ISSN 1518-3548

BANCO CENTRAL DO BRASIL

Working Paper Series 234

Cyclical Effects of Bank Capital Requirements with Imperfect Credit Markets

Pierre-Richard Agénor and Luiz A. Pereira da Silva

January, 2011

ISSN 1518-3548
CGC 00.038.166/0001-05

Working Paper Series	Brasília	n. 234	Jan.	2011	p. 1-68

Working Paper Series

Edited by Research Department (Depep) – E-mail: workingpaper@bcb.gov.br

Editor: Benjamin Miranda Tabak – E-mail: benjamin.tabak@bcb.gov.br
Editorial Assistant: Jane Sofia Moita – E-mail: jane.sofia@bcb.gov.br
Head of Research Department: Adriana Soares Sales – E-mail: adriana.sales@bcb.gov.br

The Banco Central do Brasil Working Papers are all evaluated in double blind referee process.

Authorized by Carlos Hamilton Vasconcelos Araújo, Deputy Governor for Economic Policy.

General Control of Publications

Banco Central do Brasil

Secre/Surel/Cogiv

SBS – Quadra 3 – Bloco B – Edifício-Sede – 1º andar

Caixa Postal 8.670

70074-900 Brasília – DF – Brazil

Phones: +55 (61) 3414-3710 and 3414-3565

Fax: +55 (61) 3414-3626

E-mail: editor@bcb.gov.br

Consumer Complaints and Public Enquiries Center

Banco Central do Brasil

Secre/Surel/Diate

SBS – Quadra 3 – Bloco B – Edifício-Sede – 2º subsolo

70074-900 Brasília – DF – Brazil

Fax: +55 (61) 3414-2553

Internet: http://www.bcb.gov.br/?english

Cyclical Effects of Bank Capital Requirements with Imperfect Credit Markets*

Pierre-Richard Agénor†

Luiz A. Pereira da Silva‡

Abstract

This paper analyzes the cyclical effects of bank capital requirements in a simple model with credit market imperfections. Lending rates are set as a premium over the cost of borrowing from the central bank, with the premium itself depending on firms' effective collateral. Basel I- and Basel II-type regulatory regimes are defined and a capital channel is introduced through a signaling effect of capital buffers on the cost of bank deposits. The macroeconomic effects of various shocks (a drop in output, an increase in the refinance rate, and a rise in the capital adequacy ratio) are analyzed, under both binding and nonbinding capital requirements. Factors affecting the procyclicality of each regime (defined in terms of the behavior of the risk premium) are also identified and policy implications are discussed.

Keywords: capital requirements; credit market; financial regulation.

JEL Classification: E44, H52, G28.

---

*We are grateful to Koray Alper, Charles Goodhart, and seminar participants at the Bank for International Settlements, Banque de France, the International Center for Monetary and Banking Studies, the OECD, the University of Clermont-Ferrand, and the World Bank, for helpful comments. Financial support from the World Bank is gratefully acknowledged. The views expressed are our own.

†School of Social Sciences, University of Manchester, Oxford Road, Manchester M13 9PL, United Kingdom, and Centre for Growth and Business Cycle Research.

‡Deputy Governor of Banco Central do Brasil.

1 Introduction

The global financial crisis triggered by the collapse of the subprime mortgage market in the United States has led to a reassessment of the policies and rules that have allowed the buildup of financial fragilities. The regulatory framework, and the distortions in bank behavior and the financial intermediation process that it may have led to, have come under renewed scrutiny. Indeed, it is now well recognized that the Basel I regulatory capital regime that U.S. banks were subject to gave them strong incentives to reduce required capital by shifting loans off their balance sheets.[1] Banks turned to an "originate and distribute" model, in which standardized loans, mostly high-risk mortgages—involving no money down, interest only or less as the initial payment, with no documentation on borrowers' capacity to pay, and initial "teaser" interest rates that would adjust upward even if market rates remained constant—could be bundled and sold as securities, thereby leaving the originating bank free to use its capital elsewhere. As the housing market deteriorated, and uncertainty about the underlying value of subprime mortgage-backed securities mounted, efforts to maintain capital adequacy led to massive deleveraging, capital hoarding, liquidity shortages, and contractions in credit supply, with adverse consequences for the functioning of both real and financial markets (see Calomiris (2009), and Kashyap, Rajan, and Stein (2009)).

Since consultations on the Basel II accord started, and since its eventual adoption in 2004, there has been a broader debate on the procyclicality effect of prudential and regulatory rules and practices.[2] With Basel II, capital requirements are based on asset *quality* rather than only on asset *type*, and banks must use "marking to market" to price assets, rather than book value. As the rules make bank capital requirements more sensitive to changes in the banks' risk exposure, and as the riskiness of loan books changes over the business cycle, the required regulatory capital varies with the business cycle. For instance, when asset prices start declining, banks may be forced to undertake continuous writedowns (accompanied by increased provisioning), and this raises their need for capital. Capital requirements may therefore increase in a cyclical downturn. If banks are highly leveraged, to maintain their capital ratio during a recession, they must either raise capital (which is difficult and/or costly in bad times) or cut back their lending, which in turn tends to amplify the downturn. Thus, the "common view" is that the introduction of risk-sensitive capital charges may not only

[1] The 1988 Basel I Accord prescribed that banks hold capital of at least 8 percent of their risk-weighted assets. Critics noted early on that it treated all corporate credits alike and thereby invited regulatory arbitrage, and that it failed to take account of the distortions induced by capital regulation.

[2] The 2004 Basel II allows banks to use their internal models to assess the riskiness of their portfolios and to determine their required capital cushion—provided that their internal model is validated by the regulatory authority. It also acknowledges the importance of two complementary mechanisms to safeguard financial stability, namely supervision and market discipline.

increase the volatility of regulatory capital, it may also (by limiting banks' ability to lend) exacerbate an economic downturn.

Most existing studies of the cyclicality of capital regulatory regimes, both theoretical and empirical, are based on industrialized countries.[3] However, the pervasiveness of financial market imperfections in developing countries, coupled with their greater vulnerability to shocks, makes a focus on these countries warranted. For middle-income countries, in particular, these imperfections cover a broad spectrum: underdeveloped capital markets, which imply limited alternatives (such as corporate bonds and commercial paper) to bank credit; limited competition among banks; more severe asymmetric information problems, which make screening out good from bad credit risks difficult and fosters collateralized lending; a pervasive role of government in banking, both directly or indirectly; uncertain public guarantees; inadequate disclosure and transparency, coupled with weak supervision and a limited ability to enforce prudential regulations; weak property rights and an inefficient legal system, which makes contract enforcement difficult and also encourages collateralized lending; and a volatile economic environment, which increases exposure to adverse shocks and magnifies (all else equal) both the possibility of default by borrowers and the risk of bankruptcy of financial institutions. One implication is that a large majority of small and medium-size firms (operating mostly in the informal sector) are simply squeezed out of the credit market, whereas those who do have access to it—well-established firms, often belonging to members of the local elite—face an elastic supply of loans and borrow at terms that depend on their ability to pledge collateral. Credit rationing—which results fundamentally from the fact that inadequate collateral would have led to prohibitive rates—is therefore largely "exogenous." A second implication is the importance of the cost channel, which becomes a key part of the monetary transmission mechanism.[4] The goal of this paper is to analyze the cyclical effects of Basel I- and Basel II-type capital standards in a simple macroeconomic model that captures some of these financial features and implications. As it turns out, a key variable in the determination of macroeconomic equilibrium is the risk premium that banks charge their customers, depending on the effective collateral that they can pledge.

The paper continues as follows. Section II presents the model. Basel I- and Basel II-type

[3]For empirical studies on industrial countries, see for instance Ayuso, Pérez, and Saurina (2004), Bikker (2004), Gordy and Howells (2006), and Van Roy (2008). For theoretical contributions, see Blum and Hellwig (1995), Zicchino (2005), Cecchetti and Li (2008), and the literature surveys by Drumond (2008), and VanHoose (2008). Pereira (2009) provides references to the limited literature on middle-income countries. He also provides a critical review of the empirical evidence, based on the general equilibrium implications of the present paper.

[4]The direct effect of lending rates on firms' marginal production costs is a common feature of developing economies, and there is evidence that it may be important also in industrial countries. See the references in Agénor and Alper (2009), for instance.

regulatory capital regimes are defined, the latter by linking the risk premium on loans to risk weights. A "bank capital channel" is accounted for by introducing a signaling effect of capital buffers on bank deposit rates; this differs significantly from the literature on this topic, which tends to focus on the financing choices of banks in an environment where the Modigliani-Miller theorem fails (see, for instance, Van den Heuvel (2007)). Section III focuses on the case where capital requirements are not binding and studies the impact of three types of shocks on macroeconomic equilibrium and the degree of cyclicality of lending and interest rates: a negative supply shock, an increase in the central bank's policy rate, and an increase in the capital adequacy ratio. Considering a range of shocks is important because a regulatory regime may impart a procyclical bias to some variables for certain shocks and a countercyclical bias to the same variables for other shocks. In addition, considering a shock to the policy interest rate allows us to assess how the regulatory regime affects the transmission of monetary policy in the context of a middle-income country—an issue that has not received much attention in the literature. The final section offers some concluding remarks.

2 The Model

The model that we develop builds on the static framework with monopolistic banking developed by Agénor and Montiel (2008a). Specifically, it combines the cost channel of monetary policy with an explicit analysis of the links between collateral, capital requirements, and bank pricing behavior. Both features capture key aspects of credit market imperfections in middle-income countries, as documented earlier. Because borrowers' ability to repay is uncertain, lending is collateralized, and effective collateral affects the terms of credit through a risk premium that banks incorporate in lending rates. Moreover, at the prevailing lending rate, the supply of loans is perfectly elastic. There is therefore no endogenous credit rationing, as noted earlier. As is now standard, we also assume that the central bank's supply of liquidity is perfectly elastic at a target interest rate. Monetary policy is therefore implemented through a standing facility. In what follows we describe the behavior of the four types of agents that populate the economy, firms, households, a commercial bank, and the central bank.

2.1 Firms

Firms produce a single, homogeneous good. To finance their working capital needs, which consist solely of labor costs, firms (which have no retained earnings, for simplicity) must borrow from the bank. Total production costs faced by the representative firm are thus equal to the wage bill plus the interest payments made on bank loans. For simplicity, we will assume that loans contracted for the purpose of financing working capital (which are short-term in nature), are fully collateralized by the firm's capital stock, and are therefore made at a rate that reflects only the cost of borrowing from the central bank, i_R.[5] Firms repay working capital loans, with interest, at the end of the period, after goods have been produced and sold. Loans are therefore one-period debt contracts. Profits are transferred at the end of each period to the firms' owners, households.

Let W denote the nominal wage, N the quantity of labor employed, and i_R the official rate charged by the central bank to the commercial bank (or the refinance rate, for short); the wage bill (inclusive of borrowing costs) is thus $(1+i_R)WN$. The maximization problem faced by the representative firm can be written as

$$N = \arg\max[PY - (1+i_R)WN], \tag{1}$$

where Y denotes output and P the price of the good.

The production function takes the form

$$Y = AN^{\alpha}K_0^{1-\alpha}, \tag{2}$$

where $A > 0$ is a supply or productivity shock, K_0 is the beginning-of-period stock of physical capital (which is therefore predetermined), and $\alpha \in (0,1)$.

