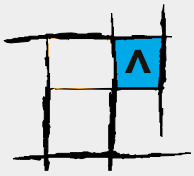
LACEA 2007
MONTEVIDEO URUGUAY

José Antonio Licandro, joint wih Mario Bergara

Prudential Regulation and Credit Cycles: A Microeconomic Approach



Very preliminar

PRUDENTIAL REGULATION AND CREDIT CYCLES: A MICROECONOMIC APPROACH

Mario Bergara*
José A. Licandro

Abstract: There is a broad consensus that prudential regulation stimulates bank credit variability, thus amplifying business cycle. To analyze this issue within a coherent framework, we develop a simple model of portfolio selection with microfoundations. We conclude that, under some general circumstances, the procyclicality of credit is determined by the bankers' myopia, while capital adequacy and provisions requirements do not have amplifying effect but, on the contrary, an smoothing impact. The ability to mitigate credit procyclicality depends on the specific design of the regulatory rules. In order to smooth the credit evolution, an implementable suggestion consists of setting current loss provisions according to the cyclically adjusted default risk. Although this does not compensate the "point in time" focus of banks, this allows prudential regulation to alleviate the procyclicality in a more efficient way, without sacrificing its ability to mitigate the moral hazard problems in risk taking activities.

JEL Classification: **E32, E44, E58, G28**

I – INTRODUCTION

The link between credit cycles and business cycles is a stylized fact in the economic literature. There are several papers showing that link and suggesting communication channels that promote the feed back processes. Actually, bank loans support business cycle expansions, encouraging private expenditure to rise. Conversely, bank credit slows or decreases during recessions, negatively affecting aggregate demand and thus reinforcing the adverse macroeconomic situation. Seminal papers by Bernanke and Blinder (1987 y 1988) emphasize the "credit view" on the mechanisms of the monetary policy, insisting on the importance of bank loans as opposed to other sources of funds for borrowers.[1] More recently, Gourinchas *et al.* (2000) confirm the relationship under study by considering the stylized facts associated to credit booms.

* Comments and suggestions are welcome to the following electronic addresses: bergara@bcu.gub.uy and licandro@bcu.gub.uy. The authors are extremely grateful to Jorge Ottavianelli for previous discussions on the topics of the paper. We also thank Gerardo Licandro, Phillip Lowe, Andrés Masoller and Agustín Villar for helpful comments. The views stated herein are those of the authors and do not engage the institutional view of the Central Bank of Uruguay.

[1] Alternative approaches on the "credit channel" or the "financial accelerator" can be found in Kiyotaki and Moore (1997), Aghion *et al.* (1998), Bernanke *et al.* (1998) and Schneider and Tornell (1999).

In addition, there is a growing amount of economic literature discussing and supporting the existence of financial regulation and prudential rules, in general, related to the 1988 Basle Accord. On these grounds, a microeconomic approach of the banking firm was developed, emphasizing the role of information asymmetries, moral hazard and adverse selection on the financial (in particular, lending) activities.[2] Rochet (1999) describes the evolution of bank solvency regulations and analyzes them within a coherent conceptual framework that applies contract theory.

Prudential solvency regulation, which main goal is precisely to mitigate the negative effects of information asymmetries, has been extensively used at an international scale, without taking into account the eventual macroeconomic impact derived from this kind of rules. Nevertheless, over time there seems to be a broad consensus that prudential regulation, although accurate to promote the soundness of the financial system, stimulates bank credit variability, thus amplifying business cycle. These macroeconomic concerns are faced from an analytical viewpoint in the nineties. In particular, Blum and Hellwig (1995) show that, under some specific circumstances, capital adequacy regulation may reinforce macroeconomic fluctuations.[3]

More recently, several financial regulators have been modifying some aspects of solvency rules, in order to eliminate the procyclical bias supposedly inherent to the credit performance.[4] Moreover, taking into consideration the recessive period in developing countries (particularly in Latin America) in recent years, some authors argue for a mix of anti-cyclical policies, including the monetary, exchange rate and public debt management and the relaxation of financial regulation. For example, Ocampo (2000) emphasizes the need to design instruments that introduce a countercyclical element into prudential regulation, which should be strengthened during periods of financial euphoria.

Nevertheless, the proposals are not being evaluated within a coherent and well-structured analytical framework. This paper develops a microeconomic setting in order to consider the variables that the banks mainly take into account to determine the credit

[2] An excellent survey is developed in Freixas and Rochet (1997) while it is also worth to revise Dewatripont and Tirole (1994).

[3] Several papers about capital requirements and bank behavior are reviewed in BIS (1999).

[4] Recent cases can be found in the changes in the regulatory frameworks of Spain and Peru since early 2000. The Spanish case is properly described in Poveda (2000) and

levels, including the regulatory requirements in terms of capital adequacy and loss provisions. Furthermore, the model allows us to explore how prudential rules affect the procyclicality of credit and what factor must be considered for a proper regulatory design to mitigate it.

