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Bank Capital Requirements, Business Cycle Fluctuations and the Basel Accords: A Synthesis

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Abstract

In order to survey the mechanisms through which the introduction of Basel II bank capital requirements is likely to accentuate the procyclical tendencies of banking, this paper brings together the theoretical literature on the bank capital channel of propagation of exogenous shocks and the literature on the regulatory framework of capital requirements under the Basel Accords.

We conclude that, although the theoretical models that revisit the bank capital channel under the new Accord generally support the Basel II procyclicality hypothesis, this issue is still subject to some debate. In particular, the magnitude of the procyclical effects under Basel II should essentially depend on (*i*) the composition of banks' asset portfolios, (*ii*) the approach adopted by banks to compute their minimum capital requirements, (*iii*) the nature of the rating system used by banks, (*iv*) the view adopted concerning how credit risk evolves through time, (*v*) the capital buffers over the regulatory minimum held by the banking institutions, (*vi*) the improvements in credit risk management, and (*vii*) the supervisor and market intervention under Basel II.

Keywords: Bank Capital Channel, Basel Accords, Business Cycles, Procyclicality

JEL Classification Codes: E44, G28

1 Introduction

The Basel Committee on Banking Supervision released, in 2004, the new Basel Capital Accord (usually referred to as Basel II) to address some of the major shortcomings of the previous Basel Accord of 1988 (Basel I), thus fostering stability in the financial system. One of the central changes proposed by Basel II is the increased sensitivity of a bank's capital requirement to the risk of its assets: the amount of capital that a bank has to hold is to be directly connected to the riskiness of its underlying assets. This aspect of the new regulation has raised some concerns, at both academic and policy-making levels, since it may accentuate the procyclical tendencies of banking, in the presence of an imperfect market for bank capital: if, during a recession, bank borrowers are downgraded by the credit risk models in use, minimum bank capital requirements will increase. To the extent that it is difficult or costly for banks to raise external capital in bad times, this co-movement in bank capital requirements and the business cycle may induce banks to further reduce lending during recessions, thereby amplifying the initial downturn.

Banking regulation and, in particular, the new Basel Accord have gained special interest with the financial turmoil that began in 2007 in the U.S. subprime market, then spreading to broader credit and funding markets. As mentioned by the IMF in its latest Global Financial Stability Report (International Monetary Fund, 2008), this financial turmoil has weakened the capital and funding of large systemically important financial institutions, which then needed to raise capital or cut back assets to cope with the strains. In fact, as recently pointed out by Rosengren (2008), banks play a critical role during periods of financial turmoil because they are highly leveraged and regulated institutions, and to maintain their capital ratios after experiencing a large negative capital shock they must significantly shrink assets, which, in turn, tends to amplify the effects of economic shocks. Thus, the recent growing acceptance among investors that banks need to recapitalize, either by selling assets or issuing new shares, and the introduction of new regulatory capital requirements, can cause the crisis to deepen further, and render more difficult for policy makers to maintain macroeconomic stability.

The present work surveys the literature in order to explore whether the introduction of the new regulation on bank capital is likely to accentuate the procyclical tendencies of banking. We address this hypothesis - the Basel II procyclicality hypothesis - by bringing together the theoretical literature on the bank capital channel of propagation of exogenous shocks and the literature on the regulatory framework of capital requirements under the Basel Accords.

The bank capital channel thesis has been somehow motivated by empirical evidence that bank capital affects banks' supply of loans and, consequently, real activity. Kishan and Opiela (2000, 2006), Van den Heuvel (2002b) and Gambacorta and Mistrulli (2004), for instance, show that the real effects of monetary policy are generally stronger when banks are small and low-capitalized. Hubbard *et al.* (2002), in turn, find that, even after controlling for information costs and borrower

risk, the capital position of individual banks affects the interest rate at which their clients borrow. Additionally, there is a quite extensive empirical literature on the hypothesis that a 'credit crunch' - a significant leftward shift in the supply curve for bank loans - may have occurred in the U.S. during the early 90s, simultaneously with the implementation of Basel I. On this credit crunch literature, see, for instance, Bernanke and Lown (1991), Berger and Udell (1994), Peek and Rosengren (1995, 2000), Furfine (2001), and Sharpe (1995) for a review.

We thus begin by synthesizing the theoretical literature on the bank capital channel, according to which the introduction of bank capital requirements, for market or regulatory reasons, amplifies the effects of monetary and other exogenous shocks. This amplification effect usually rests on the argument that raising new capital can be difficult and costly for many banks, especially during economic downturns, thereby increasing the financing cost faced by firms that borrow from those banks. Firms with no effective alternative sources of credit tend to react to this increase in their financing cost by decreasing investment and output.

We then focus on whether the introduction of Basel II capital requirements will add to this amplification effect. After briefly reviewing the key reasons for regulating banks, as well as the role of bank capital requirements in banking regulation, we concentrate on whether the increased sensitivity of a bank's capital requirements to the risk of its assets under Basel II, is likely to accentuate the amplification effect underlying the bank capital channel. We conclude that, although the theoretical models which revisit the bank capital channel under the new Accord generally support the Basel II procyclicality hypothesis, this issue is still subject to some debate. In particular, the magnitude of the procyclical effects should essentially depend on (i) the composition of banks' asset portfolios, (ii) the approach adopted by banks to compute their minimum capital requirements, (iii) the nature of the rating system used by banks, (iv) the view adopted concerning how credit risk evolves through time, (v) the capital buffers over the regulatory minimum held by the banking institutions, (vi) the improvements in credit risk management, and (vii) the supervisor and market intervention under Basel II.

The paper is organized as follows. After this introduction, Section 2 synthesizes the bank capital channel theoretical literature. Section 3 takes a closer look at regulatory capital requirements. After briefly reviewing the key reasons for regulating the banking system and the role of regulatory capital requirements in this context, we focus on the Basel Accords and, in particular, on capital requirements for credit risk under Basel II. Section 4 discusses the Basel II procyclicality hypothesis, both at the empirical and theoretical level, also pointing out some corrective measures that may counteract the potential procyclical effects. Section 5 concludes with some final remarks.

2 The Bank Capital Channel: Related Theoretical Literature

The theoretical literature distinguishes three channels of monetary policy propagation, through financial imperfections: (*i*) the bank lending channel, arising from the fact that banks finance loans in part with liabilities that carry reserve requirements, (*ii*) the borrowers' balance sheet channel, focusing on borrowers' financial position and its effect on the external finance premium that borrowers face and, more recently, (*iii*) the bank capital channel, emphasizing that monetary policy affects bank lending through its impact on bank capital.[1]

The bank lending channel and the borrowers' balance sheet channel have been more extensively studied - see Bernanke and Gertler (1995), for a review. Instead, we focus on the bank capital channel models, summarized in Table 1 and classified according to (*i*) the motivation for bank capital holdings (market *vs* regulatory capital requirements), (*ii*) the nature of bank capital (issued capital and/or retained earnings), and (*iii*) the effects of exogenous shocks on lending and on the business cycle.

The rationale for bank capital holdings builds on the premise that banks may hold capital for market and/or regulatory reasons. Market capital requirements, as defined by Berger *et al.* (1995), are associated with the capital ratio (*i.e.*, the ratio of bank capital to assets) that maximizes the value of the bank in the absence of regulatory capital requirements, but in the presence of the remaining regulatory structure that protects the safety and soundness of the banking system. According to these authors, market requirements can be justified (*i*) by the costs of banks' financial distress, which tend to increase if the bank capital ratio decreases, (*ii*) by the transaction costs of issuing equity, coupled with substantial financial distress costs from low capital, and (*iii*) by the existence of agency problems between shareholders and creditors.