Solving problem (1) subject to (2), taking i_R, P and W as given, yields

$$\alpha APN^{\alpha-1}K_0^{1-\alpha} - (1+i_R)W = 0.$$

This condition yields the demand for labor as

$$N^d = [\frac{\alpha AK_0^{1-\alpha}}{(1+i_R)(W/P)}]^{1/(1-\alpha)}, \tag{3}$$

which can be substituted in (2) to give

$$Y^s \equiv [\frac{\alpha A}{(1+i_R)(W/P)}]^{\alpha/(1-\alpha)}K_0. \tag{4}$$

These equations show that labor demand and supply of the good are inversely related to the effective cost of labor, $(1+i_R)(W/P)$.

Given the short-run nature of the model, the nominal wage is assumed to be rigid at $\bar{W}$.[6] This implies, from (3) and (4), that

$$N^d = N^d(P; i_R, A), \qquad Y^s = Y^s(P; i_R, A), \tag{5}$$

[5] Adding a fixed profit margin over and above the refinance rate would not affect the results qualitatively.

[6] Assuming that the nominal wage is indexed to the price level would not alter qualitatively our results as long as indexation is less than perfect.

with $N^d_P, Y^s_P > 0$, $N^d_{i_R}, Y^s_{i_R} < 0$, and $N^d_A, Y^s_A > 0$.[7] An increase in borrowing costs or a reduction in prices (which raises the real wage) exert a contractionary effect on output and employment.

Real investment is negatively related to the real lending rate:

$$I = h(\frac{1+i_L}{1+\pi^a}), \tag{6}$$

where i_L is the nominal lending rate, π^a the expected rate of inflation, and $h' < 0$.[8]

Using (5) and (6), the total amount of loans demanded (and allocated by the bank) to finance labor costs and capital accumulation, L^F, is thus

$$L^F = \bar{W}N^d(P; i_R, A) + Ph(\frac{1+i_L}{1+\pi^a}). \tag{7}$$

2.2 Households

Households supply labor inelastically, consume goods, and hold two imperfectly substitutable assets: currency (which bears no interest), in nominal quantity $BILL$, and bank deposits, in nominal quantity D. Because households own the bank, they also hold equity capital, which is fixed at $\bar{E}$.[9] Household financial wealth, F^H, is thus defined as:

$$F^H = BILL^H + D + \bar{E}. \tag{8}$$

The relative demand for currency is assumed to be inversely related to its opportunity cost:

$$\frac{BILL^H}{D} = \nu(i_D), \tag{9}$$

where i_D is the interest rate on bank deposits and $\nu' < 0$. Using (8), this equation can be rewritten as

$$\frac{D}{F^H - \bar{E}} = h_D(i_D), \tag{10}$$

[7]Except otherwise indicated, partial derivatives are denoted by corresponding subscripts, whereas the total derivative of a function of a single argument is denoted by a prime.

[8]Throughout the analysis, we assume that inflation expectations are exogenous. In a static model such as ours, this is a reasonable assumption if expectations have a strong backward-looking component. There is evidence that this is indeed the case for many middle-income countries; see Agénor and Bayraktar (2010).

[9]It could be assumed, as in Cecchetti and Li (2008), that bank capital is directly and positively related to aggregate output, because an increase in that variable raises the value of bank assets—possibly because borrowers are now more able to repay their debts. However, our assumption that E is fixed is quite reasonable, given the short time frame of the analysis. Note also that there is no distinction between the book value and market value of equity. Our implicit assumption is that equity prices are determined by future dividends, which are taken as given.

where $h_D(i_D) = 1/[1 + \nu(i_D)]$ and $h'_D > 0$. Thus,

$$\frac{BILL^H}{F^H - \bar{E}} = h_B(i_D), \tag{11}$$

where $h_B = \nu(i_D)/[1 + \nu(i_D)]$ and $h'_B < 0$.

Real consumption expenditure by households, C, depends negatively on the real deposit rate (which captures an intertemporal effect) and positively on labor income and the real value of wealth at the beginning of the period:[10]

$$C = \alpha_0 + \alpha_1 \frac{\bar{W}N}{P} - \alpha_2 (\frac{1 + i_D}{1 + \pi^a}) + \alpha_3 (\frac{F_0^H}{P}), \tag{12}$$

where π^a is the exogenous expected inflation rate, $\alpha_1 \in (0, 1)$ the marginal propensity to consume out of disposable income, and α_0, α_2, $\alpha_3 > 0$. The positive effect of current labor income on private spending is consistent with the evidence regarding the pervasiveness of liquidity constraints in middle-income countries (see Agénor and Montiel (2008*b*)) and the (implicit) assumption that households cannot borrow directly from banks to smooth consumption.

2.3 Commercial Bank

Assets of the commercial bank consist of total credit extended to firms, L^F, and mandatory reserves held at the central bank, RR. The bank's liabilities consist of the book value of equity capital, $\bar{E}$, household deposits, and borrowing from the central bank, L^B. The balance sheet of the bank can therefore be written as:

$$L^F + RR = \bar{E} + D + L^B, \tag{13}$$

where all variables are measured in nominal terms. Reserves held at the central bank pay no interest and are set in proportion to deposits:

$$RR = \mu D, \tag{14}$$

where $\mu \in (0, 1)$.

2.3.1 Interest Rate Pricing Rules

The bank is risk-neutral and sets both deposit and lending rates.[11] We consider both decisions in turn.

[10] Recall that profits are distributed only at the end of each period. For simplicity, we also assume that interest on deposits is paid at the end of the period; current income consists therefore only of wages.

[11] In our simple framework, the bank only borrows from households and the central bank, and only lends to firms. In addition, we also assume that the (operational) costs of raising funds and to produce loans—which

Deposit Rate and Capital Buffers From the monopoly bank optimization problem described in Agénor and Montiel (2008*a*), the deposit rate is given by

$$i_D = (1 + \frac{1}{\eta^D})^{-1}(1 - \mu)i_R, \tag{15}$$

where η^D is the interest elasticity of the supply of deposits.

We also consider a more general specification, in which the bank's capital position affects its funding costs, through a "signaling" effect. Specifically, we assume that the bank's capital buffer (as measured by the ratio of actual to required capital) allows it to raise deposits more cheaply, because households internalize the fact that bank capital increases its incentives to screen and monitor its borrowers. Depositors, therefore, are willing to accept a lower, but safer, return.[12]

Formally, let E^R be the capital requirement (defined below); the capital buffer, measured as a ratio, is thus $\bar{E}/E^R$. The alternative specification that we consider is thus

$$i_D = \varepsilon^D(1 - \mu)i_R f(\frac{\bar{E}}{E^R}), \tag{16}$$

where $\varepsilon^D = (1+1/\eta^D)^{-1}$, $0 < f(\cdot) \leq 1$, $f' < 0$, and $f(1) = 1$. The last condition implies that if $\bar{E} = E^R$, bank capital has no effect on the deposit rate, as specified in (15).[13] The strength of the bank capital channel, as defined here, can therefore be measured by $|f'|$. However, from (12), whether the existence of this channel (which operates through the deposit rate) matters depends on the presence of an intertemporal substitution effect on consumption.

Models consistent with this idea (and with more rigorous micro foundations) are developed in Chen (2001), where banks, which act as delegated monitors, must be well-capitalized to convince depositors that they have enough at stake in funding risky projects, and with Allen et al. (2009), who have argued 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. Our specification is also consistent with the view, discussed by Calomiris and Wilson (2004), that depositors have a low preference for high-risk deposits and may demand a "lemons premium" (or penalty interest rate) as a result of a perceived increase in bank debt risk. To limit this

are in fact zero—are independent of each other. As a result, deposit and lending rates are also independent of each other. However, as discussed by Santomero (1984) and especially Sealey (1985), in a more general stochastic setting with a large array of risky assets and a joint cost function for deposits and loans, portfolio separation does not generally hold. We will return to this issue in the concluding section.

[12] We could assume that the *absolute* magnitude of equity capital exerts also a signaling effect. However, given that we keep $\bar{E}$ constant, this modification would not have any substantive implication for our results.

[13] Note that we also assume implicitly that depositors do not observe the risk premium set by the bank; otherwise, if they are to some degree risk averse, a positive relationship could arise between θ_L and i_D.

risk (and therefore reduce deposit rates), banks may respond by accumulating capital. This view is supported by the empirical results of Demirgüç-Kunt and Huizinga (2004), which show a negative relationship between deposits rates and the ratio of bank capital to bank assets. More direct support is provided by Fonseca et al. (2010), in a study of pricing behavior by more than 2,300 banks in 92 countries over the period 1990 to 2007. They found that capital buffers (defined as $(\bar{E} - E^R)/E^R$, rather than $\bar{E}/E^R$) are negatively and significantly associated with deposit rate spreads, regardless of the regulatory regime. Moreover, this association appears to be stronger for developing countries, compared to industrial countries.

Alternatively, the link between the capital buffer and deposit rates could reflect the fact that well-capitalized banks face lower expected bankruptcy costs (that is, lower *ex post* monitoring costs in case of default) and hence lower funding costs *ex ante* from households. Whatever the interpretation, the general point is that in a volatile economic environment, where the risk of adverse shocks is high, signals about a bank's solvency can have a significant effect on depositors' behavior—particularly when government deposit guarantees (in the form of a deposit insurance system, for instance) do not exist or are not reliable.[14]

Lending Rate and the Risk Premium Again, from the bank optimization problem described in Agénor and Montiel (2008a), the contractual lending rate, i_L, is given by

$$i_L = \varepsilon^L (1 + \theta_L) i_R, \tag{17}$$

where $\varepsilon^L = (1 + 1/\eta^L)^{-1}$, with η^L denoting (the absolute value of) the interest elasticity of the demand for investment loans, and θ_L is the risk premium, which is inversely related to the repayment probability. Thus, the lending rate is set as a premium over the central bank refinance rate, which represents the marginal cost of funds. With non-binding capital requirements, we assume that the premium is inversely related to the asset-to-liability ratio of the borrower, given by the "effective" value of collateral pledged by the borrower (that is, assets that can be borrowed against) divided by its liabilities, that is, borrowing for investment purposes, PI. In turn, the "effective" value of collateral consists of a fraction $\kappa \in (0, 1)$ of the value of the firm's nominal output:[15]

$$\theta_L = g(\frac{\kappa P Y^s}{PI}), \tag{18}$$

[14] Interestingly enough, in the empirical part of their study, Calomiris and Wilson (2004) focus on the behavior of New York City banks during the 1920s and 1930s. They argue that doing so is important because during that time the U.S. deposit insurance system either did not exist or did not have much impact on the risk choices of these banks—therefore allowing them to better assess the link between deposit default risk and bank capital.

[15] Note that, in this static framework, the interest rate-setting decision and the loan demand decision are simultaneously determined: to set the risk premium the bank must know actual output (and thus

where $g' < 0$. This specification is consistent with the view that collateral, by increasing borrowers' effort and reducing their incentives to take on excessive risk, reduces moral hazard and raises the repayment probability—inducing the bank therefore to reduce the premium on its loans for investment purposes.[16] Thus, an increase in goods or asset prices, or a reduction in borrowing, tends to raise the firm's effective asset-to-liability ratio and to reduce the risk premium demanded by the bank. As discussed in subsequent sections, the fact that the premium depends endogenously on the price of the domestic good (through its impact on output) allows monetary policy to generate financial accelerator or decelerator effects, implying that the premium may be either procyclical or countercyclical.