The model formalizes the idea that, in general, prudential regulation does not exacerbate the credit cycle, since credit would be more volatile in the case of absence of rules. Solvency regulation leads the financial intermediaries to internalize, although partially, the negative externalities derived from bank failures. Thus, the regulators encourage the conformation of provisions and capital reserves to cover expected and unexpected losses. In order to smooth the credit cycle, the *first best* solution consists of varying regulatory requirements (in particular, provision rates) through time, depending in what phase of the boom-bust cycle the economy is. This should be done in a way that it compensates the effect of the bankers' myopia. However, this result is not feasible, since it implies that the regulator is able to identify exactly the actual point of the cycle and to measure the exact degree of the bankers' myopia in their decision-making processes. These two preconditions are not likely to be true. A *second best* (although implementable) solution consists of requiring institutions to determine current provisions on the basis of expected losses calculated over an entire cycle, *i.e.* cyclically adjusted, supporting some recent changes in this direction that are taking place in a few countries. Although this does not compensate the "point in time" focus of banks, this allows prudential regulation to alleviate the procyclicality in a more efficient way, without sacrificing its ability to mitigate the moral hazard problems in risk taking activities. Prudential measures to mitigate the procyclical bias of credit should then focus on loss provision policies and not on capital adequacy regulation. Given the latter are designed following the Basle Accord recommendations, they do not operate in a procyclical manner, since banks choose the portfolio composition according to the business cycle.

The paper is organized as follows. Section II introduces the main conceptual ingredients to motivate and discuss the issue. In section III we develop the basic model, which is used in sections IV and V to evaluate the design of alternative prudential regulatory measures and their impact on credit procyclicality. Finally, section VI concludes.

Fernándes de Lis *et al.* (2000). A broad discussion of this topic with an international

II – CREDIT PROCYCLICALITY AND SOLVENCY REGULATION

A main theoretical justification for prudential regulation resides on the moral hazard problem: banks have less incentives to insure themselves in the long run, because they do not internalize the negative effects of bank failures on the payment system and because of agency relations at the managerial level. Related to the first aspect, there is a substantial difference between the utility function of the bank and that of the regulator,[5] related to banking crisis and the limited liability argument, encouraging moral hazard in the bank's risk taking decisions. Regarding the second aspect, bank managers typically measure gains and losses with a relatively short horizon, since they are encourage to show a good performance in a very systematic way (not only in the long run).[6] This also induces a risky behavior from the social standpoint. These issues leads the regulator (who represents the social interests, in particular those of the uninformed small depositors) to impose banks the conformation of safety funds for expected and unexpected losses. At the theoretical level, there seems to be a consensus that provisions should be held to cover expected losses, while capital should be held as protection against unexpected losses.[7] In order to alleviate the moral hazard problem, the economic literature suggests that the insurance premiums to conform such reserves are risk-adjusted for each institution.[8]

Prudential regulation is based on a set of rules regarding the level of bank capital and credit loss provisions. Santos (2000) reviews the theoretical literature on bank capital regulation, its justification related to information asymmetries, the representation of uninformed depositors and the systemic risk argument, and the alternative approaches on setting capital standards suggested by the Basle Committee. It must be noted that capital requirements are typically calculated according to a risk *ranking* linked to the asset type. In fact, a bank's capital ratio is defined as the ratio of equity to the total risk-

---

perspective is submitted by Cortavarria *et al.*(2000).

[5] Here we assume that the regulator's objectives coincide with those of the society, ruling out the possibility of regulatory capture and the implementation of private agendas.

[6] This is consistent with the view of Dewatripont and Tirole (1994) that bank managers are subject to (not necessarily formal) incentive schemes regarding the potential outside involvement in management by shareholders and the regulator, who represents depositors.

[7] See Falkenheim and Powell (1999) and Jackson and Lodge (2000).

[8] See Freixas and Rochet (1997), Escudé (1999) and Bergara and Licandro (1999).

weighted assets. Weights for assets depend on the institutional nature of the borrower. For example, loans to firms are in general taken as intrinsically riskier than governmental bonds.[9] Therefore, a well-known drawback of this kind of solvency regulation is that the capital requirement for a given portfolio does not vary as its riskiness changes through time. The capital adequacy requirement changes basically as the bank's optimal portfolio structure varies regardless the fact that the underlying credit quality is changing. On the other hand, credit loss provisions vary with the business cycle, since the expected losses change with the bankers' risk perception and with the valuation of collateral.

Tirole (1994) points out that the Basle Accord insulate bank managers from aggregate risk, sometimes forcing liquidation or sale of banking institutions in circumstances that are out of the realm of managerial control. He also discuss the convenience of setting capital adequacy requirements depending on the business cycle, since regulators are often more lenient during recessions. Regulators defend their policy precisely on the grounds that solvency rules should be indexed on the cycle.