As reported in Table 1, Chen (2001), Meh and Moran (2007), Aikman and Paustian (2006) and Sunirand (2003) focus on this type of bank capital requirements. The first three of these models have been built upon Holmstrom and Tirole (1997)'s formulation, featuring two sources of moral hazard. The first source affects the relationship between banks and borrowers: entrepreneurs (borrowers) can choose between different projects and have an incentive to undertake the riskier projects in order to enjoy private benefits. To deter entrepreneurs from going after those private benefits, banks require them to invest their own funds in the project. The second source of moral hazard influences the relationship between banks and households (depositors) and is the reason for the existence of market capital requirements: since banks may not dutifully monitor

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[1]As both the bank lending channel and the bank capital channel build on the hypothesis that monetary policy works, in part, by affecting banks' supply of loans, they are sometimes treated as part of a broader bank lending channel, notwithstanding being based on different transmission mechanisms. Note, for instance, that in contrast to the traditional bank lending channel, the borrowers' balance sheet and the bank capital channels may operate in response to factors other than changes in monetary policy.

entrepreneurs, households only lend to banks that invest their own net worth (bank capital) in financing the entrepreneurs' projects. As delegated monitors for depositors, banks must then be well capitalized to convince depositors that they have enough stake in the entrepreneurs' projects.

In this context, Chen's model predicts that, since both bank capital and firms' net worth are used as collateral, a change in their level has a direct effect on bank lending and, thus, on aggregate investment: when bank capital decreases, banks find it difficult to seek alternative sources of finance and are forced to cut back lending to firms, which, in turn, affects negatively firms' investment. This effect tends to persist over time: less investment in the previous period, causes entrepreneurs and banks to earn less revenue, which affects negatively their level of net worth. This further weakens the lending capability of banks and the borrowing capacity of entrepreneurs.

Meh and Moran (2007) go a step further and embed Holmstrom and Tirole (1997)'s framework within a dynamic general equilibrium model, in which a contractionary monetary policy not only raises the opportunity cost of the external funds that banks use to finance investment projects but also leads the market to require banks and firms to finance a larger share of investment projects with their own net worth. Since banks and firms' net worth are largely predetermined, bank lending must decrease to satisfy the market requirements, thereby leading to a decrease in investment. This, in turn, affects negatively banks and firms' earnings and, consequently, banks and firms' net worth in the future, leading to the propagation of the initial shock over time. Furthermore, Aikman and Paustian (2006)'s model, building on the earlier work by Chen (2001), predicts that financial frictions lead to a persistent (as in Meh and Moran, 2007) and amplified response of the macroeconomic variables to technology, monetary and bank capital shocks. The amplification effect rests on the existence of external capital adjustment costs in the model: a contractionary monetary policy, for instance, reduces the net worth of both entrepreneurs and banks, and, as in Kiyotaki and Moore (1997) and Bernanke *et al.* (1999), induces a negative feedback effect from net worth to asset prices, and then back from asset prices to net worth, which greatly magnifies the impact of the initial shock.

	Capital Requirements (CR)		Bank Capital	Effect of exogenous shocks on lending and/or on the business cycle
Chen (2001)	Market	-	-	Amplified and more persistent*
Sunirand (2003)	Market	-	Retained Earnings	Amplified with the introduction of a double CSV approach
Aikman and Paustian (2006)	Market	-	Retained Earnings + Endowment	Amplified and more persistent with the introduction of an asym. inform. problem between depositors and banks and between banks and firms
Meh and Moran (2007)	Market	-	Retained Earnings	More persistent*
Blum and Hellwig (1995)	Regulatory	Binding	Fixed (no new equity issue)	Amplified with the introduction of binding CR
Thakor (1996)	Regulatory	Binding	-	↑ Risk-based CR ⇒ decrease in aggregate lending; Expansionary MP when CR are binding may not increase lending
Repullo and Suarez (2000)	Regulatory	Binding	Retained Earnings	Contractionary MP ⇒ ↓ bank lending relative to market lending
Furfine (2001)	Regulatory	Not Binding	Retained Earnings + Issued Equity	↑ Risk-based CR or a negative shock to bank capital ⇒ decrease in loan growth
Chami and Cosimano (2001)	Regulatory	Binding/Not Binding	Issued Equity (but predetermined)	*Bank capital accelerator effect*: amplifies the impact of MP on the economy
Van den Heuvel (2002a)	Regulatory	Binding/Buffer	Retained Earnings	*Bank capital channel* (BCC): with CR, lending overreacts to a MP shock; the BCC amplifies the standard interest rate channel of MP
von Peter (2004)	Resembles a Regulatory CR	Binding/Not Binding	Retained Earnings	Negative shock ⇒ ↓asset prices ⇒ ↑firms default ⇒ ↑loan losses ⇒ ↓bank capital ⇒ ↓credit supply (if CR are binding) ⇒ ↓asset prices
Kopecky and VanHoose (2004)	Regulatory	Binding	Issued Equity	↑ Risk-based CR reduces the effects of MP
Honda (2004)	Regulatory	Binding/Not Binding	Fixed	The more the banks are constrained by CR, the less effective MP is
Berka and Zimmermann (2005)	Regulatory	Binding	Issued Equity	Negative aggregate shock ⇒ credit crunch; But negative ag. shock and procyclical CR (tighter during recession) soften the loan decrease
Cecchetti and Li (2005)	Regulatory	Binding/Not Binding	Moves with aggregate output (by assumption)	Confirms Blum and Hellwig (1995)'s results + Optimal MP neutralizes the procyclical impact of binding CR
Bolton and Freixas (2006)	Regulatory	Binding	Issued Equity	Potential amplifying effect of MP: tightening in MP ⇒↓ incentives to raise bank capital ⇒ further decline of lending
Markovic (2006)	Regulatory	-	Issued Equity	Amplification of output response to a contractionary MP
Aguiar and Drumond (2007)	Regulatory	Binding	Issued Equity	Introduction of CR amplifies monetary shocks through a liquidity premium effect on the external finance premium faced by firms
Jorge (2007)	Regulatory	Binding	Retained Earnings	Due to CR, loans react with a delay to shifts in monetary policy
Van den Heuvel (2008)	Regulatory	Binding/Not Binding	Issued Equity	↑ CR reduces welfare

*When compared to a situation where information frictions between banks and depositors are absent

MP = Monetary Policy; CR = Capital Requirements

Table 1: The Bank Capital Channel - Related Theoretical Models

Following a different approach, Sunirand (2003) also supports the bank capital amplification hypothesis: by extending the financial accelerator model of Bernanke *et al.* (1999) to consider a two-sided costly state verification (CSV) framework, Sunirand is able to dissociate the amplification effect caused by the moral hazard problem between depositors and banks, from the amplification effect caused by the asymmetric information problem between banks and firms. In the well known CSV framework, first introduced by Townsend (1979), the lender must pay a cost in order to observe the borrower's realized return. In Sunirand's model, banks act as delegated monitors on firms' investment projects, as in Bernanke *et al.*, while depositors perform the role of 'monitoring the monitor', as in Krasa and Villamil (1992).[2] The two-sided costly state verification framework leads to a wedge between the internal and external cost of funds, that motivates an endogenous role for firms' and banks' capital in the model. Sunirand then shows that embedding the informational asymmetry between households and banks into the financial accelerator model, further amplifies and propagates the effects of a negative monetary shock on aggregate output and investment.

Several other studies have focused instead on bank capital requirements imposed by banking regulation - *e.g.*, Blum and Hellwig (1995), Thakor (1996), Repullo and Suarez (2000), Chami and Cosimano (2001), Van den Heuvel (2002a, 2008), Berka and Zimmermann (2005), Bolton and Freixas (2006), Markovic (2006) and Aguiar and Drumond (2007). Blum and Hellwig (1995), who have pioneered this approach, argue that a rigid link between bank capital and bank lending imposed by regulation may amplify macroeconomic fluctuations, by leading banks to lend more when times are good and to lend less when times are bad. Assuming that banks cannot issue new capital and that firms do not fully replace bank loans by other sources of finance, the amplification mechanism works as follows. If many banks face low return realizations at the same time, they may all become simultaneously undercapitalized and then all may have to decrease lending (or to recapitalize) at the same time, in the presence of a regulatory capital adequacy requirement. This is likely to reduce firms' investment and, therefore, aggregate demand and firms' cash flows, which negatively affects the ability of firms to pay their debts and hence the return that banks receive on their loans. A given initial shock to asset returns may thus be amplified by a rigid application of a capital adequacy requirement (Blum and Hellwig, 1995, pp. 741-742).