2.3.2 Capital Requirements

Capital requirements are based on the bank's risk-weighted assets. Suppose that the risk weight on "safe" assets (reserves and loans for working capital needs) is 0, whereas the risk weight on investment loans is $\sigma > 0$, respectively. Risk-weighted assets are thus σPI. The capital requirement constraint can therefore be written as

$$E^R = \sigma \rho PI, \tag{19}$$

where $\rho \in (0, 1)$ is the capital adequacy ratio (the so-called Cooke ratio). If the penalty (monetary or reputational) cost of holding capital below the required level is prohibitive, we can exclude the case where $\bar{E} < E^R$; the issue is therefore whether $\bar{E} = E^R$ or $\bar{E} > E^R$.

We consider two alternative regimes for the determination of the risk weight σ. Under the first regime, which corresponds to Basel I, the risk weight is exogenous at σ_R; the bank keeps a flat minimum percentage of capital against loans provided for the purpose of investment. Under the second, which corresponds to Basel II, capital requirements are risk-based; the risk weight is endogenous and inversely related to loan quality, which in turn is inversely related to the risk premium imposed by the bank, θ_L. This is similar in spirit to linking the risk weight to the probability of default of borrowers, as proposed by Heid (2007). Thus, as allowed under Basel II, we assume that the bank uses an IRB approach, or its own default risk assessment, in calculating the appropriate risk weight—and by implication required regulatory capital. This assumes in turn that the standards embedded in the bank's risk management system have been validated by the regulator—the central bank here—through

employment and credit demand), whereas to determine employment and credit demand firms must know the cost of borrowing.

[16] Note also that (18) is based on flows, rather than stocks, as in Agénor and Montiel (2008). There is therefore no "balance sheet" or "net worth" effect on the premium, as in the Bernanke-Gertler tradition, but rather a (flow) collateral effect.

an Internal Capital Adequacy Assessment Process (ICAAP).[17]

Formally, the two regimes can be defined as[18]

$$\sigma = \begin{cases} \sigma_R \leq 1 \text{ under Basel I} \\ \\ \sigma(\theta_L),\ \sigma' > 0 \text{ under Basel II} \end{cases}. \tag{20}$$

Inspection of equations (5), (7), (17), (18), (19), and (20) yields the following result:

Proposition 1. *In partial equilibrium, a negative supply shock (a fall in A) lowers effective collateral and raises the risk premium on investment loans; under Basel II, the risk weight associated with these loans and capital requirements also increase and bank lending for investment must fall if the capital constraint is binding ($\bar{E} = E^R$).*

The link between σ and θ_L under Basel II is consistent with specifications that relate risk weights to the borrower's probability of default over the business cycle, as for instance in Tanaka (2002) and Heid (2007). Proposition 1 captures one of the general concerns about Basel II: during a recession for instance (say, a negative supply shock, as discussed here), if lending to firms is considered riskier because collateral values fall, the bank will be required to hold more capital—or, failing that, to reduce lending (indirectly in the present case, by increasing the risk premium). In turn, the credit crunch will exacerbate the economic downturn, making capital requirements procyclical.

However, in the present setting there are also a number of other (endogenous) factors that will affect the premium. The fall in lending that may result from a binding capital constraint following an increase in risk tends not only to reduce output but also the collateral required by the bank; this dampens the initial increase in the premium. In addition, changes in lending and aggregate supply will affect prices, which will affect the equilibrium value of the premium as well. With the bank capital channel embedded in the model, changes in the capital buffer will also affect the deposit rate and consumption, which in turn will affect aggregate demand and prices. These interactions imply that the net effect of shocks can be fully assessed only through a general equilibrium analysis.

2.3.3 Borrowing from the Central Bank

Given that firms' demand for credit determines the actual supply of loans, and that the required reserve ratio is set by the monetary authority, the balance sheet condition (13) can

[17] The Standardized Approach in Basel II can be modeled by making the risk weight a function of output (in a manner similar to Zicchino (2006) for instance), under the assumption that ratings are procyclical.

[18] Under Basel II, it is technically possible for σ to exceed unity.

be solved residually for borrowing from the central bank, L^B. Because there is no reason for the bank to borrow if it can fund its loan operations with deposits, and using (14), we have $L^B = \max[0, L^F - (1-\mu)D - \bar{E}]$.[19]

2.4 Central Bank

The balance sheet of the central bank consists, on the asset side, of loans to the commercial bank, L^B. On the liability side, it consists only of the monetary base, MB:

$$L^B = MB, \tag{21}$$

with the monetary base given also by the sum of total currency in circulation, $BILL$, and reserves:

$$MB = BILL + RR. \tag{22}$$

Monetary policy is operated by setting the refinance rate at the constant rate i_R and providing liquidity (at the discretion of the commercial bank) through a standing facility.

Because central bank liquidity is endogenous, the monetary base is also endogenous; this implies, using (14) and (21), that the supply of currency is

$$BILL^s = L^B - \mu D. \tag{23}$$

2.5 Market-Clearing Conditions

There are five market equilibrium conditions to consider: four financial (deposits, loans, central bank credit, and cash), and one for the goods market. Markets for deposits and loans adjust through quantities, with the bank setting prices in both cases. The supply of central bank credit is perfectly elastic at the official refinance rate i_R and the market also equilibrates through quantity adjustment.

The equilibrium condition of the goods market, which determines the goods price P, is given by:

$$Y^s = C + I. \tag{24}$$

The last equilibrium condition relates to the market for cash, and (under the assumption that the counterpart to bank loans is held by firms in the form of currency) involves (11)

[19] Note that in the present setting the bank's profits are not necessarily zero. Just like firms' profits, we assume that this income is distributed to households only at the end of the period.

and (23). However, there is no need to write this condition explicitly, given that by Walras' Law it can be eliminated.[20]

Table 1 summarizes the list of variables and their definitions.

3 Non-Binding Capital Requirements

We first consider the case where existing equity capital is higher than the required value, that is, $\bar{E} > E^R$, regardless of whether σ is endogenous or not. This is consistent with the evidence suggesting that, in normal times, banks often hold more capital than the regulatory minimum—possibly as a result of market discipline (see Rochet (2008)). However, although bank capital is not a binding constraint on the bank's behavior, it still plays an indirect role,

[20] A simple proof that Walras' Law holds is as follows. Consider an end-of-period specification where the savings-investment equilibrium refers to flows within the period, whereas the equilibrium of the asset markets refer to stocks at the end of the period (see Buiter (1980)). Thus, the outstanding stock of X at the end of the period, after taking account of changes (accumulation or decumulation) within the period, is given by $X_1 = X_0 + \Delta X$, where X_0 is the beginning-of-period stock; it must equal stock demand.

Formally, given that there is no market *per se* for equity, Walras' Law takes the following form for the five markets (deposits, credit to firms, borrowing by the commercial bank, cash holdings by private agents, and goods):

$$(D_1^d - D_0 - \Delta D) + (L_1^{F,d} - L_0^F - \Delta L^F) + (L_1^{B,d} - L_0^B - \Delta L^B)$$
$$(BILL_1^{H,d} - BILL_0 - \Delta BILL) + (I - Y + C) = 0,$$

where D_1^d is the demand for deposits from (10), $L_1^{F,d}$ is total credit demanded by firms, $L_1^{B,d}$ is the demand for central bank liquidity from (14), and $BILL_1^{H,d}$ is the demand for cash from (11). With markets in deposits, credit to firms, borrowing by the commercial bank, and goods always in equilibrium (through either a perfectly elastic supply or demand curve in the first four markets, and flexible prices in the last), $\Delta D = D_1^d - D_0$, $\Delta L^F = L_1^{F,d} - L_0^F$, $\Delta L^B = L_1^{B,d} - L_0^B$, and $I = Y - C$; this condition yields

$$BILL_1^{H,d} - BILL_0 - \Delta BILL = 0.$$

Now, from (13), (14) and (23),

$$\Delta BILL = \Delta L^B - \mu \Delta D = \Delta L^F - (1-\mu)\Delta D - \mu \Delta D = \Delta L^F - \Delta D.$$

Combining the above two equations yields

$$BILL_1^{H,d} = BILL_0 + (\Delta L^F - \Delta D).$$

Intuitively, any expansion in credit that is not funded by a change in deposits translates into a change in central bank borrowing, which in this economy is the only counterpart to cash in circulation (see (21)); it must therefore be matched by a change in the demand for cash.

by affecting how the bank sets the deposit rate.[21]

3.1 Macroeconomic Equilibrium

The solution of the model is described in the Appendix. , under the assumptions that $\pi^a = \mu = 0$ and $\bar{W} = 1$. As shown there, the model can be condensed into two equilibrium conditions in terms of the risk premium, θ_L, and the price of the domestic good, P:

$$\theta_L = g[\frac{\kappa Y^s(P; i_R, A)}{h[\varepsilon^L(1+\theta_L)i_R]}], \tag{25}$$

$$Y^s(P; i_R, A) = \alpha_1 \frac{N^d(P; i_R, A)}{P} - \alpha_2 \varepsilon^D i_R f\left\{\frac{\bar{E}}{\sigma\rho P h[\varepsilon^L(1+\theta_L)i_R]}\right\} \tag{26}$$

$$+\alpha_3(\frac{F_0^H}{P}) + h[\varepsilon^L(1+\theta_L)i_R].$$

The first is the financial equilibrium condition, defined by (18), whereas the second is the goods market equilibrium condition (24), after substitution from (5), (6), (12), (16), (17), and (20).

A graphical presentation of the equilibrium is shown in Figure 1. In the northeast quadrant of the figure, the financial equilibrium curve is labeled FF. As shown in the Appendix, FF does not depend on the regulatory regime; it slope is given by

$$\left.\frac{d\theta_L}{dP}\right|_{I,II}^{NB,FF} = \frac{g'}{\Sigma}(\frac{\kappa Y_P^s}{h}) < 0,$$

where NB stands for "nonbinding" and $\Sigma > 0$ is defined in the Appendix. Intuitively, a rise in prices stimulates output and increases the effective value of firms' collateral relative to the initial demand for loans; the risk premium must therefore fall, at the initial level of investment.