In addition, Blum and Hellwig (1995) present a model to explain the macroeconomic implications of capital requirements for banks, particularly on the lending side. They focus on the effects of solvency regulation derived from the Basle Accord, concluding that they operate in a procyclical manner. The microeconomic aspects are formalized by introducing a bank with deposit demand and equity. The institution can put its funds into loans to firms, government bonds, or reserves of high-powered money. The bank optimal portfolio composition is determined by two main factors:

(i) Rate of return considerations induces a strict preference for loans over bonds and for bonds over reserves. Consequently, the bank will allocate as much as possible to the firms' lending activity. Risk considerations are not in the picture when the institution determines its portfolio structure.

(ii) A regulator impose that the bank must satisfy a minimum-reserve requirement (formalized as a fixed percentage of deposits) and a capital adequacy requirement (modeled as the "Cooke ratio" on loans to firms, following the Basle Accord intention).

[9] Dewatripont and Tirole (1994) detail the implementation of the Basle Accord at the

Risk considerations absent, credit to firms is determined as the minimum between the loanable funds (i.e. the sum of reserves-net deposits and equity) and the constraint imposed by the solvency requirement. In order to introduce cyclical considerations, they take the true market value accounting rule for the bank's assets. Obviously, market values are associated to macroeconomic fluctuations. Within this framework, during a recession the market value of bank's assets decreases, leading to a reduction in bank lending and opening the possibility of a *credit crunch*. As a result, a rigid link between bank equity and bank lending may act as an automatic amplifier for macroeconomic fluctuations, reinforcing any underlying shocks.

We suggest a portfolio model to determine the optimal credit level, based on the idea that the managerial and regulatory incentives of intermediaries let us get a better understanding of financial markets. The model suggests that credit is naturally procyclical when bankers are risk averse and they measure returns and risk with a "point in time" focus, regardless the presence of prudential regulation. The bankers' myopia is related to the fact that their perception of risk moves positively with the economic cycle. They are too optimistic during booms and particularly tough during recessions.[10] A common perspective states that risk increases during recessions and falls during booms. There is also a contrasting view suggesting that risk increases in booms and this materializes during recessions with a larger amount of defaults. Nevertheless, both underlying views are consistent with the fact that the *perception of risk* varies positively with the business cycle. Actually, most of the commonly used measures of risk and quantitative models of credit risk are consistent with the view that risk falls in booms and increases in recessions. This is reinforced by some evidence that suggests that banks' internal models are more likely to generate measures of risk with a cyclical pattern. The presence of asymmetric information and agency relations between managers and depositors and between managers and equityholders underlie this problem. The model also allows us to suggest that prudential regulation (including provision and capital requirements) can be designed to mitigate the credit procyclicality.

European Union level.

[10] About the notion of bankers' myopia, see Devlin (1986), Herring (1999) and Herring and Wachter (1999).

III – BASIC MODEL

Since we intent to emphasize the impact of prudential regulation on credit from the asset side, the model will focus on the portfolio decisions of the financial intermediaries. In particular, we consider that the portfolio of a representative bank (*P*) contains two type of assets, bonds (*B*) and loans (*C*), such that: $P = B + C$. Let *c* be the loan share of the bank's portfolio: $c = C/P$. Both assets differ by their risk and return features, according to the following notation: r_B and r_C represent the rates of return of bonds and loans respectively, with $r_C > r_B$,[11] while the default risk associated to the bond is assumed to equal zero ($q_B = 0$) and the credit risk is $0 < q \leq 1$. The focus here is on the borrowers' credit risk, ruling out the presence of other sources of risk that are typical of the financial activity (interest rate, exchange rate, legal, etc.). This constraint, together with the fact that the bank can exert some market power in lending, makes the assumption that the return from loans is higher than the return from bonds reasonable.

In order to introduce cyclical considerations, we define the variable $y = Y - Y^*$ as the difference between actual (*Y*) and trend (*Y**) output levels. The stylized fact that the perception of credit risk increases in recessions and falls in booms is capture by the function $q(y)$, with $q'(y) < 0$.

The sources of credit volatility can be associated to the monetary channel and to the credit channel. The model focuses on the latter. Thus, we assume that the representative bank's deposit level is given by $D = \overline{D}$. Consequently, we insulate the issue under scrutiny from other sources of credit procyclicality linked to the monetary channel or derived from constraints in the supply of loanable funds.

To introduce prudential regulation in the model, we follow the spirit of the Basle Accord. We formalize the capital adequacy requirement as: $K_{min} = k_B.B + k_C.C$, with $k_B = 0$ and $k_C > 0$. Then, the capital constraint for one unit of credit will be k_C. Let the opportunity cost of holding one unit of capital, *r*, constant, the cost for one unit of credit will be: $k = rk_C$. In addition, credit loss provisions will be determined as a fraction $a > 0$ of the total amount of current non-performing loans. It must be noted that if the

[11] In fact, the spread between both rates of return varies with the cycle. Nevertheless, for simplicity they are assumed to be constant. This assumption does not affect the qualitative insights of the model.

provisions are calculated on the amount of non-collateralized non-performing loans, the current valuation of collateral amplifies their cyclical pattern. Therefore, the results we will obtain regarding the provision policy will also be valid for the collateral valuation policy over the business cycle.[12] Consequently, the amount of loss provisions for one credit will be represented by: $aq(y)$.