An alternative explanation for the decrease in bank loan supply during bad times, under regulatory capital requirements, rests on banks' exposure to the interest rate risk. In Repullo and Suarez (2000), for instance, some long-term bank assets involve fixed interest rates whereas the returns of many short-term bank liabilities are closely linked to market interest rates. A monetary tightening thus generates losses to the banks, thereby reducing bank capital, which, in turn, produces a credit crunch under regulatory capital requirements: bank lending and investment decrease, and the higher quality bank borrowers tend to shift to market finance. Van den Heuvel (2002a) also assumes that banks are exposed to interest rate risk, while not able to issue new capital. An

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[2]See also Zeng (2002) on this approach.

increase in the interest rate after a contractionary monetary policy and, consequently, an increase in the bank's cost of funding, leads to a decrease in bank's profits, given the maturity mismatch on the bank's balance sheet, weakening the bank's future capital position and thus increasing the likelihood that its lending will be constrained by an inadequate level of capital. Therefore, new lending overreacts to the monetary policy shock, when compared to a situation of unconstrained banks. Van den Heuvel refers to this channel operating via the supply of bank loans through its impact on bank capital as the bank capital channel. Its strength depends on the capital adequacy of the banking sector and on the distribution of capital across banks (since, as mentioned by Benink *et al.*, 2008, there is no interbank market for bank equity). In particular, lending by banks with low capital is delayed and then amplified in reaction to interest rate shocks, relative to well capitalized banks.

Chami and Cosimano (2001), Berka and Zimmermann (2005), Bolton and Freixas (2006), Markovic (2006) and Aguiar and Drumond (2007) also consider regulatory capital requirements, but, in contrast with Van den Heuvel, assume that banks may issue equity. However, equity issuance may involve costs, as in Bolton and Freixas (2006), who introduce a cost of outside capital for banks by assuming information dilution costs in the issuance of bank equity: outside equity investors, having less information about the profitability of bank loans, tend to misprice the equity issues of the most profitable banks. In such a context, binding regulatory capital requirements may magnify the effects of a contractionary monetary policy, since this policy may cause a decrease (or prevent an increase) in bank capital, as bank loans become insufficiently lucrative when information dilution costs in bank equity issuance are taken into account.

Markovic (2006) also explores the asymmetric information relationship between banks and their shareholders, developing a model that extends Bernanke *et al.* (1999)'s work to account for three bank capital channels: (*i*) the adjustment cost channel, which builds on the allocation cost necessary to reduce the aforementioned asymmetric information problem; (*ii*) the default risk channel, which arises from the possibility of banks defaulting on their capital; and (*iii*) the capital loss channel, based on the assumption that, during a recession, banks' shareholders anticipate a future fall in the value of bank capital. All channels trigger an increase in the required return on bank capital by shareholders, and thus an increase in the cost of bank capital, during a recession. This higher cost is then transferred to firms, leading to lower firms' investment and output. All the three channels thus amplify the output response to a contractionary monetary policy.

In a slightly different perspective, Van den Heuvel (2008) quantifies the potential welfare costs of bank capital requirements by embedding the role for liquidity creation by banks in a general equilibrium growth model, with no aggregate uncertainty. The households' preferences for liquidity play here a major role: equilibrium asset returns reveal the strength of these preferences and allow the quantification of a fairly large (according to the author's simulations for the U.S. economy) welfare cost of bank capital requirements. Regulators, thus, face a trade-off between keeping the

effective capital requirement ratio as low as possible while keeping the probability of bank failure acceptably low.

In fact, Diamond and Rajan (2000) and Gorton and Winton (2000) suggest that bank capital may be costly by reducing banks' ability to create liquidity through deposits: an increase in bank capital may reduce the probability of financial distress but also reduces liquidity creation by banks by decreasing the aggregate amount of deposits (the 'financial fragility-crowding out effect', as Berger and Bouwman, 2006, put it, which may be especially significant for small banks). In this context, Aguiar and Drumond (2007) build a bank capital channel, working through a liquidity premium effect, into a dynamic general equilibrium model. The liquidity premium effect rests on the fact that bank capital is more expensive to raise than deposits, due to households' preferences for liquidity, and the amplification effect arises as this difference tends to widen (narrow) during a recession (expansion). In bad times, for instance, the increase in the liquidity premium required by households to hold bank capital in their portfolios, is passed on to firms by the bank through an increase in the external finance premium. Hence, the external finance premium faced by firms increases, not only because firms' leverage increases (as in Bernanke *et al.*, 1999's model), but also because the liquidity premium required by the households increases, thus further amplifying the real effects of both nominal and real exogenous shocks.

To summarize, the bank capital channel thesis overall predicts that the introduction of bank capital requirements, for market or regulatory reasons, tends to amplify the effects of monetary and other exogenous shocks. The amplification effect typically arises from imperfections in the markets for bank capital: in some models banks are not able to raise capital in the open market, implying that bank capital becomes determined by banks' retained earnings and changes in their asset values, whereas in other models banks may issue capital but face an issuance cost that tends to increase during economic downturns. In this context, if the value of bank capital decreases or its issuance costs increase, the banks' cost of funds tends to increase, particularly when the amount of bank capital is not much higher than the level demanded by regulators or the market. This higher cost is then transferred to firms, when borrowing from banks, thereby leading to lower investment and output.

Finally, it should be emphasized that economic policy conclusions must be drawn carefully from this review, since some of the models abstract from many important features of the economy, and, most importantly, from some benefits of banking regulation (in preventing bank failure and systemic risk). As a matter of fact, our analysis has not been concerned with questions such as whether bank capital regulation is itself optimal and what type of regulation is more appropriate. We, thus, proceed in next section to a more detailed analysis of the institutional regulatory bank capital requirements, in order to further investigate their potential role in the propagation of business cycle fluctuations.

3 Capital Requirements within Banking Regulation

In the preceding section we have reviewed the bank capital channel literature and have seen how it hinges on the requirement of capital holdings by banks, either for market or regulatory reasons. We now take a closer look at regulatory capital requirements, with the purpose of discussing, in the next section, whether the new Basel Capital Accord will strengthen or weaken the amplification effect underlying the bank capital channel.

3.1 Banking Prudential Regulation

Regulatory bank capital requirements are part of a broader set of instruments used in banking prudential regulation. As mentioned by Freixas and Rochet (1997), other instruments include (i) entry, branching, network, and merger restrictions, (ii) portfolio restrictions, (iii) deposit insurance, (iv) regulatory monitoring (including closure policy), and (v) deposit interest rate ceilings.

The rationale for any regulation is usually associated with market failures, such as externalities, market power or asymmetric information. For the particular case of the banking industry, Lind (2005) points out three motives for regulation: (i) certain banking activities are intrinsically vulnerable;[3] (ii) even minor disturbances can threaten overall financial stability through contagion; (iii) banks are the dominant providers of some services crucial for the society, such as the payment system and lending to small and medium-sized enterprises.

Other authors focus on explanations related to asymmetric information. Santos (2001) argues that the inability of depositors to monitor banks is a major reason for banking regulation (the other being the risk of a systemic crisis, which will be analyzed below). According to Dewatripont and Tirole (1994), small depositors protection is indeed one of the primary concerns behind current prudential regulation of banks. Asymmetric information leads to substantial moral hazard and adverse selection in banking, which requires that investors must perform several monitoring activities, such as screening and auditing. However, these activities are complex, expensive, and time-consuming, and their duplication by several parties is technically wasteful. Since bank debt is primarily held by a very large number of small depositors, who are most often unable to understand the specificities of banking activities, a free riding problem emerges: each small depositor has little individual incentive to perform the various monitoring functions. This free riding gives rise to a need for private or public representatives of depositors (Dewatripont and Tirole, 1994, pp. 31-32).[4] It is true that large corporations are also financed by the public and that stocks and bonds issued

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[3]For instance, as loans usually have a longer duration than deposits, banks may lose a large proportion of their deposits rather quickly while their loans remain outstanding.

[4]To ensure that there is better public information, regulators can also require banks to follow certain standard accounting principles and to disclose a wide range of information that helps to assess the quality of a bank's portfolio (Mishkin, 2006, p. 268).

by large companies are also widely diffused. However, these securities are not used as a means of payment, and the ratio of debt to assets is substantially higher for financial intermediaries than for nonfinancial firms. Therefore, the free rider problem involved in the monitoring of widely held firms seems to be quantitatively much more important in the case of banks (Freixas and Rochet, 1997, p. 264).

