assets: reserves \( (R^d) \), business loans \( (L) \), and government bonds \( (BB) \). Therefore,

\[
R^d = \rho D^d
\]

(5)

\[
LS = \min \left[ \frac{E}{c}, E + (1 - \rho)D^d \right]
\]

(6)

\[
\frac{1}{1 + r} BB = \max \left[ 0, E + (1 - \rho)D^d - E \right],
\]

(7)

with bank capital \( (E) \) being determined such that

\[
E = R_0 + B_0^B - D_0 + \delta,
\]

(8)

where subscript 0 denotes the initial value of the variable.\(^4\)

In Equation (5), reserves \( (R) \) are a function of demand deposits, where \( \rho \) is the required reserve ratio, and \( D^d \) is demand deposits that are set by households.\(^5\) In

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\(^3\) The authors also note the relationship with respect to price, \((dp/d\varepsilon) = (\partial y^d/\partial \varepsilon) / ((\partial y^d/\partial p) - (\partial y^d/\partial p))\).

\(^4\) It is assumed that there is no issuance of new equity, no distribution of dividends, and operating costs are zero.

\(^5\) The monetary aspects of this model are the same as those of Blum and Hellwig (1995).
Equations (6) and (7), banks’ asset allocation between business loans and securities depends on not only demand deposits, but also on bank equity and capital adequacy requirements. Specifically, under the 1988 Basel Accord, banks are subject to a minimum regulatory capital standard

$$E \geq cL^S,$$  
(9a)

where \(c\) is the risk-based capital requirement on loans, fixed at 8%, thus making regulatory capital requirements independent of the credit quality of the underlying corporate borrowers.\(^6\)

Alternatively, Jacques and Nigro (1997) note that under risk-based capital standards banks may hold buffer stocks of capital as insulation against shocks that would otherwise result in their being capital constrained, or because by choosing to hold capital above the regulatory minimum, banks signal to the market and regulators that they are in compliance with the standards, thereby reducing agency costs. Thus, one of the innovations of this study is the explicit modeling of capital buffers into the theoretical model in a manner that recognizes the structure of both the 1988 and revised Basel Accords. Specifically, in contrast to Equation (9a)

$$E \geq cL^S + \theta,$$  
(9b)

where \(\theta\) is the buffer stock of capital.

The existing empirical research (Ayuso, Perez, and Saurina, 2004; Lindquist, 2004) reveals that banks’ buffer stocks reflect factors exogenous to banks, such as the business cycle, as well as endogenous factors, such as banks’ risk tolerance with respect to minimum capital requirements. With regard to the effect on the business cycle, Greenspan (2002), Segoviano and Lowe (2002), and Lowe (2002) argue that banks could build up their capital levels during periods of economic growth and draw them down their buffer stocks in response to negative shocks, thereby making the partial of the buffer stock with respect to output \((\theta_y)\) positive. (As in Blum and Hellwig (1995), subscripts represent derivatives or partial derivatives.) Alternatively, banks could increase their capital levels in response to deteriorating economic conditions, thereby making \(\theta_y < 0\). Therefore, banks’ buffer stocks respond directly to the state of the economy, and this channel exists regardless of whether regulators employ the 1988 or revised Accords.

Furthermore, the fact that under the revised Accord the minimum regulatory capital requirements are stochastic means that the structure of the risk-based capital requirements themselves could also influence banks’ capital buffers (Jokivuolle and Peura, 2001). Alfon, Argimon, and Bascuñana-Ambrós (2004) recognize this point when they state that one of the risks considered by banks in determining the capital buffer stock is the risk of breaching minimum capital requirements. Under the revised Accord, during periods of heightened risk, the minimum regulatory

\(^6\) Equation (9a) assumes that all securities are government securities which carry a 0% risk weight.
capital requirements could increase, thereby shrinking banks’ capital buffers. If banks choose to optimize their buffers as a form of insurance against violating regulatory capital requirements (Furfine, 2001), then the buffer stocks will itself also become a function of the revised Accord. Recognizing a role for both the business cycle and the changing nature of the risk weights under the revised Accord, the buffer stock can be written

\[ \theta = \theta(y, \tilde{c}), \quad (9c) \]

where \( \tilde{c} \) signifies that the risk-based capital requirement on corporate loans is variable.