The goods market equilibrium condition yields the curves labeled G^1G^1 (which corresponds to the Basel I regime) and G^2G^2 (corresponding to the Basel II regime). The slopes of these curves are given by, respectively

$$\left.\frac{d\theta_L}{dP}\right|_{I}^{NB,GG} = \frac{1}{\Delta_1}\left\{Y_P^s + \frac{\alpha_1}{P^2}(N^d - PN_P^d) - \alpha_2(1+i_R)f'\frac{\bar{E}}{\sigma_R\rho P^2 h} + \alpha_3(\frac{F_0^H}{P^2})]\right\}, \tag{27}$$

where $\Delta_1 < 0$ if α_2 is not too large (see the Appendix) and, with $\sigma(\theta_L) = \sigma_R$ initially,

$$\left.\frac{d\theta_L}{dP}\right|_{II}^{NB,GG} = (\frac{\Delta_1}{\Delta_2})\left.\frac{d\theta_L}{dP}\right|_{I}^{NB,GG}, \tag{28}$$

[21] Equivalently, the condition $\bar{E} > E^R$ sets an upper bound on investment, $PI < \bar{E}/\sigma\rho$. We will assume that this restriction is not binding.

where $\Delta_2 < 0$ and $|\Delta_2| > |\Delta_1|$. Thus, a comparison of (27) and (28) implies that G^2G^2 is flatter than G^1G^1. Inspection of these results also shows that curves G^1G^1 and G^2G^2 have a steeper slope than in the absence of a bank capital channel ($f' = 0$), given by

$$\left.\frac{d\theta_L}{dP}\right|^{GG} = \frac{1}{(1+i_R)h'}\left\{Y_P^s + \frac{\alpha_1}{P^2}(N^d - PN_P^d) + \alpha_3(\frac{F_0^H}{P^2})]\right\},$$

which is the slope of curve GG in Figure 1.

Intuitively, the negative slope of the GG curves can be explained as follows. A rise in prices tends to lower aggregate demand through a negative wealth effect on consumption. At the same time, it increases the nominal value of loans and thus capital requirements; the fall in the capital buffer raises the deposit rate, which (through intertemporal substitution) lowers current consumption. However, the increase in P also boosts aggregate supply, by reducing the real (effective) wage, and may stimulate consumption, as a result of higher labor demand and distributed wage income.[22] Because the shift in supply outweighs the wage income effect, and because the wealth and capital buffer effects are unambiguously negative, an increase in prices creates excess supply. The risk premium must therefore fall to stimulate investment and restore equilibrium in the goods market. This implies that the GG curves have a negative slope, as shown in the figure.

Curves G^1G^1 and G^2G^2 are steeper than curve GG (which corresponds to $f' = 0$) because the bank capital channel adds additional downward pressure on consumption—requiring therefore a larger fall in the premium to generate an offsetting expansion in investment.

By implication, the intuitive reason why G^2G^2 is flatter than G^1G^1 is because under Basel II there is an additional effect—the fall in the risk premium alluded to earlier lowers the risk weight. This mitigates therefore the initial drop in the capital buffer (at the initial level of investment) induced by the rise in prices. In turn, this dampens the increase in the deposit rate and the drop in consumption. Given that aggregate supply and wage income increases in the same proportion in both regimes, the risk premium must fall by *less* under Basel II to stimulate investment and reestablish equilibrium between supply and demand.

Under standard dynamic assumptions, local stability requires the GG curves to be steeper than FF.[23] The positive relationship between the risk premium and the lending rate is shown in the northwest quadrant, whereas the negative relationship between the lending

[22]The net effect of distributed wage income on consumption depends on the sign of $PN_P^d - N^d$. Thus, a positive effect requires that $PN_P^d/N^d > 1$, or equivalently that the elasticity of labor demand with respect to prices be sufficiently high.

[23]Local stability can be analyzed by postulating an adjustment mechanism that relates changes in P to

rate and investment is displayed in the southwest quadrant. The supply of goods, which is an increasing function of the price level, is shown in the southeast quadrant. The difference between supply and investment in the southwest quadrant gives private spending, C. The economy's equilibrium is determined at points E, D, H, and J.[24]

We now turn to an analysis of the adjustment process to a supply shock, a change in the refinance rate, and a change in the capital adequacy ratio.

3.2 Negative Supply Shock

Consider first a negative shock to output, that is, a drop in A.[25] The results are illustrated in Figure 2; because the difference between the two regulatory regimes is only in terms of the slope of curve GG, we consider only the Basel I regime, to avoid cluttering the graph unnecessarily. Differences between the two regimes are pointed out later. We also focus at first on the movement that leads to point E'.

The first effect of the shock is of course a drop in output; as shown in the southeast quadrant, the supply curve shifts inward, with output (at the initial level of prices) dropping from H to M. The drop in output lowers the value of collateral at the initial level of investment; the premium must therefore increase to account for the fact that lending has now become more risky. Curve FF therefore shifts upward, and θ_L rises first from E to B. The fall in output also leads to excess demand on the goods market; at initial prices, the risk premium must therefore increase to restore equilibrium (by lowering investment). Curve G^1G^1 therefore shifts also upward.

There is, however, "overshooting" in the behavior of the premium; the initial increase in not sufficient to eliminate excess demand through a drop in investment only—to do so would require an increase from E to B'', which is not feasible. Accordingly, prices must increase, which tend (through a negative wealth effect) to lower consumption as well. Because the increase in prices also lowers real wages, the initial drop in output is dampened; after falling

excess demand for goods, and changes in the risk premium to the difference between the its equilibrium and current values; see Agénor and Montiel (2008a).

[24] Of course, GG, G^1G^1, and G^2G^2 would not normally intersect FF at the same point E. This is shown only for convenience.

[25] Instead of a supply shock, we could also consider a negative demand shock, as measured by a fall in α_0 in (12). Although the transmission mechanism is different, the conclusion about the procyclicality of Basel I and Basel II in this case are qualitatively similar to those discussed below. We therefore do not report them to save space.

from H to M, output recovers gradually from M to H'. The associated increase in the value of collateral allows the premium to fall, from B to the new equilibrium point, E'. In the new equilibrium, the lending rate is higher, investment lower, and so is consumption.

However, it is also possible for the new equilibrium to be characterized by a *lower* premium and higher prices; this is illustrated by the curves intersecting at point E''' in Figure 2. This corresponds to a case where curve FF shifts only slightly (which occurs if the risk premium does not adjust rapidly to changes in the collateral-loan ratio, that is, g' is small) and G^1G^1 shifts by a large amount (which occurs if investment is not very sensitive to the lending rate).[26] Following an upward jump (from E to B'), the premium undergoes a prolonged "decelerator" effect, eventually with a smaller adverse effect on investment, but at the cost of higher prices.[27]

How does the "capital channel" operate in this setting? Because investment falls, capital requirements also fall. This implies that the bank's capital buffer increases. Through the signaling effect discussed earlier ($f' < 0$), the deposit rate falls; this, in turn, tends to increase consumption today (all else equal), through intertemporal substitution. This result can be summarized as follows:

Proposition 2. *With non-binding capital requirements, the bank capital channel induces (all else equal) an expansion of consumption in response to a negative supply shock.*

Put differently, although bank capital has no direct effect on loans, it does have indirect effects, to the extent that it affects deposit rates, aggregate demand, and thus prices—which in turn affect output, collateral, and the risk premium. This transmission channel is similar under both regulatory regimes—except that with Basel II the effect on price are magnified and the effect on the risk premium is mitigated.

More formally, consider the following definition:[28]

Definition. *A variable x is procyclical (countercyclical) with respect to an exogenous shock z if its movement in response to z, as measured by the first derivative dx/dz, is such as to amplify (mitigate) the movement in equilibrium output in response to that shock, dY/dz.*

[26] If the premium does not adjust at all following a drop in A—so that FF remains at its initial position—the new equilibrium point would be at E''. The case where FF does not change would occur if, for instance, effective collateral was measured, as in Agénor and Montiel (2008*a*), in terms of the value of the beginning-of-period capital stock, PK_0.

[27] Although not represented in Figure 2, it is also possible for the equilibrium outcome to entail a *rise* in the premium and a *fall* in prices (that is, an equilibrium point located to the northwest of E). This would ocur if FF shifts by a large amount and G^1G^1 shifts only a little.

[28] Borio and Zhu (2008) for instance use a definition that is essentially similar. Note that, in the literature, procyclicality is often defined in terms of required capital only.

In the present setting, we can focus on the risk premium, given that the supply of loans is perfectly elastic, and that the demand for credit for the purpose of financing working capital needs is (by definition) procyclical.[29] Here, we have $d\theta_L/dA \lesseqgtr 0$, which implies that the risk premium can be either procyclical with respect to A—falling during booms and rising during downswings, thereby exacerbating the initial movement in output, as per the definition above—or countercyclical ($d\theta_L/dA > 0$).This ambiguity exists *regardless of the regulatory regime*, because it holds even in the absence of a bank capital channel ($f' = 0$ or $\alpha_2 = 0$)—given that in this case neither FF, nor GG, depends on σ.

In the case where $f' > 0$ (and $\alpha_2 > 0$), the impact of the regulatory regime on the degree of procyclicality of the risk premium can be formally assessed by calculating the derivative of the equilibrium outcome $d\theta_L/dA$ with respect to σ, that is, $d^2\theta_L/dAd\sigma$, in a manner similar to Heid (2007). More intuitively, this outcome can be gauged by examining how σ affects the slopes of FF and GG. As noted earlier, FF does not depend on σ; G^2G^2 is flatter than G^1G^1; and both G^1G^1 and G^2G^2 have a steeper slope with $f' > 0$ than with $f' = 0$. This leads to the following proposition:

Proposition 3. *With non-binding capital requirements, and a bank capital channel, both regulatory regimes magnify the procyclical effect of a negative supply shock on the risk premium; all else equal, Basel II is less procyclical than Basel I.*

Intuitively, the reason why the regulatory capital regime magnifies an upward movement in the risk premium compared to the case where the regime does not matter ($f' = 0$) is because the improvement in the capital buffer tends (as noted in Proposition 2) to stimulate private consumption; consequently, at the initial level of prices, "bringing down" aggregate demand to the lower level of output requires a larger drop in investment—and therefore a larger increase in the premium. This movement is also more significant in the Basel I regime, because in the case of Basel II the initial increase in the premium raises the risk weight—which in turn limits the downward effect on capital requirements resulting from the fall in the level of investment (that is, E^R falls by less than the drop in I because σ rises); as a result, the increase in the capital buffer is less significant, the deposit rate falls by less, and the stimulus to consumption is mitigated. The rise in the risk premium required to restore equilibrium to the goods market is thus of a lower magnitude.

[29]Note that the cyclicality of the *nominal* value of loans for investment purposes, PI, depends on the behavior of prices as well. Our focus on the risk premium is equivalent to focusing on *real* lending for investment, given that these two variables always vary in opposite directions.

3.3 Increase in Official Refinance Rate

The macroeconomic effects of an increase in the refinance rate are illustrated in Figure 3. The immediate effect of an increase in i_R is twofold. First, it raises production costs and lowers output, which drops from point H to M in the southeast quadrant, following an inward shift in the supply curve. The resulting drop in effective collateral tends to put upward pressure on the risk premium. Second, there is a direct effect on the lending rate; because an increase in the refinance rate raises the cost of marginal funds, it is "passed on" directly to borrowers. In the northeast quadrant, the curve linking θ_L and i_L shifts outward. The increase in the lending rate lowers investment, which in turn tends to lower the risk premium by reducing the volume of bank loans. The net impact effect on the premium is thus ambiguous. We assume in what follows that the net effect of an increase in i_R is to raise the premium. As formally established in the Appendix, this requires that the elasticity of output with respect to the refinance rate be higher (in absolute terms) than the elasticity of investment with respect to that rate. The "collateral" effect therefore dominates the "loan demand" effect.[30] If so, then, curve FF shifts upward and the premium jumps from point E to point B.