The prudential regulation of banks is further motivated by systemic risk prevention. As pointed out by Santos (2001), depositors' panic or the release of information when depositors have asymmetric information about bank returns, may lead to the premature liquidation of assets and trigger a bank run, culminating in a banking system failure through contagion. In this context, Allen and Herring (2001) argue that reserve, capital and liquidity requirements designed to ensure that banks will be able to honor their liabilities to depositors, have a consumer protection and microprudential rationale as well as a macroprudential rationale to protect the system against systemic risk. Overall, among the proposals to avoid bank runs are the development of narrow banks - banks that invest the deposits of the public in traded securities -, the development of banks that finance loans entirely with equity, the suspension of convertibility, the central bank's role as lender of last resort and the development of deposit insurance.[5]

In particular, to avoid bank panics and their social costs, the authorities of many countries have established deposit insurance schemes, under which each bank depositors have their deposits insured up to a fixed limit in case the bank fails. However, the creation of a government safety net for depositors may generate excessive risk taking by banks' managers, which itself calls for additional regulation. As Mishkin (2006) argues, with a safety net, depositors know they will not suffer huge losses if a bank fails and, therefore, tend not to withdraw deposits even when they suspect that the bank is taking on too much risk. Additionally, as pointed out by Gorton and Winton (2003), once deposit insurance has been adopted, there is a further need for government intervention via bank regulation because of the incentive of banks to take additional risks once they have (underpriced) government deposit insurance.[6] Regulatory capital requirements should thus be introduced as part of the prudential regulation, providing a cushion against losses, as well as disciplining banks' managers: when a bank is forced to hold a large amount of capital, it faces larger losses in case of failure (Mishkin, 2006, p. 265). In this context, Kashyap and Stein (2004) describe capital regulation as an instrument the regulator uses in order to have each bank internalizing the systemic costs, such as losses backed by government deposit insurance and disruptions suffered by other financial system agents, which are not fully borne by the bank in question.

Capital standards are also seen as an important instrument for promoting optimal governance

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[5] See Santos (2001) for details.

[6] There is a large body of literature on the moral hazard issue of deposit insurance. See Santos (2006) for a review.

of banks, as those standards can be used to define the threshold for the transfer of control from banks' shareholders to the regulator (Santos, 2001, p. 59). Additionally, Morrison and White (2005) argue that capital regulation should also discourage unsound and unreliable institutions from setting up operations: capital requirements can be used to select out bad banks from the system, thus solving adverse selection problems.

In sum, as argued by Santos (2001), rules on bank capital are one of the most prominent aspects of banking regulation, with this prominence resulting mainly from the role of bank capital in banks' soundness, risk-taking incentives and corporate governance, as the literature reviewed in this section shows.

3.2 Bank Capital Regulation: the Basel Accords

The bank capital regulation framework of the Basel Accord of 1988 (Basel I, hereafter), and adopted not only by the countries belonging to the Basel Committee[7] but by more than 100 countries around the world, establishes banks' obligation to continually meet a risk-based capital requirement. In short, under Basel I each bank must maintain a total risk-weighted capital ratio - defined as the ratio of bank capital to the bank's risk-weighted assets - of at least 8%, with the weights depending on the institutional nature of the borrower. For example, a zero weight is assigned to a government security issued in the OECD, meaning that the bank can finance such asset through deposits without adding any capital. Basel I allows for other three weights, in ascending order of risk: 0.2 (*e.g.*, for interbank loans in OECD countries), 0.5 (*e.g.*, for loans fully secured by mortgages on residential property) and 1 (*e.g.*, for industrial and commercial loans).[8]

Under Basel I, the same risk weight thus applies to all loans of a particular category ('one-size-fits-all' approach). Consequently, this categorization does not reflect the risk that a particular borrower actually poses for the bank. The failure to distinguish between loans of very different degrees of credit risk created the incentive for arbitrage activities. As Jones (2000), p. 36, puts it,

> "in recent years, securitization and other financial innovations have provided un-
> precedented opportunities for banks to reduce substantially their regulatory measures
> of risk, with little or no corresponding reduction in their overall economic risks - a
> process termed regulatory capital arbitrage (RCA)."

As argued by Jones, RCA typically exploits differences between a portfolio's true risks and the risk measurements defined by the bank regulation, and usually involves the unbundling and

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[7]The Basel Committee on Banking Supervision consists of central banks and supervisory authorities representatives from Belgium, Canada, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States.

[8]See Basel Committee on Banking Supervision (1988), for a detailed description of the rules introduced by Basel I, and Dewatripont and Tirole (1994), for a short review.

repackaging of a bank's portfolio risks - so that a disproportionate amount of the portfolio's true underlying credit risk is treated as lower risk-weighted assets or as having been sold to third-party investors. According to Jones, capital arbitrage has thus undermined the effectiveness of Basel I: at least for large banks, capital ratios under this framework became no longer reliable measures of capital adequacy.[9] Furthermore, financial innovation has been making RCA increasingly accessible to a wider set of banks.[10]

In this context, a new framework for capital requirements, also established by the Basel Committee on Banking Supervision (BCBS), has been put forth in order to address some of the major shortcomings of Basel I and thus foster stability in the financial system: the new Basel Accord - Basel II, hereafter. One of the central changes proposed by Basel II is an increased sensitivity of a bank's capital requirement to the risk of its assets: the amount of capital that a bank has to hold against a given exposure becomes a function of the estimated credit risk of that exposure. Consequently, the constant risk weight of 100% for commercial and industrial (C&I) loans, for instance, is replaced by a variable weight, so that C&I loans with a low credit rating and a high probability of default are assigned a high risk weight. Hence, under Basel II the risk weights used to compute bank capital requirements are determined both by the category of borrower and by the riskiness of each particular borrower.

Basel II is built on three complementary pillars:[11]

- Pillar 1 (minimum capital requirements) establishes the capital requirements for credit risk, market risk and operational risk;[12]

- Pillar 2 (supervisory review process) outlines the requirements on banks' management of risks and capital and defines the roles and powers of the supervisors (Basel II should thus involve

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[9]Nevertheless, Jones also argues that RCA has been beneficial in minimizing allocative inefficiency in lending markets: RCA permits banks to compete effectively with nonbanks in low-risk businesses they would otherwise be forced to exit owing to high regulatory capital requirements.

[10]Gorton and Winton (2000) also suggest that national regulators have consistently weakened the 1988 Basel agreement both by applying capital guidelines selectively and by redefining what is meant by 'capital'. Even as international bank regulators have been revising the 1988 Basel Accord to strengthen it (*e.g.*, the statement issued by the Basel Committee on "Instruments Eligible for Inclusion in Tier 1 Capital"), "the national regulators have successfully lobbied to weaken these standards by broadening the definition of capital." (Gorton and Winton, 2000, p. 2). von Thadden (2004) adds that Basel I ignored modern credit risk management techniques, failed to take account of the dynamic distortions of capital regulation, and neglected complementary regulatory instruments such as supervisory monitoring or prompt corrective regulatory action.

[11]See Basel Committee on Banking Supervision (2004) for details. On July 2006, the BCBS issued a comprehensive version of the Basel II framework. This document is a compilation of Basel Committee on Banking Supervision (2004), the elements of the Basel I that were not revised during the Basel II process, the 1996 Amendment to the Capital Accord to Incorporate Market Risks, and the 2005 paper on the Application of Basel II to Trading Activities and the Treatment of Double Default Effects. For a concise chronology of the Basel II process see Dierick *et al.* (2005), p. 9, box 1.

[12]Operational risk is the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events (Basel Committee on Banking Supervision, 2004).

supervisors more directly in the review of banks' risk profiles, risk management practices and risk-bearing capacity than Basel I);

- Pillar 3 (market discipline) sets out requirements on banks for public disclosures, namely the obligation to publish information on their business profile, risk exposure and risk management (market participants will thus have better information on banks, improving the functioning of market discipline).

Since in this paper we intend to discuss the relationship between regulatory capital requirements and business cycle fluctuations, our attention is focused now on Pillar 1 of Basel II.