One feature of the forthcoming Basel revisions is the explicit incorporation of credit ratings on the underlying corporate borrowers into the risk-based standards. Therefore, another contribution of this study is that it incorporates some of the unique features of the revised Accord. Specifically, under the standardized approach, the fact that the risk-based capital requirement on loans depends on external credit ratings \( \Phi \) of the borrowing entities means

\[ c = \tilde{c}(\Phi) \quad \text{where} \quad \tilde{c}_\Phi < 0. \quad (9d) \]

In Equation (9d), the risk-based capital requirement on corporate loans is negatively related to the external credit ratings of the borrowing entities. Following Saunders (2006), the credit rating of corporate borrowing entities is further assumed to reflect both borrower-specific \( \eta \) and market-specific factors, such as the business cycle \( y \). Therefore,

\[ \Phi = \Phi(\eta, y) \quad \text{where} \quad \Phi_y > 0. \quad (9e) \]

### 3. Results under the 1988 and revised Accords

#### 3.1. Binding versus nonbinding standards

Using the system of Equations (1) through (9a), Blum and Hellwig (1995) examined how the 1988 Accord altered the bank equity-lending relationship, and in turn influenced macroeconomic conditions. They concluded that for capital-constrained banks, the 1988 Accord exacerbated macroeconomic fluctuations in the event of a negative aggregate demand shock. Alternatively, using Equation (9b) to represent the revised Accord, and substituting Equations (9c) through (9e) into the system reveals a number of channels through which the revised Accord could have a different impact on the economy than the 1988 standards.

When risk-based capital is not binding, \( \frac{(E-\theta)}{e} > E + (1-\rho)D^d \), the critical components of the aggregate demand multiplier in Equation (2) become

\[ \frac{\partial i^d}{\partial y} = f_3(p - w'l'(y) - \delta_y) + \frac{\partial i^d}{\partial L^d} \left( \delta_y + \frac{1-\rho}{1+\gamma} M^d_y \right). \quad (10) \]
\[
\frac{\partial i^d}{\partial r} = f_2 + \frac{\partial i^d}{\partial LS} \frac{1 - \rho}{1 + \gamma} M^d_r, 
\]

(11)

where \( f \) is the investment function detailed in Equation (3), \( M^d \) is the money demand function, and \( \gamma \) is the currency-deposit ratio. In Equations (10) and (11), the responsiveness of investment to changes in output and interest rates is independent of the capital requirement. Therefore, the effect of an aggregate demand shock on output is the same regardless of whether banks are subject to the 1988 or revised standards.

In contrast, under both the 1988 and revised Accords, the risk-based capital standards become binding when \( \frac{E - \theta}{c} < E + (1 - \rho)D^d \). With respect to the revised Accord

\[
\frac{\partial i^d}{\partial y} = f_3(p - \omega l'(y) - \delta_y) + \frac{\partial i^d}{\partial LS} \left( \delta_y \frac{1}{c} + \frac{-(E - \theta)}{c^2} \tilde{c}_\phi \Phi_y + \frac{-1}{c} (\theta_y + \Phi_y \tilde{c}_\phi \theta_y) \right)
\]

(12)

\[
\frac{\partial i^d}{\partial r} = f_2.
\]

(13)

Equations (12) and (13) reveal the critical components of the aggregate demand multiplier under the revised Accord. Specifically, Equation (12) contains a number of distinct channels for transmitting aggregate demand shocks to the economy, thereby allowing for a comparison of the procyclical effects of the 1988 and revised Accords.