The unit expected return of the bank's portfolio will be:

$$m_P = (1-c)r_B + c\{r_C[1-q(y)] - aq(y) - k\} \quad (1)$$

Note that the expected return *per* credit unit includes the gross expected return (*i.e.* the interest gains associated to performing loans) less the costs related to the regulatory constraints: loss provisions (which covers from expected capital losses) and capital requirement. We assume that the bank can recover a fraction $(1-a)$ of non-performing loans, thus the provision constraint correctly measures the expected losses. Equation (1) implies the bankers' myopia, since he measures the expected return according to the current (and not long term) value of credit risk. As a result, the bankers' perception of risk is optimistic in booms and pessimistic in recessions. *Cæteris paribus*, the expected returns of bank's portfolio increases during booms ($\partial m_P / \partial y > 0$) and decreases with a more stringent regulation ($\partial m_P / \partial k < 0$ and $\partial m_P / \partial a < 0$). Note that, given how prudential rules are designed, the effects of the cyclical fluctuations on the bank's returns basically depend on the provision policy and not in the capital requirement.

Additionally, the default risk associated to the portfolio will be determined by the amount of non-performing loans and on the share of credit in the bank's total assets. The portfolio risk per asset unit will be:

$$q_P = c.q(y) \quad (2)$$

[12] In order to introduce this aspect into the model, we should redefine: $q(y) = l(y) - r(y)$, with l representing the probability of a credit loss and r being the value of collateral, with $r'(y) > 0$.

Cæteris paribus, credit risk decreases during booms ($\partial q_P / \partial y < 0$). From equations (1) and (2), we derive the investment possibilities curve (*IPC*), which links expected returns and risk for every c:

$$m_P = r_B + \left[\frac{(r_C - r_B - k)}{q(y)} - (r_C + a) \right] q_P = r_B + MRT \cdot q_P \quad (3)$$

The slope of the *IPC* corresponds to the marginal rate of transformation of one unit of risk into one unit of expected return.

The representative bank is assumed to have a utility function determined by risk and expected return considerations: $U(m_P, q_P)$, with $\partial U / \partial m_P = U_m > 0$ and $\partial U / \partial q_P = U_q < 0$. An additional assumption refers to the bank's risk aversion, such that the marginal rate of substitution (*MRS*) will be positive: $-U_q / U_m > 0$.

The equilibrium condition for the bank is derived from maximizing its utility function subject to the constraint impose in equation (3). In equilibrium, the marginal rate of substitution in consumption equals the marginal rate of transformation of risk into returns:

$$MRT = \left[\frac{(r_C - r_B - k)}{q(y)} - (r_C + a) \right] = -\frac{U_q}{U_m} = MRS \quad (4)$$

Then, equation (4) determines the equilibrium levels of m_P* and q_P*, setting the optimal composition of the portfolio between bonds and loans (c*). It remains to study how the optimal portfolio structure varies with the economic cycle. Given a constant total amount of funds, this structure in turn determines the total magnitude of bank lending. Differentiating (4) with respect to the output gap variable yields:

$$\left[\frac{\partial MRS}{\partial q_P} \frac{\partial q_P}{\partial y} \right] dy = -\frac{(r_C - r_B - k)}{q^2(y)} q'(y) dy \quad (5)$$

From equation (2), we obtain:

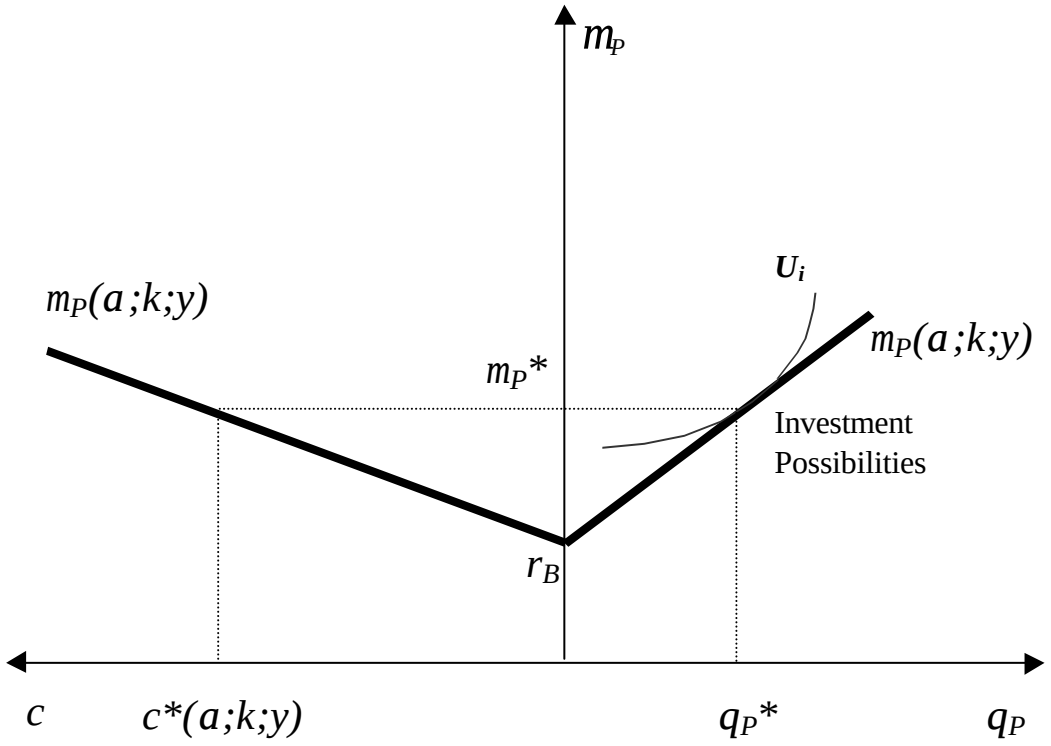
$$\frac{\partial q_P}{\partial y} = \frac{\partial c}{\partial y} q(y) + c q'(y) \quad (6)$$

Substituting (6) into (5) and rearranging terms, it yields:

$$\left.\frac{\partial c^*}{\partial y}\right|_{a q(y)} = -\left[\frac{r_C - r_B - k}{q^2(y)} \frac{1}{\partial MRS / \partial q_P} + c^*\right] \frac{q'(y)}{q(y)} > 0 \quad (7)$$

As a result, given the design of prudential measures and bank's risk aversion, bank lending (here represented by the share of loans in total assets) varies positively with the business cycle.

The graph shows the equilibrium levels of m_P^*, q_P^* and c^*. In particular, the optimal share of credit in the bank's portfolio is increasing during booms (higher values of y) and with a less stringent prudential regulation (lower values of a and k).



IV – THE IMPACT OF REGULATION ON CREDIT

Equation (7) shows that credit varies positively with the business cycle, but it is not informative about how much of the procyclicality is determined by the bankers' behavior and how much is induced by the specific design of prudential regulation. In order to get a better understanding of the role played by these factors on credit variability, we need to distinguish several aspects. First, we will analyze how cyclical consideration affect the credit volatility under the assumption of absence of prudential regulatory measures. To keep matters simple, we assume that, if allowed, banks will not hold capital at all and will not save credit loss provisions at all.[13] This leads to rewrite equation (1):

$$m_P = (1-c)r_B + c\{r_C[1-q(y)]\} \quad (1')$$

By solving the model, we get the equilibrium condition:

$$MRT = \left[\frac{(r_C - r_B)}{q(y)} - r_C\right] = -\frac{U_q}{U_m} = MRS \quad (4')$$

When prudential regulation is absent, the opportunity cost of lending is now lower and, thus, the *MRT* is higher. This implies that the bank will set a higher share of credit in the optimal portfolio structure, in order to choose a risk-return combination derived from a higher *MRS*. This result holds for every *y*, *i.e.* regardless cyclical considerations. Additionally, we can obtain the impact of the cyclical fluctuations on the value of *c**. Thus, equation (7) is now represented by the following expression, where "*npr*" means "no prudential regulation":

$$\left.\frac{\partial c^*}{\partial y}\right|_{npr} = -\left[\frac{r_C - r_B}{q^2(y)}\frac{1}{\partial MRS/\partial q_P} + c^*\right]\frac{q'(y)}{q(y)} > 0 \quad (7')$$

[13] This is just a simplifying assumption. If banks would "naturally" hold capital and provisions, the results would remain valid if we would assume that their "natural" requirements are lower than those imposed by the regulatory standards; *i.e.* they are binding. Formally, we can redefine: $\alpha = \alpha_R - \alpha_B$, with α_R and α_B being the provision rates set by the regulator and the bank respectively.

This suggests that the credit shows a procyclical behavior, regardless the fact that the prudential norms are absent or non-binding. This result is determined by the bankers' "point in time" focus, *i.e.* they perceived loans to firms riskier during recessions. In addition, comparing (7´) and (7) yields:

$$\left.\frac{\partial c^*}{\partial y}\right|_{npr} > \left.\frac{\partial c^*}{\partial y}\right|_{aq(y)} \quad (8)$$

This result proposes that prudential regulation does not actually exacerbate the credit cycle. On the contrary, it may smooth the lending pattern. In fact, prudential rules partially absorbs the credit "natural" procyclicality, if this can be measured by the credit variability over the boom-bust cycle. From this standpoint, without adding other factors, we can not assert that these norms amplify the *credit crunch*. These conclusions does not support the idea that prudential regulation involves a *trade-off* between the ability to mitigate moral hazard and to alleviate credit procyclicality. An accurate design of prudential norms may smooth the credit cyclical pattern, without sacrificing the competence of mitigating the moral hazard problems in risk taking activities.