According to Basel II rules, banks may adopt one of the two following approaches to compute their minimum capital requirements for credit risk:

- The Standardized Approach. Under this approach, the risk weight associated with each loan is based on an external rating institution's assessment of the counterparty risk. This could markedly change risk weights compared to Basel I: for instance, the less risky C&I loans may be assigned a risk weight of 20% whereas loans granted to the riskiest C&I firms may be assigned a weight of 150%. However, capital charges for loans to unrated companies remain essentially unchanged when compared to Basel I. Some authors (*e.g.*, Hakenes and Schnabel, 2006) thus argue that, in practice, the standardized approach may become similar to the regulation imposed by Basel I, since in many countries no external ratings exist for a large fraction of corporate loans;

- The Internal Ratings Based (IRB) Approach. Here, the estimated credit risk and the consequent risk weights are assumed to be a function of four parameters associated with each loan: the probability of default (PD), the loss given default (LGD), the exposure at default (EAD) and the loan's maturity (M). Banks adopting the 'Advanced' variant of the IRB approach are responsible for providing all four of these parameters themselves from their own internal rating models. Banks adopting the 'Foundation' variant of the IRB approach will be responsible for providing only the PD parameter, with the other three parameters set externally by the regulatory authorities. By aligning required capital more closely to banks' own risk estimates, Basel II should decrease the gap between regulatory and market capital requirements, thus encouraging banks to improve their risk assessment methods.

Basel II contains a long list of minimum requirements that a bank has to fulfill to be eligible for the IRB approach. Consequently, as argued by Hakenes and Schnabel (2006), this approach requires high fixed costs which may deter smaller and less sophisticated banks from adopting it. Nonetheless, Lind (2005) points out that banks still have an incentive to move to the IRB approach since the required capital will then be more closely aligned with each bank's actual risk.[13] In addition, the adoption of the IRB approach may imply a lower capital requirement. In fact, the

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[13]See Repullo and Suarez (2004) and Hakenes and Schnabel (2006), for instance, on the banks' optimal choice between the IRB and the standardized approaches.

Quantitative Impact Study 5 (QIS 5) released by the Committee of European Banking Supervisors (2006) concludes that, for a sample of European banks, the minimum required capital under Pillar 1 would decrease in comparison to Basel I and that this decline would be amplified if banks move to more advanced approaches to compute their minimum capital requirements. Note, however, that, as mentioned in the QIS 5, these results might be influenced by the fact that the study was carried out in a period of favorable macroeconomic conditions in most countries. Moreover, Zsámboki (2007) points out that the market segments identified by QIS 5 as responsible for the decrease in capital requirements (*e.g.*, mortgage lending), are the most sensitive to changes in risk parameters. Zsámboki, thus, argues that, from the financial stability point of view, these 'low-capital-need' portfolios should be examined carefully, as banks concentrating their activities on these markets may become capital constrained during periods of major shifts in risk parameters.[14]

Concerns have also been raised by Benink *et al.* (2008), who argue that the potential for risk arbitrage will remain, to a certain extent, under the IRB approach, since the risk weights will be based on banks' private information rather than on external, verifiable variables - with private information possibly used to place relatively high-risk and high-return credits in a lower risk bucket. In their view, although Pillars 2 and 3 should limit the scope for underestimation of risk, banks will always be somewhat able to shape their capital requirements based on private information.

In addition, Altman and Sabato (2005) point out that Basel II may increase the financing costs of small and medium-sized enterprises (SMEs), due to banks' potential perception that these firms are riskier and, hence, carry higher capital requirements than under Basel I. Accordingly, the last version of the new framework recognizes a special treatment for these firms:[15] subject to certain conditions, aggregate exposures to a SME may be treated as 'retail exposures', which have an advantageous treatment compared to other corporate lending. Even SMEs considered as corporate can benefit, under certain conditions, from a preferential treatment based on an adjustment relative to the firm's size.[16]

Finally, there is a general concern that the new regulation may accentuate the procyclical tendencies of banking, which we now analyze in detail.

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[14] At a theoretical level, Zhu (2007)'s model predicts that the changeover from Basel I to Basel II capital requirements may differ substantially across banks depending on the risk profile of their loan portfolios: Basel II has a particularly significant disciplinary role in the case of small banks, forcing them to hold a higher ratio of bank capital to loans, and rewards those banks with high-quality assets.

[15] Based on the fact that default probabilities for smaller firms are observed to be less correlated with the overall state of the economy (Dierick *et al.*, 2005).

[16] See, for instance, the illustrative risk weights calculated for four asset classes types, including SMEs, in the Annex 3 of Basel Committee on Banking Supervision, 2004.

4 Basel II Capital Requirements and Procyclicality

As argued by Lowe (2002), Allen and Saunders (2003) and Amato and Furfine (2004), the banking industry is inherently procyclical, in the sense of tending to reinforce the business cycle, regardless of the design of capital requirements. This is mainly due to the existence of asymmetric information and market imperfections: banks tend to decrease lending during recessions, because of their concern about loan quality and repayment probability - exacerbating the economic downturn as credit constrained firms decrease their real investment activity -, and to increase it during expansions, thereby contributing to a potential overheating of the economy.

As predicted by the theoretical models reviewed in Section 2, the introduction of regulatory capital requirements may accentuate the procyclical tendencies of banking, in the presence of an imperfect market for bank capital. These procyclical effects may even be more prominent under the new bank capital requirements rules proposed by Basel II. In fact, as pointed out in the previous section, under both the standardized and the IRB approaches the higher the credit risk of a given asset, the higher the capital that a bank will have to hold against it. If the credit risk of banks' assets is countercyclical, the risk weights used to compute capital requirements and, consequently, the minimum bank capital requirement will increase during recessions.[17] Hence the concerns with the possible macroeconomic effects of Basel II: a co-movement in capital requirements and the business cycle may induce banks to further reduce lending during recessions due to high capital requirements. This contention finds support in some literature, as, for instance, Daníelsson *et al.* (2001), p.15:

> "[T]he riskiness of assets varies over the business cycle. Risk assessments, whether based on credit rating agencies' assessments or internal ratings, reflect this procyclical-ity - possibly more so in the case of internal ratings, which typically do not attempt to assess risk 'through the cycle'. This procyclicality in ratings will create a similar procyclicality in capital charges, with the implication that banks hold less capital or overlend at the cusp of a cycle - exactly when the danger of a systemic crises is largest - while they will hold too much capital or underlend during the downturn when macro-economic stabilisation requires an expansion of lending. As a result, regulation not only renders bank crises more likely but could also destabilise the economy as a whole by exaggerating fluctuations."

In order to further clarify the Basel II procyclicality hypothesis, let us consider the potential effects of an economic downturn under Basel I and Basel II. Under Basel I, minimum capital requirements are fixed through time, and may become binding when banks' capital declines following

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[17]See Lowe (2002) and Allen and Saunders (2003) for a review on the relationship between the measures of credit risk exposure (namely, PD, LGD and EAD) and macroeconomic conditions.

the identification of credit losses. Under Basel II, capital requirements may become binding not only because of the same effect (capital decline) but also because non-defaulted loans are likely to become significantly riskier, and as loans move to higher risk classes, the minimum capital requirement increases. To the extent that it is difficult or costly to raise external capital in bad times, as predicted by several models analyzed in Section 2, banks will be forced to reduce their lending activity, accentuating the initial downturn. Consequently, Basel II may lead to a greater financial amplification of the business cycle than Basel I, which counteracts the capital regulation's goal of fostering financial stability.

Moreover, as pointed out by Benink *et al.* (2008), Basel II may harmonize banks' behavior - by requiring financial institutions to use similar risk models and directly control the type of models used -, which by itself may be sufficient to bring on a crisis episode: in times of uncertainty, all the risk models in the industry indicate higher risk, create a decrease in capital ratios and, consequently, motivate the whole industry of banks to sell risky assets and buy safe assets, enhancing the so-called 'endogenous risk'.[18]

4.1 Empirical Evidence on the Procyclicality Hypothesis

The Basel II procyclicality hypothesis has recently been subject to some empirical research, which typically simulates the capital charge cyclicality during a given period of time had Basel II rules been in use. Segoviano and Lowe (2002), using data on internal ratings from banks operating in Mexico over the second half of the 1990s, conclude that measured risk is likely to increase in economic downturns and decrease in economic booms, so that the banks' required amount of capital under Basel II would have risen significantly after the crisis in 1994 and then declined as the economy recovered. Carling *et al.* (2002)'s results, using data from a major Swedish bank for the period from 1994 to 2000, also suggest that the application of the IRB approach would increase the credit risk sensitivity of minimum capital charges and accentuate the procyclical tendencies of banking.