3.2. Retained-earnings channel

The first argument in Equation (12), \( f_3(p - \omega l'(y) - \delta_y) \), reveals how an aggregate demand shock is transmitted through retained earnings to firms’ investment demand functions. In Figure 1, a negative demand shock decreases output which in turn leads to a reduction in retained earnings as firms’ revenue declines. The reduction in retained earnings, in turn, reduces investment demand \( (f_3 < 0) \) thereby further decreasing output. While the retained-earnings channel accentuates the initial decrease in output, because the shock is not transmitted through the banking system, investment is independent of the regulatory capital requirements and procyclicality is not influenced by regulators choice between the 1988 and revised Accords.

3.3. Aggregate debt-service channel

In Equation (12), the second argument contains three elements, each of which describes a unique path revealing how a negative shock to economic output is transmitted through banks’ loan supply functions to investment demand. Common to each of these elements is the response of firms’ investment demand function to a change in loan supply, \( \frac{\partial i^d}{\partial L^s} > 0 \).
The first element in this group, \( \frac{\partial id}{\partial LS} \delta y \), reveals how a shock impacts aggregate debt service to influence banks’ loan supply. In Figure 1, the shock reduces output, thereby causing a significant number of corporations to experience a decreasing ability to repay loans (\( \delta y \)). As a result, banks suffer loan losses with a corresponding decline in capital (\( \frac{\partial E}{\partial \delta} = 1 \)). Given the explicit linkage between capital and lending created by the risk-based capital standards, the reduction in capital results in banks reducing their supply of business loans (\( \frac{\partial LS}{\partial E} = 1 \)). In this case, the economic shock ultimately leads to a further decline in output and makes regulatory capital standards more procyclical.

The aggregate debt-service channel exists whether banks are subject to the 1988 or revised Accord, and existing studies by Alfon, Argimon, and Bascuñana-Ambrós (2004) and Lindquist (2004) provide empirical evidence that \( \delta y > 0 \). Therefore, differences in the loan supply-equity relationship influence how investment responds to a shock and whether procyclicality is greater under the 1988 or revised Accords. While under the 1988 Accord \( \frac{\partial LS}{\partial E} \) is fixed such that \( \frac{\partial LS}{\partial E} = \frac{1}{c} = \frac{1}{0.06} \), under the revised standards \( \frac{\partial LS}{\partial E} \) is stochastic with \( c \) ranging between 1.6 and 12%. Given the stochastic nature of the loan supply-equity relationship, \( \frac{\partial id}{\partial LS} \delta y \frac{1}{c} > 0 \), with the aggregate debt-service channel either amplifying or reducing procyclicality relative to the 1988 standards depending on the credit quality of banks’ loan portfolios.

Figure 1
Transmission of an economic shock under the revised Basel Accord
This figure illustrates the various channels through which an economic shock is transmitted to economic output under the revised Basel Accord.
For portfolios composed of loans to companies rated AA- to AAA, the aggregate debt-service channel has an influence on procyclicality that is five times greater under the revised Accord than under the 1988 standards, as $\frac{1}{c} = \frac{1}{0.16}$. In this case, banks subject to the revised Accord would be better able to leverage their existing capital when originating loans relative to the 1988 standards. But in the event of a negative economic shock, because of the low credit risk nature of their commercial loan portfolios, banks would have less capital available to absorb loan losses, thereby increasing the need to reduce lending. As a result, the lower initial capital charge on the loan portfolio under the revised Accord causes a larger reduction in loan supply after the shock, thereby making the revised standards more procyclical than the 1988 standards. Only for those portfolios composed of loans from companies rated B+ or below would the revised standards dampen procyclicality relative to the 1988 Accord.

In reality, banks’ loan portfolios are not composed of loans of a single credit quality. Rather, banks’ loan portfolios represent a distribution of credit qualities. Catarineu-Rabell, Jackson, and Tsomocos (2005) note a study by the Basel Committee that finds the distribution of credit quality corporate exposures in banks in G-10 countries to be that 8.2% of corporate loans are in the AAA or AA category, 26.8% are in the A category, 58.6% are in the BBB or BB category, and 5.4% are rated in categories B or below. Extending the results of this channel to a representative portfolio suggests that, baring a Lucas critique like shift in the credit quality distribution of commercial loans, the aggregate debt-service channel will amplify the procyclical effects of the revised Accord relative to the 1998 standards.