On the goods market, there are several effects at play at the initial level of prices. As noted earlier, both aggregate supply and investment fall. In addition, consumption changes as well, as a result of two effects. On the one hand, the refinance rate raises directly the deposit rate, thereby lowering consumption as a result of the standard intertemporal effect. On the other, the fall in investment reduces capital requirements, thereby increasing the capital buffer, which in turn tends to lower the deposit rate and stimulate consumption. The net effect on consumption is thus ambiguous in general. We assume in what follows that the net effect on aggregate demand is negative; a sufficient (although not necessary) condition for that to occur is for the direct cost effect of i_R on i_D to dominate the indirect capital buffer effect. Because aggregate supply and aggregate demand both fall, prices may either increase or fall to restore equilibrium in the goods market. Graphically, curve G^1G^1 may shift either left or right. If excess demand (supply) prevails at the initial level of prices, the price level must increase (fall) and G^1G^1 shifts to the left (right).

Thus, following its initial jump from E to B, the risk premium can either continue increasing, from B to E', or fall from B to E''. In the first case, there is a financial accelerator

[30] This is quite appropriate for middle-income countries where bank loans are essential for short-term economic activity.

effect; the drop in prices stimulates consumption (through the wealth effect), raises real wages and lowers output (which falls from M to H'), and the fall in collateral tends to increase the premium—despite the drop in the demand for loans. In the second case, the increase in prices tends to stimulate output and to raise the effective value of collateral while reducing consumption; there is therefore a financial "decelerator" effect.[31]

Again, what is the role of the regulatory capital regime? The capital buffer effect mitigates the drop in consumption (as before) and reinforces the possibility that aggregate demand falls by less than supply—and therefore increases the likelihood of a drop in prices and the occurrence of a financial accelerator effect. Thus, even if capital requirements are not binding, they do affect the transmission process of monetary policy. Indeed, the bank capital channel, as modeled here, may enhance the effectiveness of a contractionary monetary policy—in contrast to some of the predictions in the literature (see, for instance, Tanaka (2002)). Moreover, under the Basel II regime, the effects described above operate in similar fashion. But because G^2G^2 is less steep than G^1G^1, price effects are magnified, whereas changes in the premium are mitigated. Moreover, from Proposition 2, both of these curves are steeper than curve GG with $f' = 0$. We therefore have the following result:

Proposition 4. *With non-binding capital requirements, and under either regulatory regime, the bank capital channel magnifies the impact of an increase in the central bank refinance rate on the risk premium and mitigates its impact on prices, compared to the case where it does not exist. In addition, the Basel II regime imparts less procyclicality to the risk premium compared to the Basel I regime.*

3.4 Increase in Capital Adequacy Ratio

The effects of an increase in the capital adequacy ratio are illustrated in Figure 4. Curve FF does not change, given that the financial equilibrium condition does not depend directly on that ratio. the increase in ρ increases capital requirements and lowers the capital buffer. The cost of deposits therefore increases, which tends to lower consumption as households engage in intertemporal substitution. At the initial level of the risk premium, prices must fall to stimulate consumption (through the wealth effect) and eliminate the excess supply of goods. Curve GG therefore shifts downward (or to the left), and prices fall from E to B. In turn, the fall in prices raises the real wage and leads to a contraction in output, from H to

[31] Note also that even if G^2G^2 does not shift— which is the case if $\alpha_2 = 0$—there would still be a financial accelerator effect (this time from B to C, the new equilibrium), but the financial decelerator effect cannot emerge. The reason is that excess demand cannot occur in that case.

M. Because the fall in output lowers the value of collateral, the risk premium starts rising, from E to E', while output continues to drop, from M to H'. During the transition period, prices decline continuously. The new equilibrium point is located at E', characterized by a higher lending rate, lowers prices, a lower level of investment, and lower output.

Thus, tighter capital regulation reduces bank leverage while at the same time increasing the cost of (market) funding for the bank and the cost of borrowing for firms. The fact that an increase in the capital adequacy ratio leads to a higher equilibrium loan rate and reduced lending is consistent with the prediction of various other models based on very different premises (see VanHoose (2007)). Of course, if the bank capital channel is not present ($f' = 0$), curve GG would not shift and a change in ρ would have no effect on output and prices as long as $\bar{E} > \sigma\rho L^F$.[32]

4 Binding Capital Requirements

We now consider the case where the capital requirement constraint (19) is continuously binding, that is, $\bar{E} = \sigma\rho PI$. Because equity is predetermined, bank lending for investment must adjust to satisfy the capital requirement:

$$PI = \bar{E}/\sigma\rho, \tag{29}$$

regardless of whether σ is endogenous or not.[33] We assume that constraint (29) is continuously binding, due possibly to heavy penalties or reputational costs associated with default on regulatory requirements, as noted earlier.

With (29) determining investment, equation (6) is now solved for the lending rate:

$$1 + i_L = h^{-1}(\frac{\bar{E}}{P\sigma\rho}), \tag{30}$$

where $\pi^a = 0$ for simplicity. The interest rate-setting condition (17) is now used to solve for the risk premium:

$$\theta_L = (\frac{1 + i_L}{1 + i_R}) - 1 = (\frac{1}{1 + i_R})h^{-1}(\frac{\bar{E}}{P\sigma\rho}) - 1. \tag{31}$$

Collateral therefore plays no longer a direct role in determining the risk premium; equation (18) serves now to determine the effective collateral required, that is, coefficient κ. Of

[32] Of course, this also depends on the assumption $\alpha_2 > 0$.

[33] If $\sigma_R = 1$, the capital adequacy requirement is a leverage ratio, which restricts on-balance-sheet assets to a simple multiple of available capital ($L^F = \bar{E}/\rho$). Note also that because the bank holds no other risky assets in its portfolio, it cannot engage in regulatory arbitrage.

course, for the solution to be feasible requires $\kappa < 1$, which we assume is always satisfied. Thus, we continue to assume that credit rationing does not emerge.

In addition to the financial equilibrium condition (31), whose solution now depends on the regulatory regime, macroeconomic equilibrium requires equality between supply and demand in the goods market. Using (29), this condition takes now the form:

$$Y^s(P; i_R, A) = \alpha_1 \frac{N^d(P; i_R, A)}{P} - \alpha_2 \varepsilon^D i_R \tag{32}$$
$$+\alpha_3(\frac{F_0^H}{P}) + \frac{\bar{E}}{P\sigma\rho},$$

whose solution depends also on the regulatory regime.

With a binding capital requirement, the capital buffer is unity, and because $f(1) = 1$, the deposit rate-setting condition is (15). Thus, the bank capital channel, as identified in the previous section, does not operate. However, the adjustment process to shocks continues to depend in important ways on the regulatory regime; for clarity, we consider them separately.

4.1 Constant Risk Weights

Macroeconomic equilibrium Under the Basel I regime is now illustrated in Figure 5. As before, the southeast quadrant shows the positive relationship between output and prices. From (29), and with σ constant at σ_R, investment and prices are inversely related, as shown in the southwest quadrant. Equations (30) and (31) also imply a negative relationship between investment and the risk premium, as displayed in the northwest quadrant. Because both the risk weight and investment and independent of the risk premium, the goods market equilibrium condition, shown as curve G^3G^3 in the northeast quadrant, is vertical. The financial equilibrium condition, shown as curve F^3F^3, has now a positive slope, given by (see the Appendix):

$$\left.\frac{d\theta_L}{dP}\right|_I^{B,FF} = -(\frac{1}{1+i_R})h^{-1\prime}(\frac{\bar{E}}{P^2\sigma_R\rho}) > 0, \tag{33}$$

where B stands for "binding."

Intuitively, the reason why FF is positively sloped is because higher prices now reduce real investment (as implied by (29)), which in turn can only occur if the premium increases. The equilibrium obtains at points E, H, J, and D. Graphically, F^3F^3 is steeper the larger σ_R is, so that $\partial[\frac{d\theta_L}{dP}\Big|_I^{B,FF}]/\partial\sigma_R > 0$. All else equal, the higher σ_R is, the larger the effect of any shock that leads to a shift in the financial equilibrium condition on the risk premium, and the smaller the effect on prices.

Figures 6, 7, and 8 illustrate the macroeconomic effects of the same three shocks analyzed earlier. A negative supply shock leads to an inward shift of the supply curve (as before), but this has no direct effect on the premium at the initial level of prices, in contrast to the case of nonbinding requirements. Thus, F^3F^3 does not shift. Excess demand of goods requires an increase in prices to clear the market and G^3G^3 shifts to the right. The increase in prices lowers investment, and this must be accompanied by an increase in the risk premium. The price hike also lowers consumption, through a negative wealth effect. Thus, the adjustment to a negative supply shock entails both an increase in prices and a reduction in aggregate demand. The new equilibrium position is at points E', H', J', and D'. The risk premium is thus unambiguously procyclical ($d\theta_L/dA < 0$).

To analyze the role of the capital regime in the transmission process of this shock, recall that with a binding requirement the deposit rate-setting condition (16) becomes independent of the capital buffer. However, as can be inferred from (29), the higher the risk weight (and the capital adequacy ratio), the larger the drop in investment and lending; the smaller therefore the adjustment in prices required to equilibrate supply and demand. Thus, the "capital channel" operates now through investment, rather than consumption. At the same time, however, a larger drop in investment must be accompanied by a larger increase in the risk premium. Formally, it can be shown that the general equilibrium effect is $|d^2\theta_L/dAd\sigma_R| > 0$.

The effects of an increase in the refinance rate are illustrated in Figure 7. For the reasons discussed in the previous section, the goods market equilibrium condition can move either left or right, depending on whether excess demand or supply prevails at the initial level of prices. However, for P given, the increase in the refinance rate must now be accompanied by a *fall* in the risk premium, in contrast to the nonbinding case, to keep investment at its initial level. The curve linking I and θ_L in the northwest quadrant shifts inward, and the premium drops from E to B (or equivalently from D to L). If excess demand prevails initially, prices must increase to restore equilibrium, and curve G^3G^3 must shift to the right; after its initial drop, the risk premium begins to rise, to validate the drop in investment. By contrast, if there is excess supply initially, prices must fall, thereby increasing investment and consumption (the latter through the wealth effect) and curtailing aggregate supply. The risk premium adjusts gradually downward from B to E'' to validate the increase in investment. As can be inferred from (29), if prices fall, and given that σ is constant at σ_R, investment *always* increases in equilibrium (from J to J''). The larger σ_R is, the smaller this increase (or the larger the fall, if prices rise). The regulatory regime therefore magnifies changes in the risk premium ($|d^2\theta_L/di_R d\sigma_R| > 0$).

Figure 8 shows the impact of an increase in the capital adequacy ratio. The immediate effect, as can be inferred from (29), is a reduction in investment at the initial level of prices; the curve in the southwest quadrant shifts inward. Investment drops from J to L, and this must be accompanied by an upward jump in the premium, from E to point B, located on the new F^3F^3 curve positioned to the left of the original curve. Because of the incipient excess supply, prices must fall; thus, curve G^3G^3 also shifts to the left. The drop in prices mitigates the initial drop in investment, which recovers from L to J'. Although output (and thus collateral) falls during the transition, the gradual increase in investment must be associated with a drop in the risk premium, from B to E'. At E', the risk premium is higher than in the initial equilibrium; however, if the shift in F^3F^3 is not large, the end result may be a *fall* in the risk premium (point E''). In either case, prices always fall, as in the nonbinding case (Figure 4). Again, regardless of the direction of the effect, the larger σ_R is, the larger the equilibrium change in the risk premium ($|d^2\theta_L/d\rho d\sigma_R| > 0$).