Kashyap and Stein (2004) simulate the degree of capital charge cyclicality that would have taken place over the 1998-2002 interval - a period characterized by economic slowdowns in both the U.S. and Europe - had the Basel II foundation IRB approach been in use. Their simulations, using data on the U.S., some European countries and the 'Rest of the World', suggest that Basel II capital requirements have the potential to create an additional cyclicality in capital charges that may be quite large - depending on the bank's customer mix and its credit risk models. Altman *et al.* (2005) point out that the procyclical effects of Basel II may be even larger if banks use their own estimates of LGD: low recovery rates when defaults are high will amplify cyclical effects,

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[18]Benink *et al.* define endogenous risk as a situation whereby a substantial number of market participants act in concert and therefore in aggregate exerts significant price impact (Benink *et al.*, 2008, p. 91).

which will tend to be especially strong under the advanced IRB approach, according to which banks estimate their own recovery rates and may revise them downward when defaults increase and ratings worsen. The use of long term recovery rates should attenuate this effect, but would also force banks to maintain a less updated picture of their risks, thereby substituting stability for precision (Altman *et al.*, 2005, p. 2225).

Concerning the standardized approach of Basel II, Carpenter *et al.* (2001)'s estimates on how risk-weighted C&I loans might have evolved in the U.S. over the last three decades had banks been using this approach, suggest very little additional cyclical impact compared to Basel I: the variation in ratings over the business cycle would not have been enough to imply much additional cyclicality under the standardized approach of the new Accord. As pointed out above, under the standardized approach of Basel II, unrated firms are treated as in Basel I and the risk weights assigned to rated firms are based on ratings of external agencies. Many of those rating agencies follow a through-the-cycle approach to compute the default probability over the life of the loan, rating borrowers according to their ability to withstand a recession. An advantage of this approach, according to Segoviano and Lowe (2002), is that it makes ratings less sensitive to the business cycle, thus justifying Carpenter *et al.*'s results. Amato and Furfine (2004), using data on all U.S. firms rated by Standard & Poor's, support this idea showing that a firm's rating, conditional on its underlying financial and business characteristics, does not generally exhibit excess sensitivity to the business cycle.

However, as argued by Carpenter *et al.* (2001), while the through-the-cycle approach may create a presumption against changes in ratings over the business cycle, the additional information available during actual downturns may nevertheless induce some cyclical effects. As noted by Pederzoli and Torricelli (2005), if actual conditions are worse than the scenario considered by the rating agencies, downgrades are likely to follow. In fact, Zsámboki (2007) shows that Moody's database on rating transitions reveals that downgrades tend to dominate during recessions, and that this downgrade tendency often continues for a while even when the recession is over. Tanaka (2003) also points out that credit ratings derived from the existing through-the-cycle models tend to follow the business cycle, instead of leading it, so that the capital requirements based on external credit ratings are likely to be somewhat loose during booms and stringent during recessions.

Amato and Furfine (2004) emphasize that it is difficult to assess whether ratings are excessively procyclical because it is difficult to determine what an appropriate degree of co-movement between ratings and the cycle would be like. They argue that since most of the studies perform an analysis unconditional with respect to the specific characteristics of firms, one cannot conclude that ratings are assigned in a procyclical manner, but only that ratings move procyclically. Amato and Furfine's results indicate that the co-movement between through-the-cycle credit ratings and the business cycle is generally driven by cyclical changes in business and financial risks, and not in rating standards.

An alternative to the through-the-cycle approach is the point-in-time approach, followed by several banking institutions. The point-in-time rating systems assign ratings according to the ability of borrowers to fulfill obligations over the credit horizon, typically one year, and are likely to be more sensitive to the business cycle than the through-the-cycle approach.

That the extent of additional procyclicality associated with the IRB approach of Basel II could depend on the nature of the rating system used by banks, seems supported by some recent empirical literature, as, for instance, Catarineu-Rabell *et al.* (2005). According to this study, if banks use internal ratings similar to those of the main rating agencies (which are designed to be relatively stable over the cycle) the increase in capital requirements during a recession is around 15%, whereas if banks choose an approach based on point-in-time rating systems, the increase in capital requirements during a recession will be much more pronounced (between 40% and 50%). As mentioned by Pederzoli and Torricelli (2005), the final version of Basel II, released in 2004, implicitly requires a through-the-cycle rating system, by recognizing that banks adopting the IRB approach are required to use a time horizon longer than one year in assigning ratings and to assess ratings according to the "borrower's ability and willingness to contractually perform despite adverse economic conditions or the occurrence of unexpected events" (Basel Committee on Banking Supervision, 2004, par. 415). Yet, Repullo and Suarez (2007) argue that, although Basel II implicitly requires a through-the-cycle rating system, "industry practices based on point-in-time rating systems, the dynamics of rating migrations, and composition effects make the effective capital charges on a representative loan portfolio very likely to be higher in recessions than in expansions." (Repullo and Suarez, 2007, p. 1). Additionally, Zsámboki (2007), focusing on the QIS 5, finds that minimum capital requirements can fluctuate substantially over the business cycle under Basel II, even if long-term average default rates are used for estimating the PD.

The rating process will thus certainly play a key role in the implementation of Basel II and in its procyclical effects. The assessment in the literature and some recent events, namely the subprime crisis - that, according to Benink *et al.* (2008), is a good example of how the over reliance on risk models has the potential to create a financial catastrophe - suggest some margin for concerns. According to Buiter (2007), the models used by rating agencies are typically the models of the designers and sellers of complex structures (created by pooling heterogeneous underlying asset classes), who work for the issuers of the instruments. The potential for conflict of interest is, therefore, obvious. He further argues that even honest models tend to be useless during periods of disorderly markets, because there are not enough observations on these type of episodes to construct reasonable estimates of the risks involved. Buiter, thus, concludes that the regulatory function of private credit risk ratings in Basel II should be de-emphasized and preferably ended altogether: the procyclical effect of the Basel capital requirements and the more recent doubts about the quality of the rating process should lead to an immediate re-opening and rethinking of Basel II (Buiter, 2007, p. 8).

The procyclical effects of Basel II may also depend on the view adopted concerning how credit risk evolves through time. According to Lowe (2002) and Segoviano and Lowe (2002), one possible view is that the current performance of the economy can be taken as the best guess of its future performance (the random walk view). This view leads to risk being measured as low in good times and high in bad times, leading to higher regulatory capital requirements in a downturn than in a boom, under Basel II. An alternative view postulates that the forces driving economic booms often (although not always) contribute to future economic downturns by generating imbalances in both real and financial sectors - the predictability view. Segoviano and Lowe argue that these imbalances increase risk by increasing uncertainty about the financial strength of individual borrowers, by making default probabilities more highly correlated, and by making the future value of collaterals more uncertain. In this context, the increase in defaults during a recession might be thought of as the materialization of risk built up during the boom, which would suggest relatively high measured credit risk when times are good, leading to higher regulatory capital requirements in a boom than in a downturn.

As argued by Pederzoli and Torricelli (2005), while there is no controversy on the relationship between real activity and default rates (as a measure of the materialized risk), the debate is still ongoing regarding the relationship between economic conditions and risk accumulation. This debate is crucial to assess the potential procyclical effects of Basel II, as the adoption of one of the two views described above will influence the path of the risk-based capital requirements during the business cycle: depending on the view adopted, ratings may decline when economic conditions are depressed or when financial imbalances emerge in good times.