### 3.4. Ratings-migration channel

The second argument in Equation (12) also introduces a ratings-migration channel, $\left(\frac{\partial d}{\partial \Phi}\right) - \left(\frac{(E-\theta)}{c^2}\right)\phi \Phi_y$, that reveals how economic shocks influence investment via changes in credit ratings. In Figure 1, a negative economic shock reduces output which could lead to deteriorating credit ratings as $\frac{\partial \Phi}{\partial y} > 0$. Assuming that credit ratings across corporate borrowers are positively correlated and deteriorate during a downturn (Amato and Furfine, 2004), the decline in credit ratings causes the regulatory capital requirements on commercial loans of capital-constrained banks to increase ($\phi < 0$). Viewed as a regulatory tax (Berger and Udell, 1994), this higher tax on commercial loans under the revised risk-based capital standards leads to a reduction in banks’ loan supply ($\frac{\partial L_S}{\partial c} = -\frac{(E-\theta)}{c^2} < 0$). As a result, $\left(\frac{\partial d}{\partial \Phi}\right) - \left(\frac{(E-\theta)}{c^2}\right)\phi \Phi_y$ is positive with the reduction in loan supply reducing investment and amplifying the procyclical effects of the regulatory capital standards.

While a growing body of research has been devoted to examining the ratings-migration channel, under the standardized approach the migration of credit ratings only alters procyclicality when external credit ratings move across risk-weight buckets ($\phi \neq 0$). Given that $-\left(\frac{(E-\theta)}{c^2}\right)\phi \Phi_y > 0$, the ratings-migration channel increases procyclicality in cases of credit rating downgrades. In cases where ratings are downgraded but do not lead to a change in risk weights, the ratings-migration channel
has no effect on procyclicality as $\bar{c}_\Phi = 0$. In contrast, under the 1988 Accord, the ratings-migration channel does not exist because capital requirements are invariant to fluctuations in credit risk ($c_\Phi = 0$). These results are consistent with Jokivuolle and Peura (2001) in suggesting that the revised Accord exacerbates changes in economic activity beyond what would have occurred under the 1988 Accord.

Given these results, a relevant question becomes how frequently credit ratings deteriorate sufficiently to require higher capital requirements under the revised Accord. In examining historical data, Carpenter, Whitesell, and Zakrajsek (2001) and Bangia, Diebold, Kronimus, Schagen, and Schuermann (2002) conclude that during a recession migration from the 20% risk-weight category to a higher risk category occurs in less than 3% of loans to AAA and AA rated companies. For loans in the 20% and 50% risk-weight categories, downgrades to a higher risk-weight category occur in at most 2.1% and 3% of cases, respectively. Applying these results suggests that while the ratings-migration channel will increase procyclicality, migration across risk-weight categories during recessions is an infrequent event.

3.5. Buffer-stock channel

The existence of a buffer stock of capital influences the procyclicality of the revised Accord in two ways. First, if $\theta > 0$, then banks that are not constrained by the risk-based standards may act as if the standards are binding even though these banks satisfy the regulatory capital requirement. In this case, Equation (9b) replaces Equation (9a) as the relevant condition. Second, banks’ capital buffers could respond to not only the business cycle, but also to the risk-varying nature of the revised regulatory capital standards themselves. These paths are shown at the bottom in Figure 1. The term $(\frac{\partial id}{\partial LS})^{-1} (\theta_y + \bar{c}_\Phi \theta_z)$ in Equation (12) shows how, under the revised Accord, an economic shock interacts with banks’ buffer stocks to influence the investment function. Given that $(\frac{\partial id}{\partial LS}) > 0$ and that from Equation (9b) $\frac{\partial LS}{\partial \theta} = -1 < 0$, the effect of the buffer stock on procyclicality is determined by the sign of $(\theta_y + \bar{c}_\Phi \theta_z)$.