These results seem to contradict Blum and Hellwig's (1995) findings, since they imply that prudential norms are anticyclical, i.e. they soften the credit procyclicality derived from the bankers' myopia. Nevertheless, this inconsistency is somehow more semantic than real. In fact, besides the fact that we are applying very different formal settings, Blum and Hellwig conclude that the *credit crunch* in the United States in the early nineties was at least partly due to the banks' scrambling to meet the increasing capital adequacy requirements. This result can be recovered in our model, without the capital scarcity argument, by taking into account an increase in k_C (*i.e.* the credit unit capital requirement) when the economy is in the bust cyclical phase.

V – PRUDENTIAL REGULATORY DESIGN AND CREDIT VOLATILITY

Equation (7) represents the changes on lending according to the business cycle, letting some prudential regulation including capital requirements *à la* Basle and provision rules based on fixed coefficients *per* risk unit. This constellation of solvency norms is featured by two processes when cyclical considerations are introduced, since the credit share in the bank portfolio increases with the cycle.

(i) The capital adequacy requirement implies a heavier burden during booms than during recessions, given the changes in the riskier credit share in the optimal portfolio structure. Consequently, this regulatory exigency does not amplify credit and macroeconomic fluctuations, since it makes lending more costly during economic expansions and cheaper during the bust phase.

(ii) On the contrary, loss provisions based on fixed coefficients vary positively with the risk faced by banks. Thus, they do not operate in an anticyclical fashion. During economic expansions, the perceived risk is lower and, then, the opportunity cost of lending decreases, encouraging the credit channel. On the other side, default risk increases during recessions, making lending more expensive. This amplifies the bust or makes the economic recovery more difficult.

Consequently, once introduced risk considerations in the maximization problem of banks, the prudential measures to alleviate credit procyclicality should focus on the loss provisioning policy and not on the capital adequacy requirements. One option is for regulators to vary the stringency of requirements through time, depending on the business cycle. This could compensate the impact of the bankers' myopia and smooth the economic fluctuations. Alternatively, regulators could require banks to determine credit loss provisions on the basis of expected losses calculated over an entire cycle. This would not compensate the managerial "point in time" focus, but it would stabilize the current burden for institutions and mitigate credit procyclicality. Both options are evaluated below, by using the analytical framework developed here.

V.1 – *First best*: compensating provision policy

In order to completely smooth the credit patters, the model allows to set provisioning rates varying with the macroeconomic fluctuations such that they compensate the effects of the "point in time" focus of bankers. Thus, instead of taking fixed coefficients over the whole cycle, the provision rates will depend on the business cycle: $\tilde{a} = \tilde{a}(y)$.

Accurately rewriting the basic model, the equilibrium condition for the representative bank will be:

$$MRT = \left[\frac{(r_C - r_B - k)}{q(y)} - [r_C + \tilde{a}(y)]\right] = -\frac{U_q}{U_m} = MRS \quad (4'')$$

Differentiating (4'') with respect to the output gap variable and rearranging terms, it yields:

$$\left.\frac{\partial c^*}{\partial y}\right|_{\tilde{a}(y)} = -\left[\left(\frac{(r_C - r_B - k)q'(y)}{q^2(y)} - \tilde{a}'(y)\right)\frac{1}{\partial MRS/\partial q_P} + c^* q'(y)\right]\frac{1}{q(y)} \quad (7'')$$

Imposing $\frac{\partial c^*}{\partial y} = 0$, we obtain:

$$\tilde{a}'(y) = -\left[(r_C - r_B - k) + c^* \frac{\partial MRS}{\partial q_P}\right]\frac{q'(y)}{q^2(y)} > 0 \quad (9)$$

As a result, if provisioning rates change positively with the economic cycle according to equation (9), the credit variability is eliminated, compensating the impact of the short horizon argument on banks' decisions.

In order to smooth the credit pattern, this would be the *first best* solution, but it implies two restrictive assumptions: (i) the regulator is able to identify the exact actual moment of the business cycle the economy is going through, and (ii) the regulator has a good measure of the bankers' myopia in their decision making processes. Both factors are very rarely observable in practice; thus, this solution would not be implementable in an accurate way. Taking into account that both assumptions are not likely to occur, the fact that regulators display too much discretion in setting provision rates may introduce additional noise in credit markets. Indeed, it is likely that if this discretion is nor used in a very consistent fashion, uncertainty increases and the impact on lending and lending variability is perverse.