Another factor that may influence the potential procyclical effects of Basel II are bank capital buffers, that is, the excess of current capital over the minimum capital requirements held by the banks. Taking into account that bank capital is more costly for banks than other forms of funds, it is frequently considered that regulatory capital requirements are binding. However, banks trade off this cost with those associated with approaching or falling below the minimum requirement (*e.g.*, the costs associated with an intensified supervisory review or a weakened reputation), and thus often hold capital above the regulatory minimum. In a recent paper, Allen *et al.* (2008) argue that market forces lead banks to keep capital buffers, even when capital is relatively costly, as bank capital commits the bank to monitor and, without deposit insurance, allows the bank to raise deposits more cheaply. Ayuso *et al.* (2004), drawing on a large panel of Spanish banks over the period 1986-2000, find a robust significant negative relationship between the business cycle and the capital buffers held by Spanish banks.[19] This results comes from the Basel I period but, according to von Thadden (2004), if it carries over to the era of Basel II, the current concerns

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[19]See also Peura and Jokivuolle (2004), who, using data on large banks in G10 countries, show that banks tend to hold considerable buffer capital, and Jokipii and Milne (2006), who, focusing on the cyclical behavior of European bank capital buffers, find that bank capital buffers in the accession countries have a significant positive relationship with the cycle, while in the EU15 and in the combined EU25 the relationship is significantly negative.

about the procyclicality of the new capital regulation may be exaggerated: "if banks build up capital buffers in downturns without being forced to do so by regulation, then new regulation that makes part of this build-up mandatory may have little effect." (von Thadden, 2004, p. 93)

Nevertheless, Ayuso *et al.* (2004) argue that their result offers some support to the view that some banks may behave in an excessively negligent manner during booms because they do not take properly into account the cyclical nature of output and, therefore, tend to underestimate risks under economic upturns.[20] Stolz (2007) criticizes the approach followed by Ayuso *et al.*, arguing that regressing banks' capital buffers on the business cycle does not distinguish banks' capital buffer decisions, which are supply-side effects, from demand-side effects working through loan demand. Stolz tries to circumvent this shortcoming by testing the effect of capitalization on the reaction of capital buffers to business cycles. But, using micro data for German savings and cooperative banks for 1993-2003, she finds strong evidence that capital buffers behave countercyclically, in line with Ayuso *et al.*, and that capital buffers of saving banks react more strongly to the business cycle than the capital buffers of cooperative banks.

It should be noted here that, according to Repullo and Suarez (2007)'s model, the cyclical pattern of the buffers gets reversed in Basel II, relative to Basel I, for precautionary reasons.[21] According to these authors, capital buffers contribute to dampen, but do not eliminate, the procyclicality of Basel II and it is unwise to predict the cyclical behavior of capital buffers under Basel II from the empirical behavior of capital buffers under Basel I: "If buffers are endogenously affected by the prevailing bank capital regulation (even if they appear not to 'bind'), reduced-form extrapolations from the Basel I world to the Basel II world do not resist the Lucas' critique." (Repullo and Suarez, 2007, p. 25)

In sum, the reviewed empirical studies on the procyclicality hypothesis of Basel II show that the magnitude of the procyclical effects depend on how bank capital requirements react over the business cycle, which, in turn, should depend on (*i*) the composition of banks' asset portfolios, (*ii*) the approach adopted by banks to compute their minimum capital requirements - the standardized or the IRB approach -, (*iii*) the nature of the rating system used by banks - through-the-cycle or point-in-time rating systems -, (*iv*) the view adopted concerning how credit risk evolves through time - the random walk or the predictability view, and (*v*) the capital buffers over the regulatory minimum held by the banking institutions. We now focus on how some of these factors have been incorporated in the theoretical literature that revisits the bank capital channel thesis, analyzed in Section 2, under the new Accord.

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[20] This may justify, in part, the concerns raised on the procyclicality of Basel II, since banks don't appear to be accounting for mitigating risks during an economic boom (Jokipii and Milne, 2006).

[21] See also Heid (2007).

4.2 The Bank Capital Channel under Basel II

The potential procyclical effects of Basel II motivated the development of some theoretical models that revisit the relationship between business cycle fluctuations and bank capital requirements under the new rules. Tanaka (2002) extends a static IS-LM model, in the spirit of Bernanke and Blinder (1988), to introduce the new capital requirements rules: the risk weights used to compute capital requirements become a function of the mean probability of borrowers' default over the business cycle. Her model suggests that an increase in credit risk raises the probability of banks facing a regulatory penalty, thus restricting banks' ability to lend. Therefore, if the credit risk varies with the business cycle, the new regulation may exacerbate macroeconomic fluctuations. The model also predicts that an expansionary monetary policy under Basel II may be less (more) effective during recessions (booms), when credit risk tends to be higher (lower): if banks become undercapitalized during a recession, the bank loan supply becomes more insensitive to an expansionary monetary policy, since a lower capital-to-asset ratio restricts banks' ability to increase their risky asset holdings.

Also aiming at capturing the link between loan risk weights and borrowers' creditworthiness, Zicchino (2006) introduces capital requirements risk weights that vary with macroeconomic conditions in the partial equilibrium model of Chami and Cosimano (2001): capital requirements risk weights become a function of the macroeconomic activity, which, in turn, follows a first-order autoregressive stochastic process. Consequently, if banks face binding capital constraints, they will be able to increase their loan supply when times are good but they might be forced to reduce supply during a recession. Zicchino thus concludes that Basel II may lead to a greater reduction of credit following a negative macroeconomic shock: on the top of the loan demand fall, banks may be forced to reduce loan supply to satisfy tighter capital requirements. In order to avoid such an eventuality, supervisors should, according to Zicchino, encourage banks to build a capital buffer during expansions above the one banks would choose voluntarily.

Indeed, the model developed by Heid (2007) predicts that capital buffers optimally set by banks under Basel II help to mitigate the impact of the volatility of capital requirements, but may not be sufficient to avoid a stronger procyclical effect than under Basel I. A similar conclusion is drawn by Repullo and Suarez (2007). They also consider the possibility that banks optimally choose to keep capital buffers (when the value of the on-going lending relationships is large enough and the cost of bank capital is not very large), but these buffers are insufficient to neutralize Basel II procyclicality: during a recession banks significantly decrease the supply of credit to some of their dependent borrowers causing a credit crunch that would not occur under Basel I.

Aguiar and Drumond (2007) extend their general equilibrium model, whose main conclusions were briefly reviewed in Section 2, in order to compare a simplified version of the two regulatory frameworks (Basel I and II), and find that the liquidity premium effect, which underlies the bank

capital channel in the benchmark model, amplifies business cycle fluctuations the more significantly the closer the regulatory rules are to Basel II. In face of a contractionary shock, for instance, banks must issue more capital under Basel II due to the increase in borrowers' credit risk. To absorb this additional capital, households require a stronger increase in the liquidity premium than under Basel I, which leads to a stronger increase in the external finance premium faced by firms (borrowers), and, consequently, to a more amplified decrease in investment and output.

More recently, Drumond and Jorge (2008) address the Basel II procyclicality hypothesis in the context of a dynamic heterogeneous-agent model, in which firms' access to bank credit depends on their estimated credit risk. The model thus takes into account the heterogeneity of banks' assets, predicting that, to the extent that it is more costly to raise bank capital in bad times, a negative aggregate technology shock under Basel II has a larger effect on the cost of funds for highly leveraged firms, whose bank loans require more bank capital. In this context, if the loan portfolio of the banking system is characterized by a significant fraction of high credit risk firms, the changeover from Basel I to Basel II capital requirements should reinforce the bank capital channel of propagation of aggregate shocks.

In sum, the reviewed models are unanimous in predicting that the introduction of the new bank capital requirements rules accentuates the procyclical tendencies of banking, when compared to Basel I, which may conflict with the main objective of Basel II - promoting the stability of the international banking system.

4.3 Counteracting the Likelihood of Procyclical Effects under Basel II

Despite the main conclusions of the models just reviewed, some authors still argue that Basel II procyclicality may not be a problem, suggesting that those models are not able to capture all the new aspects of Basel II. Jordan *et al.* (2003), for instance, point out that the improved risk-sensitivity will encourage banks to recognize and correct capital inadequacies earlier in the cycle, and, therefore, prevent the sudden declines in capital adequacy that cause credit crunches. Jokivuolle and Vesala (2007), in turn, argue that Basel II may have a beneficial allocation effect, which may counteract the potential procyclical effects. According to these authors, the introduction of Basel II may reduce overinvestment in high-risk investment projects and increase the entrepreneurs' general participation in the credit market, so that the overall lending volume may be higher. Basel II may thus have a dampening effect. Nonetheless, Jokivuolle and Vesala also recognize that a procyclical effect is also present - due to the increase in the probability of default of risky assets after a negative shock - and that the sign of the net effect remains an open issue.