The results of these experiments can be summarized in the following proposition:

Proposition 5. *With binding capital requirements, and under Basel I, a negative supply shock is unambiguously procyclical, whereas an increase in the refinance rate or the capital adequacy ratio may be either procyclical or countercyclical. The higher the risk weight σ_R is, the stronger the effect of all these shocks on the risk premium.*

4.2 Endogenous Risk Weights

Under the Basel II regime, the endogeneity of σ precludes the use of a four-quadrant diagram to illustrate the determination of equilibrium; it is now shown in a single quadrant, in Figure 9. The determination of the financial equilibrium condition F^4F^4 follows the same logic as before; it therefore has a positive slope, given now by (see the Appendix):

$$\left.\frac{d\theta_L}{dP}\right|_{II}^{B,FF} = -\frac{1}{\Sigma_4}\left(\frac{1}{1+i_R}\right)h^{-1\prime}\left(\frac{\bar{E}}{P^2\sigma_R\rho}\right) > 0, \tag{34}$$

where $\Sigma_4 > 0$ if σ' is not too large, and $|\Sigma_4| < 1$. A comparison of (33) and (34) shows that this slope is *steeper* than under Basel I. Intuitively, the reason is that now the direct, positive effect of an increase in prices on the premium (which validates the fall in real investment, as noted earlier), is compounded by an increase in the risk weight. Thus, all else equal, shocks would now tend to have larger effects on the risk premium, and more muted effects on prices, than under the previous regime.

The goods market equilibrium condition, however, is no longer vertical; because σ depends on θ_L, it can be displayed as a negative relationship between the risk premium and the price level, denoted G^4G^4 in Figure 9, with slope

$$\left.\frac{d\theta_L}{dP}\right|_{II}^{B,GG} = \frac{1}{\Delta_4}\left\{Y_P^s + \frac{\alpha_1}{P^2}(N^d - PN_P^d) + \alpha_3(\frac{F_0^H}{P^2}) + \frac{\bar{E}}{P^2\sigma_R\rho}\right\}, \tag{35}$$

where $\Delta_4 < 0$.

The reason why GG is downward-sloping is now different from the nonbinding case: here an increase in the price level lowers real investment, as implied by the binding constraint (29); this must be validated by an *increase* in the risk premium. However, the price increase also lowers consumption and stimulates output (for reasons outlined earlier); in turn, this requires a *fall* in the risk premium to stimulate investment and restore equilibrium between supply and demand. The figure assumes that the second effect dominates the first (or equivalently that σ' is not too large), so G^4G^4 has indeed a negative slope. Thus, the goods market equilibrium condition is now *less steep*; all else equal, shocks would tend to have more muted effects on the risk premium, and larger effects on prices, than under Basel I. Because the slopes of the two curves are affected in opposite direction by a switch from Basel I to Basel II, it cannot be ascertained *a priori* whether shocks would tend to have larger effects on the risk premium, as under the nonbinding case—where only GG was affected by a switch in regime.

Figure 10 illustrates the impact of a negative supply shock; curve G^4G^4 shifts to the right and the equilibrium is characterized by a higher risk premium and higher prices, as in Figure 6. Thus, the shock is procyclical, as under Basel I. But even though only the GG curve shifts (as is the case under Basel I), the initial position of FF matters for the final outcome. Thus, whether Basel II is more procyclical or less procyclical than Basel I cannot be determined unambiguously.

The impact of an increase in the refinance rate is illustrated in Figure 11. Because G^4G^4 can move either left or right, a range of outcomes is possible—just like under the nonbinding case (Figure 3) and the Basel I regime under the binding case (Figure 7). Whether a change in the risk premium is procyclical or not cannot therefore be ascertained a priori. Finally, Figure 12 shows the effects of an increase in the capital adequacy ratio. Both G^4G^4 and F^4F^4 shift to the left. Although prices fall unambiguously, as before, the risk premium can either fall (point E') or increase (point E''), depending on the magnitude of the shift in F^4F^4, as with Basel I (see Figure 8). Thus, whether the increase in the capital adequacy ratio is procyclical or countercyclical is again ambiguous.

The following proposition summarizes the results of these experiments:

Proposition 6. *With binding capital requirements, and under Basel II, a negative supply shock is unambiguously procyclical; an increase in the refinance rate or the capital adequacy ratio may be either procyclical or countercyclical. Whether these shocks entail more procyclicality (with respect to Basel I) in the risk premium cannot be ascertained a priori.*

5 Concluding Remarks

The purpose of this paper has been to analyze the procyclical effects of Basel I- and Basel II-type capital standards in a simple model that captures some of the most salient credit market imperfections that characterize middle-income countries. In our model, capital requirements are essentially aimed at influencing bank decision-making regarding exposure to loan default. They affect both the quantity of bank lending and the pricing of bank deposits. The bank cannot raise additional equity capital—a quite reasonable assumption for a short-term horizon. The deposit rate is sensitive to the size of the buffer, through a signaling effect. Well-capitalized banks face lower expected bankruptcy costs and hence lower funding costs from the public. We also establish a link between regulatory risk weights and the bank's risk premium under Basel II; this is consistent with the fact that in that regime the amount of capital that the bank must hold is determined not only by the institutional nature of its borrowers (as in Basel I), but also by the riskiness of each particular borrower. Thus, capital adequacy requirements affect not only the *levels* of bank lending rates, and thus investment and output; they also affect the *sensitivity* of bank rates (through the risk premium) to changes in output and prices.

Our analysis showed that different types of bank capital regulations affect in different ways the transmission process of exogenous shocks to bank interest rates, prices, and economic activity. As discussed in the existing literature, and regardless of the regulatory regime, capital requirements can have sizable real effects if they are binding, because in order to satisfy them banks may need to curtail lending through hikes in interest rates. However, we also showed that, even if capital requirements are not binding, a "bank capital channel" may operate through a signaling effect of capital buffers on deposit rates. If there is some degree of intertemporal substitution in consumption, this channel may generate significant effects on the real economy.

Several policy lessons can be drawn from our analysis. First, regulators should pay careful attention to the impact of risk weights on bank portfolio behavior when they implement regulations. Second, capital buffers may not actually mitigate the cyclical effects of bank regulation; in our model, capital buffers, by lowering deposit rates, are actually expansionary. Thus, if capital buffers are increased during an expansion, with the initial objective of being *countercyclycal*, they may actually turn out to be *procyclical*. This is an important conclusion, given the prevailing view that counter-cyclical regulatory requirements may be a way to reduce the buildup of systemic risks: if the signaling effects of capital buffers are important, "leaning against the wind" may not reduce the amplitude of the financial-business cycle.[34] A more detailed study of the empirical importance of these signaling effects, bulding perhaps on Fonseca et al. (2010), is thus a pressing task for middle-income countries. Moreover, the possibility of *asymmetric effects* should also be explored; for instance, a high capital buffer in good times may lead households (as owners of banks) to put pressure on these banks to generate more profits, in order to guarantee a "minimum" return on equity; by contrast, the signaling effect alluded to earlier may be strengthened in bad times.

Our analysis can be extended in several directions. One avenue could be to extend the bank capital channel as modeled here by assuming that a large capital buffer induces banks not only to reduce deposit rates (as discussed earlier) but also to engage in more risky behavior, which may lead them to relax lending standards and lower the cost of borrowing, in order to stimulate the demand for loans and increase profits. However, because this would lead to an expansionary effect on investment, it would go in the same direction as the consumption effect alluded to earlier. Thus, our results would not be affected qualitatively.

A second direction would be to examine the links between capital requirements and risk taking. If capital requirements reduce incentives for risk taking by banks (as in Rochet (1992) and Repullo and Suarez (2009)), we should have more collateralized lending; this could lead in the present model to a positive link between the reserve adequacy ratio, ρ, and the collateral parameter, κ. However, at the same time this could increase volatility in the risk premium, and thus the amplitude of macroeconomic fluctuations.

[34] There are also other problems associated with "forward-looking provisioning" or "buffer stock approach," as advocated by some—including the issue of coordination and roles of prudential policies and accounting rules, and the fact that if countercyclical constraints were to be applied to banks, regulatory arbitrage may encourage market funding to step in, thereby inducing risks to migrate elsewhere in the financial system.

A third direction would be to relax the assumption of portfolio separation, for instance by introducing a "joint" cost function for the production/management of loans and deposits. In that case, equilibrium conditions for profit maximization would be interdependent; both bank rates would depend on the capital buffer, and this would substantially affect the way the bank capital channel operates in the model. Alternatively, it could be assumed, as in Agénor, Alper, and Pereira da Silva (2009), that bank capital has no effect on the deposit rate but instead reduces the probability of default (by increasing incentives for banks to monitor borrowers) and that excess capital generates benefits in terms of reduced regulatory scrutiny. As shown there, a similar ambiguity in ranking the procyclicality of Basel I and Basel II may emerge.

In Agénor, Alper, and Pereira da Silva (2009), we have also embedded the financial features of the present model in a dynamic optimizing framework, in line with other contributions such as Markovic (2006), Aguiar and Drumond (2007), and Meh and Moran (2010). This allows us to account for the fact that, in practice, banks can and do issue stocks, hybrid debt capital instruments, and subordinated term debt instruments.[35] In a dynamic perspective, capital requirement may also depend on the *growth rate* of assets; this would help banks to strengthen buffers in good times. In a dynamic setting, where equity is endogenous, there is also a possibility that the capital requirement can limit the bank's ability to extend credit because increasing the capital base may be more costly than alternative funding sources at the margin (that is, as compared with the deposit base). This is the case if there is a liquidity premium. In Aguiar and Drumond (2007) for instance, households demand a liquidity premium to hold bank capital. This, combined with a standard financial accelerator effect, implies that introducing capital requirements significantly amplifies monetary policy shocks through a liquidity premium effect on the external finance premium faced by firms. This amplification effect is greater under Basel II than under Basel I regulatory rules. Determining the extent to which these results hold with the type of credit market imperfections highlighted in this paper is an important task for middle-income countries.

[35] The use of a model with proper micro foundations instead of postulated behavioral functions (no matter how plausible) would also mitigate the extent of the Lucas critique, which (taken literally) would invalidate a comparison across regulatory regimes.

References

Agénor, Pierre-Richard, and Peter J. Montiel, "Monetary Policy Analysis in a Small Open Credit-Based Economy," *Open Economies Review*, 19 (September 2008*a*), 423-55.

——, *Development Macroeconomics*, 3rd ed., Princeton University Press (Princeton, New Jersey: 2008*b*).

Agénor, Pierre-Richard, and Koray Alper, "Monetary Shocks and Central Bank Liquidity with Credit Market Imperfections," Working Paper No. 120, Centre for Growth and Business Cycle Research (August 2009).

Agénor, Pierre-Richard, and Nihal Bayraktar, "Contracting Models of the Phillips Curve: Empirical Estimates for Middle-Income Countries," *Journal of Macroeconomics*, 32 (June 2010), 555-70.