V.2 – *Second best*: cyclically adjusted provisions

In cases in which uncertainty is an issue, rules can be more accurate than discretion, regardless the fact that the *first best* solution is not achievable *a priori*. In such situations, it is important to evaluate a provision rule that require banks to set

provisions on the basis of the expected losses calculated over the entire business cycle, instead of using the current default rate. In order to introduce this rule into the model, we define the default risk associated to the whole cycle in the following way: $\bar{q} = q(0)$. Then, current provisions will be $a\bar{q}$.

This change in the regulatory design leads us to redefine the investment possibilities curve:

$$m_P = r_B + \left[\frac{\left(r_C - r_B - k - a\bar{q} \right)}{q(y)} - r_C \right] q_P \quad (3''')$$

Now, the equilibrium condition for the representative bank will be:

$$MRT = \left[\frac{\left(r_C - r_B - k - a\bar{q} \right)}{q(y)} - r_C \right] = -\frac{U_q}{U_m} = MRS \quad (4''')$$

Differentiating equation (4''') with respect to the output gap variable and rearranging terms, we get the change in the credit share of the portfolio depending on the business cycle:

$$\left. \frac{\partial c^*}{\partial y} \right|_{a\bar{q}} = -\left[\frac{r_C - r_B - k - a\bar{q}}{q^2(y)} \frac{1}{\partial MRS / \partial q_P} + c^* \right] \frac{q'(y)}{q(y)} > 0 \quad (7''')$$

The lending activity still varies positively with the economic fluctuations, but what it is interesting here is to evaluate the credit variability associated to alternative regulatory design with respect to loss provisions. Additionally, comparing equations (7) and (7''') yields:

$$\left. \frac{\partial c^*}{\partial y} \right|_{aq(y)} > \left. \frac{\partial c^*}{\partial y} \right|_{a\bar{q}} \quad (10)$$

The switching from a regime based on fixed coefficients on current default rates to a regime based on cyclically-adjusted default rates appears to be fruitful in terms of mitigating credit procyclicality and smoothing macroeconomic fluctuations. The latter

regime allows to partly alleviate the lending volatility during the boom-bust cycle, in spite of not being designed to compensate the procyclicality that emerges from bankers' "myopic" decisions. Note that the impact on credit variability depends on the value of $q'(y)$. The larger the sensibility of default with the business fluctuations, the larger the effect when the provision rule is designed as $aq(y)$; and consequently, the larger the benefits that the regulator chooses a regime designed as $a\bar{q}$ from the macroeconomic stability standpoint.

It worth to make a digression related to the relationship between prudential regulation and the moral hazard issue. The fact that the cyclically adjusted provision regime stabilizes the burden for banks over time does not imply that the moral hazard problem is ruled out or underestimated. In fact, the long term loss provision rate is bank specific, since it emerges as the result of the medium and long-term risk management. The global and relative magnitudes of credit provisions over the entire business cycle do not have to differ because they are differently distributed through time. Thus, the rule under scrutiny does not necessarily imply that the regulatory stringency is relaxed or strengthened. The total value of provisions can be equal in both alternative regimes: $\int_{\underline{y}}^{\bar{y}} aq(y)dy = \int_{\underline{y}}^{\bar{y}} aq(0)dy$, being $\underline{y}$ and $\bar{y}$ the extreme values of output in the boom-bust cycle. Additionally, the capital adequacy requirement depends on the bank specific composition of portfolio. As a result, this proposal has the merit of smoothing the credit cycle with prudential norms, without sacrificing incentives, which are designed to mitigate the moral hazard problem in banking decision making.

VI – CONCLUSIONS

The model developed here suggests that, under some general circumstances that include the bankers' myopia and risk aversion, lending shows a clear procyclical pattern. Such behavior occurs because the return-risk perception of banks varies with the business cycle. During booms, banks perceive the return-risk combination associated to loans to firms as relatively more convenient, which induces a larger share of credit in the optimal portfolio. Conversely, this share decreases during recessions. However, this procyclical behavior is partly softened by prudential regulation, which includes capital adequacy and credit loss provision requirements. This result sheds light on the current debate about the (pro)cyclical role of prudential norms. Actually, these

findings contradict the broad consensus that prudential regulation stimulates bank credit variability, thus amplifying the business cycle. In that view, the amplifying effect should be taken as a cost associated to the need to mitigate the moral hazard problem. According to our model, the *trade-off* between solvency goals and anticyclical policies is not valid in general.

Moreover, we support that loss provision rules based on cyclically adjusted default rates are more efficient in mitigating the credit procyclicality than rules based on current default rates. This could also be useful in terms of alleviating the problem of the regulators being more lenient during recessions, since the regulation itself would contain cyclical considerations. Regarding the capital adequacy requirements, they could be procyclical only in the case that banks do not have access to the minimum required capital during the bust phase of the business cycle.