Moreover, the magnitude of the procyclical effects of Basel II depends not only on the rules underlying the first pillar of the Accord but also on what else changes under Pillars 2 and 3. As argued by Lowe (2002), the supervisory review process specifies that supervisors (i) must assess

whether a bank is adequately capitalized, taking into account external factors such as business cycle effects, (*ii*) should expect banks to operate above the minimum regulatory capital ratios and (*iii*) should have the ability to require banks to hold enough capital buffers, especially in good times, to enable them to meet the higher requirements when times are not so good. Pillar 2 also establishes that banks must develop an internal capital adequacy assessment process (ICAAP), which should ensure that they adequately identify and measure their risks, set adequate internal capital in relation to their risk profile, and use and develop further sound risk management systems. Supervisors are responsible for evaluating banks' ICAAP and for ensuring that the processes for developing those assessments are robust and satisfactory. Additionally, credit quality problems may become evident much earlier than under Basel I not only because of better credit risk management practices but also because of broader disclosure under Pillar 3. In this context, supervisors cannot ignore deteriorations in the quality of banks' portfolios, and should help to overcome the problems that arise when banks in very poor condition are allowed to continue operating.

Finally, some authors argue that if Basel II procyclicality hypothesis is still confirmed there may be room for some corrective measures within the new Accord. Gordy and Howells (2006) suggest that the output of the IRB capital function can be smoothed:

> "Let C_{it} denote the unsmoothed output from the IRB capital formula for bank i at time t, expressed as a percentage of portfolio book value, and let $\widehat{C}_{it}$ denote the corresponding regulatory minimum applied to the bank. At present, the New Accord sets $\widehat{C}_{it} = C_{it}$. One simple smoothing rule would specify $\widehat{C}_{it}$ as an autoregressive process that adjusts towards C_{it}, i.e.,
>
> $$\widehat{C}_{i,t} = \widehat{C}_{i,t-1} + \alpha(C_{i,t} - \widehat{C}_{i,t-1}).$$
>
> The current Accord can be represented in stylized fashion as setting $\alpha = 0$, whereas the New Accord sets $\alpha = 1$. An intermediate value of α would offer a compromise between the current Accord and New Accord in sensitivity to the business cycle." (Gordy and Howells, 2006, p. 397)

Kashyap and Stein (2003, 2004) recommend a family of point-in-time risk curves, with each curve corresponding to different macroeconomic conditions. But they also recognize that their corrective measure, by suggesting the reduction of capital requirements in bad times, may be naïve since it will "give regulators an excuse to engage in after-the-fact forbearance, with all the accompanying potential for various forms of regulatory moral hazard." (Kashyap and Stein, 2004, p. 28)

In line with the empirical literature reviewed in 4.1, Pederzoli and Torricelli (2005) advocate the use of the predictability view of the business cycle and a through-the-cycle logic in the rating

assignment, in order to dampen the potential procyclical effects of Basel II. In particular, these authors develop a measure of time-varying capital requirements that, for quarterly U.S. data over the forecasting period 1971-2002, behaves quite well in anticipating the business cycle, increasing (decreasing) in anticipation of recessions (expansions), and with a possible smoothing effect on the business cycle turning points. Pederzoli and Torricelli thus conclude that if the business cycle effects are considered in a forward-looking perspective and a through-the-cycle rating system is used, both objectives - increased risk-sensitivity of capital requirements and business cycle effects neutralization - can be reconciled.

Another possibility to attenuate the Basel II procyclical effects, put forward by Pennacchi (2005), would be to combine a risk-based capital requirement with a risk-based deposit insurance such that undercapitalized banks would be required to partially adjust their capital ratio toward a target standard and pay a higher insurance premium appropriate with the capital ratio they choose. Finally, Cecchetti and Li (2005) suggest that under Basel II the optimal monetary policy should move interest rates more aggressively when the banking system is capital constrained, thus counteracting and even completely neutralizing the procyclicality of capital regulation. However, as the empirical work of Kishan and Opiela (2006) indicates, if Basel II creates more constrained banks during recessions and better capitalized banks during expansions, countercyclical policy may become more difficult: high-capital banks tend not to decrease loans in response to a contractionary monetary policy and, conversely, an expansionary monetary policy may have no stimulating effects on the loan growth of low-capital banks. Therefore, it remains to be proved whether Cecchetti and Li (2005)'s proposal would be effective. Nonetheless, as Kishan and Opiela (2006) also point out, changes introduced by Basel II will result in banks reallocating their capital and, consequently, adjusting the way they organize their balance sheets and the way they react to monetary policy shocks. In this context, it is not clear that Kishan and Opiela's results are valid under Basel II: once more, extrapolations from the Basel I world to the Basel II world may not resist the Lucas' critique.

5   Concluding Remarks

In this paper we have discussed the relationship between bank capital requirements and business cycle fluctuations, bringing together the theoretical literature on the bank capital channel of propagation of exogenous shocks and the literature on the regulatory framework of capital requirements under the Basel Accords. Our integrating review has shown how the new banking system regulatory framework may potentially strengthen the propagation of exogenous shocks to the economy and, consequently, amplify business cycle fluctuations (the Basel II procyclicality hypothesis).

Overall, the theoretical literature on the bank capital channel predicts that the introduction of bank capital requirements, either for market or regulatory reasons, amplifies the effects of monetary

and other exogenous shocks. This amplification effect usually rests on the argument that raising new capital may be difficult and costly for many banks, especially during economic downturns, thereby increasing the financing cost faced by firms that borrow from those banks. If firms are restricted to banks as sources of credit, this would affect negatively firms' investment and output.

The introduction of Basel II adds to these concerns, as it establishes that the amount of capital that a bank has to hold in its balance sheet depends on the riskiness of its portfolio. In fact, if the credit risk of banks' exposures increases during a recession, the risk weights used to compute capital requirements (and, consequently, the minimum bank capital requirements) will also increase, and, to the extent that it is difficult or costly to raise external capital in bad times, banks will be forced to reduce their lending, thereby contributing to a worsening of the downturn. Consequently, Basel II may lead to a greater financial amplification of the business cycle than Basel I, which would contradict the capital regulation's goal of fostering financial stability.

Our review suggests that the magnitude of this amplification effect is still subject to some debate. Whereas some authors argue that the new bank capital requirements rules proposed by Basel II will accentuate this effect (by imposing countercyclical minimum capital requirements), other authors argue that procyclicality may not be a problem, and that Basel II will help avoiding the type of financial crises that occasionally have very large macroeconomic effects (by encouraging banks to recognize and correct capital inadequacies earlier in the cycle, for instance).

On the basis of our assessment, it seems fair to say that theoretical studies revisiting the bank capital channel under the new Accord generally support the Basel II procyclicality hypothesis. In particular, Basel II leads to a greater reduction of credit following a negative macroeconomic shock, since banks are forced to reduce loan supply in order to satisfy tighter capital requirements. Additionally, capital buffers voluntarily set by banks seem to be insufficient to neutralize this amplification effect, and, therefore, regulators should require banks to hold enough capital buffers, especially in good times, so that the higher requirements may be met when times are not so good. In fact, this possibility is taken into account in the supervisory review process established by Pillar 2 of Basel II, which involves supervisors more directly in the review of banks' risk profiles, risk management practices and risk-bearing capacity than Basel I.

On the whole, the literature available at the moment seems to allow the conclusion that the magnitude of the procyclical effects of Basel II should depend on (i) the composition of banks' asset portfolios, (ii) the approach adopted by banks to compute their minimum capital requirements - the standardized or the IRB approach -, (iii) the nature of the rating system used by banks - through-the-cycle or point-in-time rating systems -, (iv) the view adopted concerning how credit risk evolves through time - the random walk or the predictability view, (v) the capital buffers over the regulatory minimum held by the banking institutions, (vi) the improvements in credit risk management, and (vii) the supervisor and market intervention under Pillar 2 and 3.

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