Aguiar, Alvaro, and Ines Drumond, "Business Cycle and Bank Capital: Monetary Policy Transmission under the Basel Accords," FEP Working Paper No. 242, Universidade do Porto, (June 2007).

Allen, Franklin, Elena Carletti, and Robert Marquez, "Credit Market Competition and Capital Regulation," Working Paper No. ECO 2009/08, European University Institute (March 2009).

Ayuso, Juan, Daniel Pérez, and Jesús Saurina, "Are Capital Buffers Pro-Cyclical? Evidence from Spanish Panel Data," *Journal of Financial Intermediation*, 13 (April 2004), 249-64.

Barth, James, Gerard Caprio, and Ross Levine, "Bank Regulation and Supervision: What Works Best," *Journal of Financial Intermediation*, 12 (April 2004), 205-48.

——, "Bank Regulations are Changing: For Better or Worse?," Policy Research Working Paper No. 4646, World Bank (June 2008).

Bikker, Jaap, and Paul Metzemakers, "Is Bank Capital Procyclical? A Cross-Country Analysis," Working Paper No. 9, De Nederlandsche Bank (September 2004).

Blum, Jurg, and Martin Hellwig, "The Macroeconomic Implications of Capital Adequacy Requirements for Banks," *European Economic Review*, 39 (April 1995), 739-49.

Borio, Claudio, and Haibin Zhu, "Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?," Working Paper No. 268, Bank for International Settlements (December 2008).

Buiter, Willem H., "Walras' Law and All That: Budget Constraints and Balance Sheet Constraints in Period Models and Continuous Time Models," *International Economic Review*, 21 (February 1980), 1-16.

Calomiris, Charles W., "The Subprime Turmoil: What's Old, What's New and What's Next," *Journal of Structured Finance*, 15 (March 2009), 6-52.

Calomiris, Charles W., and Berry Wilson, "Bank Capital and Portfolio Management: The 1930s 'Capital Crunch' and the Scramble to Shed Risk," *Journal of Business*, 77 (July 2004), 421-55.

Cecchetti, Stephen G., and Lianfi Li, "Do Capital Adequacy Requirements Matter for Monetary Policy?," *Economic Inquiry*, 46 (October 2008), 643-59.

Chen, Nan-Kuang, "Bank Net Worth, Asset Prices, and Economic Activity," *Journal of Monetary Economics*, 48 (October 2001), 415-36.

Demirgüç-Kunt, Asli, and Harry Huizinga, "Market Discipline and Deposit Insurance," *Journal of Monetary Economics*, 51 (March 2004), 375-99.

Drumond, Ines, "Bank Capital Requirements, Business Cycle Fluctuations and the Basel Accords: A Synthesis," Working Papers No. 277, Universidade do Porto (June 2008).

Fonseca, Ana R., Francisco González, and Luiz Pereira da Silva, "Cyclical Effects of Bank Capital Buffers with Imperfect Credit Markets: International Evidence," unpublished, University of Oviedo and World Bank (April 2010).

Gerali, Andrea, Stefano Neri, Luca Sessa, and Federico M. Signoretti, "Credit and Banking in a DSGE Model of the Euro Area," unpublished, Banca d'Italia (May 2009).

Gordy, Michael B., and Bradley Howells, "Procyclicality in Basel II: Can we Treat the Disease without Killing the Patient?," *Journal of Financial Intermediation*, 15 (July 2006), 395-417.

Heid, Frank, "The Cyclical Effects of the Basel II Capital Requirements," *Journal of Banking and Finance*, 31 (December 2007), 3885-900.

Kashyap, Anil K., Raghuram G. Rajan, and Jeremy C. Stein, "Rethinking Capital Regulation," unpublished, University of Chicago (March 2009).

Markovic, Bojan, "Bank Capital Channels in the Monetary Transmission Mechanism," Working Paper No. 313, Bank of England (November 2006).

Meh, Césaire, and Kevin Moran, "The Role of Bank Capital in the Propagation of Shocks," *Journal of Economic Dynamics and Control*, 34 (March 2010), 555-76.

Pereira da Silva, Luiz, "Cyclical Effects of Bank Capital Requirements: A Review of Methods, Evidence, and Policy Implications," unpublished, World Bank (May 2009).

Repullo, Rafael, and Javier Suarez, "The Procyclical Effects of Bank Capital Regulation," Discussion Paper No. 2010-05S, European Banking Center (October 2009).

Rochet, Jean-Charles, "Capital requirements and the behaviour of commercial banks," *European Economic Review*, 36 (June 1992), 1137-170.

——, "Procyclicality of Financial Systems: Is there a Need to Modify Current Accounting and Regulatory Rules?," *Financial Stability Review*, No. 12 (October 2008), 101-14.

Santomero, Anthony M., "Modeling the Banking Firm: A Survey," *Journal of Money, Credit and Banking*, 16 (November 1984), 576-602.

Sealey, C. Jr., "Portfolio Separation for Stockholder Owned Depository Financial Intermediaries," *Journal of Banking and Finance*, 9 (December 1985), 477-90.

Tanaka, Misa, "How do Bank Capital and Capital Adequacy Regulation Affect the Monetary Transmission Mechanism?," CESIFO Working Paper No. 799 (October 2002).

Van den Heuvel, Skander J., "The Bank Capital Channel of Monetary Policy," unpublished, Wharton School, University of Pennsylvania (July 2007).

VanHoose, David, "Theories of Bank Behavior under Capital Regulation," *Journal of Banking and Finance*, 31 (December 2007), 3680-97.

Van Roy, Patrick, "Capital Requirements and Bank Behavior in the Early 1990: Cross-Country Evidence," *International Journal of Central Banking*, 4 (September 2008), 29-60.

Zicchino, Lea, "A Model of Bank Capital, Lending and the Macroeconomy: Basel I Versus Basel II," *Manchester School*, 74 (August 2006), 50-77.

Table 1
Variable Names and Definitions

Variable	Definition
Households	
$BILL$	Currency held by households
C	Private expenditure
D	Bank deposits held by households
F_0^H	Household financial wealth (beginning of period)
π^a	Expected inflation rate
Firms	
A	Supply shock
I	Real investment
K_0	Capital stock (beginning of period)
N	Employment
P	Price of homogeneous good
Y	Aggregate output
W	Nominal wage
Commercial bank	
$\bar{E}, E^R$	Total, required bank equity
L^F	Bank loans (working capital and investment)
i_D, i_L	Bank interest rates, deposits and investment loans
θ_L	Risk premium on investment loans
RR	Required reserves
Central bank	
L^B	Loans to commercial bank
MB	Monetary base
i_R	Policy or refinance rate
ρ	Capital adequacy ratio
σ	Risk weight on investment loans
μ	Required reserve ratio