With regard to the impact of the business cycle on the buffer stock, Greenspan (2002), Lowe (2002), and Segoviano and Lowe (2002) argue that under the revised Accord $\theta_y > 0$. In the event of a negative aggregate demand shock, banks draw down their buffer stocks of capital. This decrease in the buffer stock allows banks to partially offset the decrease in loan supply that would otherwise result from the negative shock, thereby partially offsetting the decrease in investment. As a result, the drawing down of the buffer stock of capital serves to mitigate the economic effects of the shock and reduces procyclicality. One possible justification for this finding is that forward-looking banks increase capital during periods of growth because increasing capital during economic downturns can be costly (Alfon, Argimon, and Bascuñana-Ambrós, 2004).

However, Lindquist (2004) and Stolz and Wedow (2005) conclude that under the 1988 Accord $\theta_y < 0$. As output decreases banks increase their capital ratios
in response to the deteriorating credit conditions, this coinciding with a further contraction in lending. As a result, this direct portion of the buffer-stock channel serves to heighten the sensitivity of bank loans and investments to economic shocks. With respect to the forthcoming revised Accord, simulations by Peura and Jokivuolle (2003) conclude that the size of the capital buffer is likely to increase as output falls, thereby also suggesting that \( \theta_y < 0 \). But given the limitations inherent in trying to analyze forthcoming regulatory changes using historical data as noted earlier, extreme care needs to be taken in using this result.

In addition, the impact of the buffer-stock channel on procyclicality is also determined by the term \( \Phi_y \tilde{c} \Phi \theta \). This term reflects banks’ optimization decisions as to how changing regulatory capital requirements will impact capital buffers under the revised Accord, as unexpected changes in credit ratings will now alter regulatory capital requirements. This indirect effect of a shock on the buffer stock does not exist under the 1988 Accord because under the 1988 standards deteriorating credit ratings have no influence on regulatory capital requirements. With regard to the revised Accord, a negative shock to output causes credit ratings to deteriorate \( (\Phi_y > 0) \) with the deterioration causing the risk weight on loans under the revised Accord to increase \( (\tilde{c}_\Phi < 0) \). If banks hold capital buffers as insurance against the risk of being undercapitalized, the increase in the minimum regulatory capital requirements increases the likelihood of the bank violating regulatory capital standards, thereby reducing the value of the insurance provided by the buffer stock. Assuming banks seek to maintain the value of their insurance, they increase their buffers. Therefore, \( \theta \tilde{c} > 0 \) and \( (\Phi_y \tilde{c} \Phi \theta) < 0 \), results that are consistent with this indirect portion of the buffer-stock channel increasing procyclicality.

3.6. Total impact of the revised accord

With respect to the overall impact of the revised Accord on procyclicality, the more complete model reveals that two conditions must be met if procyclicality is to be reduced relative to the 1988 Accord. First, the magnitude of the combined channels of the revised Accord must be less than the magnitude of the combined channels of the 1988 Accord. Excluding the retained-earnings channel, and eliminating \( (\frac{\partial \delta}{\partial L_T}) \) from both sides of the equation, the condition is written

\[
-\frac{1}{\tilde{c}} \theta_y + \frac{1}{\tilde{c}} \delta_y > 1 \delta_y + \frac{-(E - \theta \tilde{c})}{\tilde{c}^2} \tilde{c}_\Phi \Phi_y + \frac{1}{\tilde{c}} \Phi_y \tilde{c}_\Phi \theta \tilde{c} + \frac{1}{\tilde{c}} \theta_y.
\]

(14)