We also suggest that it would not be advisable to systematically change the capital and provision requirements (in particular, to reduce them during recessions). This could help in terms of short term macroeconomic fluctuations, but also give the wrong incentives in order to mitigate the moral hazard problem and introduce further uncertainties in credit markets, inducing negative effects on the banking solvency.

This paper focuses on the cyclical features of credit based on the analysis of the portfolio composition of banks, ruling out other sources of credit procyclicality linked to the monetary channel and the global amount of banks' assets. Intuitively, the fact that the global portfolio's size also varies positively with the business cycle would reinforce our main conclusions. Nevertheless, the role of prudential measures in this context could be the subject of a broader analytical framework.

REFERENCES

Aghion, P., P. Bacchetta and A. Banerjee (1998): "Financial Liberalization and Volatility in Emerging Market Economies", Studienzentrum Gerzensee Working Papers 98/02.

Bank for International Settlements (1999): "Capital Requirements and Bank Behaviour: The Impact of the Basle Accord", Basle Committee of Banking Supervision, Working Papers Nº 1.

Bergara, M. and J. A. Licandro (1999): "Una propuesta para hacer explícito un fondo de garantía para el sistema bancario uruguayo", *Revista de Economía*, Vol. 7, Nº 1, Banco Central del Uruguay.

Bernanke, B. and A. Blinder (1987): "Banking and Macroeconomic Equilibrium", in *New Approaches to Monetary Economics*, Barnett y Singleton eds., Cambridge University Press.

Bernanke, B. and A. Blinder (1988): "Credit, Money and Aggregate Demand", *American Economic Review*, Vol. 78, Nº 2.

Bernanke, B., M. Gertler and S. Gilchrist (1998): "The Financial Accelerator in a Quantitative Business Cycle Framework", NBER Working Paper 6455.

Blum, J. and M. Hellwig (1995): "The macroeconomic implications of capital adequacy requirements for banks", *European Economic Review*, 39.

Cortavarria, L., C. Dziobek, A. Kanaya and I. Song (2000): "Loan Review, Provisioning, and Macroeconomic Linkages", *IMF Working Paper* Nº 00/195.

Devlin, R. (1986): "La estructura y el comportamiento de la banca internacional y su impacto en la crisis de América Latina", *Estudios CIEPLAN* Nº 20, Chile.

Dewatripont, M. and J. Tirole (1994): *The Prudential Regulation of Banks*, The MIT Press, Cambridge.

Easterly, W., R. Islam and J. Stiglitz (2000): "Explaining Growth Volatility", The World Bank, mimeo.

Escudé, G. (1999): "El indicador de riesgo crediticio de Argentina dentro de un enfoque de teoría de carteras de la exigencia de capital por riesgo crediticio", Documento de Trabajo Nº 8, Banco Central de la República Argentina.

Falkenheim, M. and A. Powell (1999): "The Use of Credit Bureau Information in the Estimation of Appropriate Capital and Provisioning Requirements", Central Bank of Argentina, mimeo.

Fernández de Lis, S., J. Martínez and J. Saurina (2000): "Credit Growth, Problem Loans and Credit Risk Provisioning in Spain", Banco de España, Documento de Trabajo Nº 0018.

Freixas, X. and J. C. Rochet (1997): *Microeconomics of Banking*, The MIT Press, Cambridge.

Gourinchas, P., R. Valdés and O. Landerretche (2000): "Lending Booms: Some Stylized Facts", mimeo.

Herring, R. (1999): "Credit Risk and Financial Instability", *Oxford Review of Economic Policy*, Vol. 15, Nº 3.

Herring, R. and S. Wachter (1999): "Real Estate Booms and Banking Busts: An International Perspective", Financial Institutions Center, Wharton School Nº 99-27.

Jackson, P. and D. Lodge (2000): "Fair value accounting, capital standards, expected loss provisioning, and financial stability", *Financial Stability Review*, June.

Kiyotaki, N. and J. Moore (1997): "Credit Cycles", *Journal of Political Economy*, Vol. 105, Nº 2.

Ocampo, J. A. (2000): "Developing Countries' Anti-Cyclical Policies in a Globalized World", ECLAC, mimeo.

Poveda, D. R. (2000): "La reforma del sistema de previsiones de insolvencia", Banco de España, *Boletín Económico*, January.

Rochet, J. C. (1992): "Capital requirements and the behaviour of commercial banks", *European Economic Review*, 36.

Rochet, J. C. (1999): "Solvency regulations and the management of banking risks", *European Economic Review*, 43.

Santos, J. (2000): "Bank Capital Regulation in Contemporary Banking Theory: A Review of the Literature", Bank for International Settlements, Working Paper Nº 90.

Schneider, M. and A. Tornell (1999): "Lending Booms and Asset Price Inflation", Harvard University, mimeo.

Tirole, J. (1994): "On banking and intermediation", *European Economic Review*, 38.