The left-hand side of Equation (14) contains the buffer-stock and aggregate debt-service channels under the 1988 Accord. As discussed earlier, both elements are positive thereby making the 1988 risk-based standards procyclical. On the right-hand side of the equation, the first three elements are the aggregate debt-service, ratings-migration, and indirect portion of the buffer-stock channels under the revised Accord. All three of these elements are also positive. Finally, the fourth element on the right-hand side represents the direct buffer-stock channel under the revised
Accord. Given that the total of the magnitude of the four channels under the revised Accord must be less than that of the 1988 Accord, a second condition for reducing procyclicality is that $\theta_y > 0$ under the revised Accord and is of sufficient magnitude so as to make Equation (14) true.\(^7\) This is the argument put forth by Greenspan (2002). But this requirement is not consistent with either existing evidence on the 1988 Accord or simulations of $\theta_y$ under the revised standards by Peura and Jokivuolle (2003). Therefore, if Equation (14) is to be met, and procyclicality is to be reduced under the revised Accord, bank regulators will need to use the enhanced supervisory powers (Pillar 2) or the increased disclosure powers (Pillar 3) to significantly alter banks’ capital and risk management processes in order to insure that $\theta_y > 0$.

4. Policy implications and conclusions

The purpose of this study is to understand the business cycle implications of a revised Basel Accord and to compare its effects on procyclicality with those of the 1988 standards. Given the important policy relevance of this issue, the theoretical model developed by Blum and Hellwig (1995) is extended to incorporate two of the key features of the revised Accord, the incorporation of credit ratings on business loans and the fact that regulatory capital requirements can migrate as credit ratings change. One of the contributions of this paper is that it provides a more comprehensive model to compare the procyclical effects of the 1988 and revised Accords, yet does so in a manner that recognizes the limitations of the Lucas critique as applied to regulatory capital standards.

Specifically, this study finds a number of conclusions regarding the macroeconomic effects of the revised risk-based capital standards. First, depending on the credit quality of business loans comprising banks’ portfolios, the revised standards may constrain banks’ capital at higher or lower levels of capital, with implications for bank lending, investment and the macroeconomy. The results show that the sensitivity of investment to fluctuations in output is independent of regulatory capital standards for unconstrained banks. Therefore, the argument that procyclicality will increase under the revised Accord requires that the revised standards to be constraining for at least some sufficiently large subset of internationally active banks.

Second, whether the revised Accord produces effects on investment and economic output that are greater or less than those produced by the 1988 Accord also depends on the channels through which economic shocks are transmitted to banks’ loan supply functions. For capital-constrained banks, and those behaving as if they are constrained, extending the Blum and Hellwig (1995) model provides three distinct channels detailing how the risk-based capital standards can influence procyclicality. Examining these channels as a group suggests that enhanced regulatory supervision

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\(^7\) This condition assumes that banks maintain the credit quality distribution in their loan portfolios as found by Catarineu-Rabell, Jackson, and Tsomocos, 2005.
(Pillar 2) and increased disclosure (Pillar 3) will need to make the buffer stock of capital positively related to the business cycle in order for procyclicality to be reduced under the revised Accord.

While the analysis of the revised Accord assumes that banks’ regulatory capital requirements are based on the standardized approach, many of the largest and most sophisticated internationally active banks are likely to use one of the internal ratings-based approaches of the revised Accord. The question thus becomes to what degree will the conclusions of this study hold for banks that apply the internal ratings-based approach? In this regard, Treacy and Carey (1998) reveal that many banks’ internal systems have more than four categories for classifying the credit risk of commercial loans. A priori, as the number of risk-weight categories in banks’ internal models increase, capital requirements are likely to be more granular with changes in capital requirements resulting from credit risk migration likely to be more gradual and less abrupt.

Finally, the findings of this study make the macroeconomic implications of the revised Accord responsive to more than just the credit ratings of domestic businesses. Because domestic bank loans to foreign corporations, banks, and governments are also subject to credit ratings that could migrate over the business cycle, the revised Accord provides a transmission mechanism for regulatory capital standards to cause disturbances in one economy to be transmitted to financial markets in other countries (Jacques, 2005). This could be particularly problematic for corporations and banks in developing economies as their credit ratings are strongly linked to their country’s sovereign rating, ratings that Ferri, Liu, and Majnoni (2001) argue exhibit excessive volatility. In that sense, the results of this study are consistent with Peek and Rosengren (1997) who conclude that the 1988 risk-based capital standards, combined with a decline in Japanese equity prices, caused problems in the Japanese economy to be transmitted to commercial lending in the United States.

References