Figure 1
Macroeconomic Equilibrium
with Nonbinding Capital Requirements

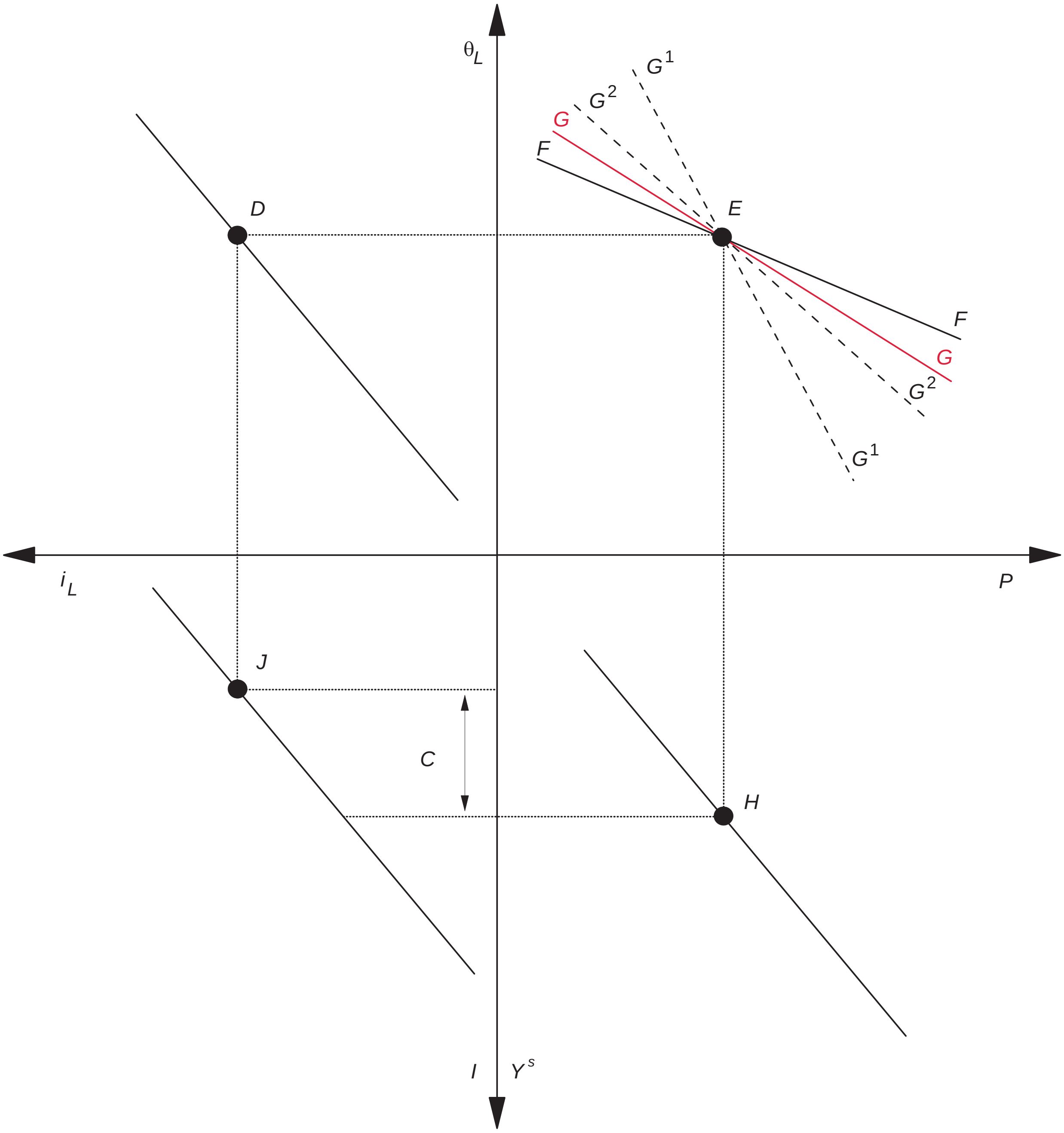


Figure 2
Negative Supply Shock
with Nonbinding Capital Requirements

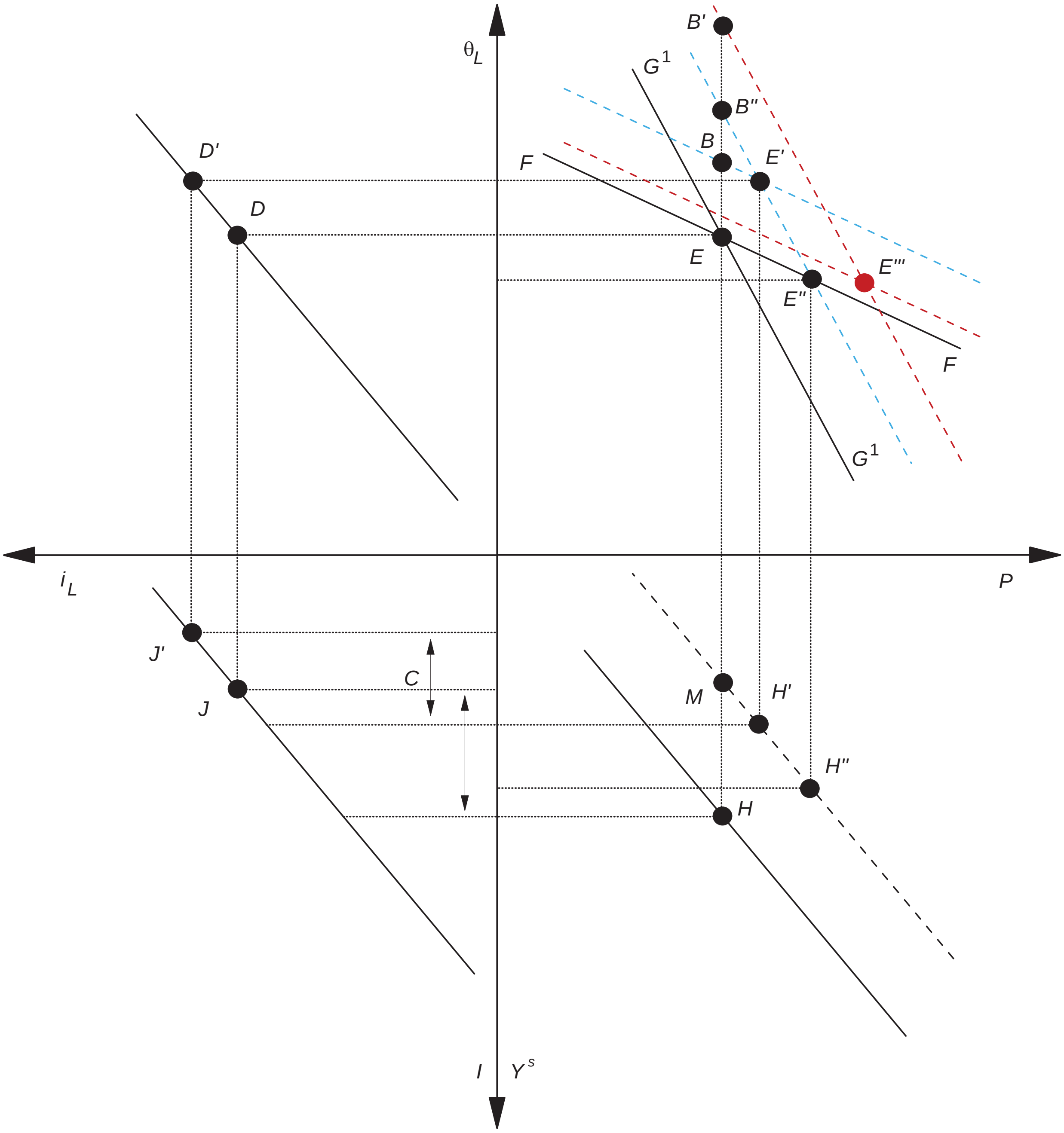


Figure 3
Increase in the Refinance Rate
with Nonbinding Capital Requirements

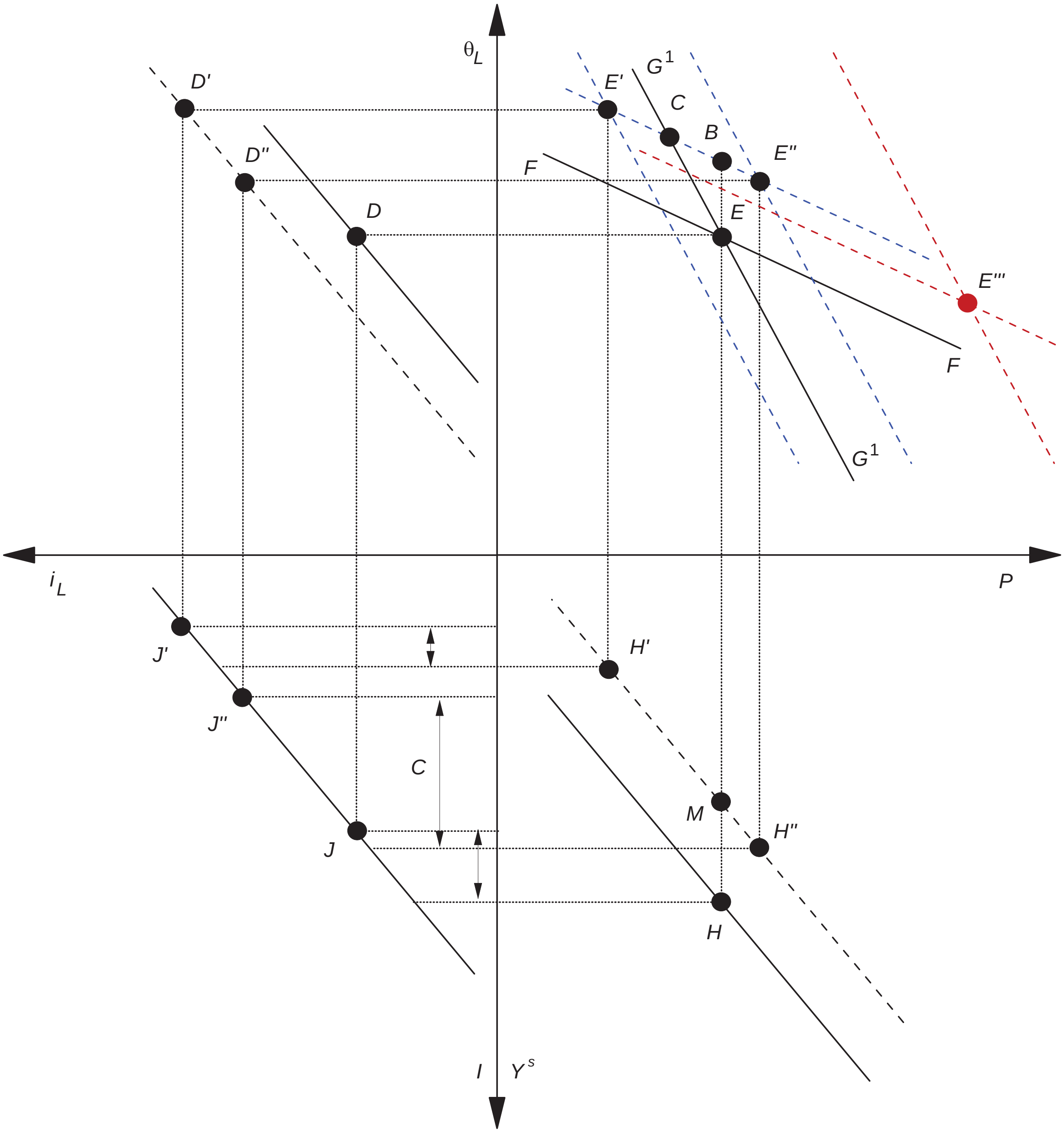


Figure 4
Increase in the Capital Adequacy Ratio
with Nonbinding Capital Requirements

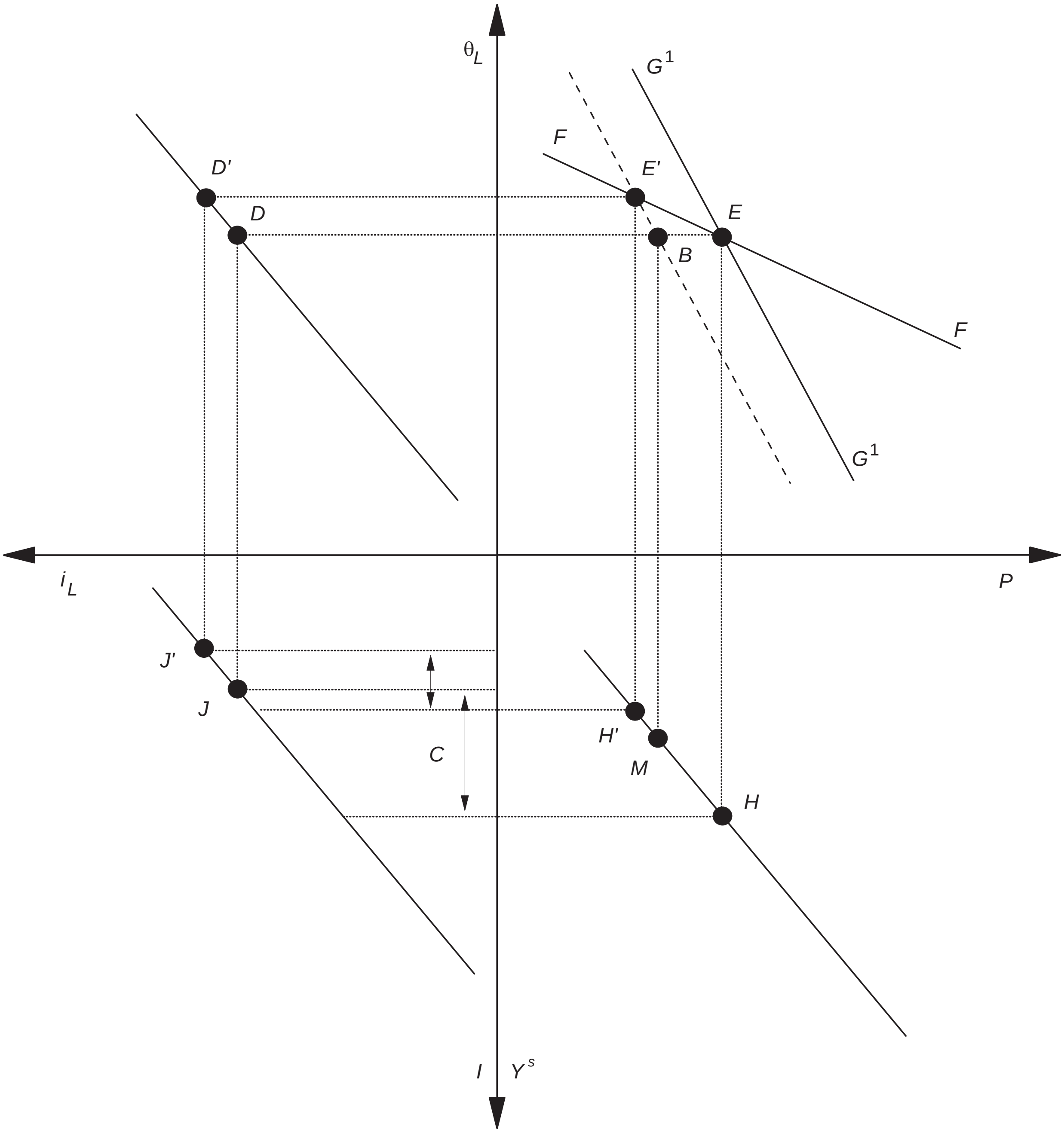


Figure 5
Macroeconomic Equilibrium
with Binding Capital Requirements
(Basel I Regime)

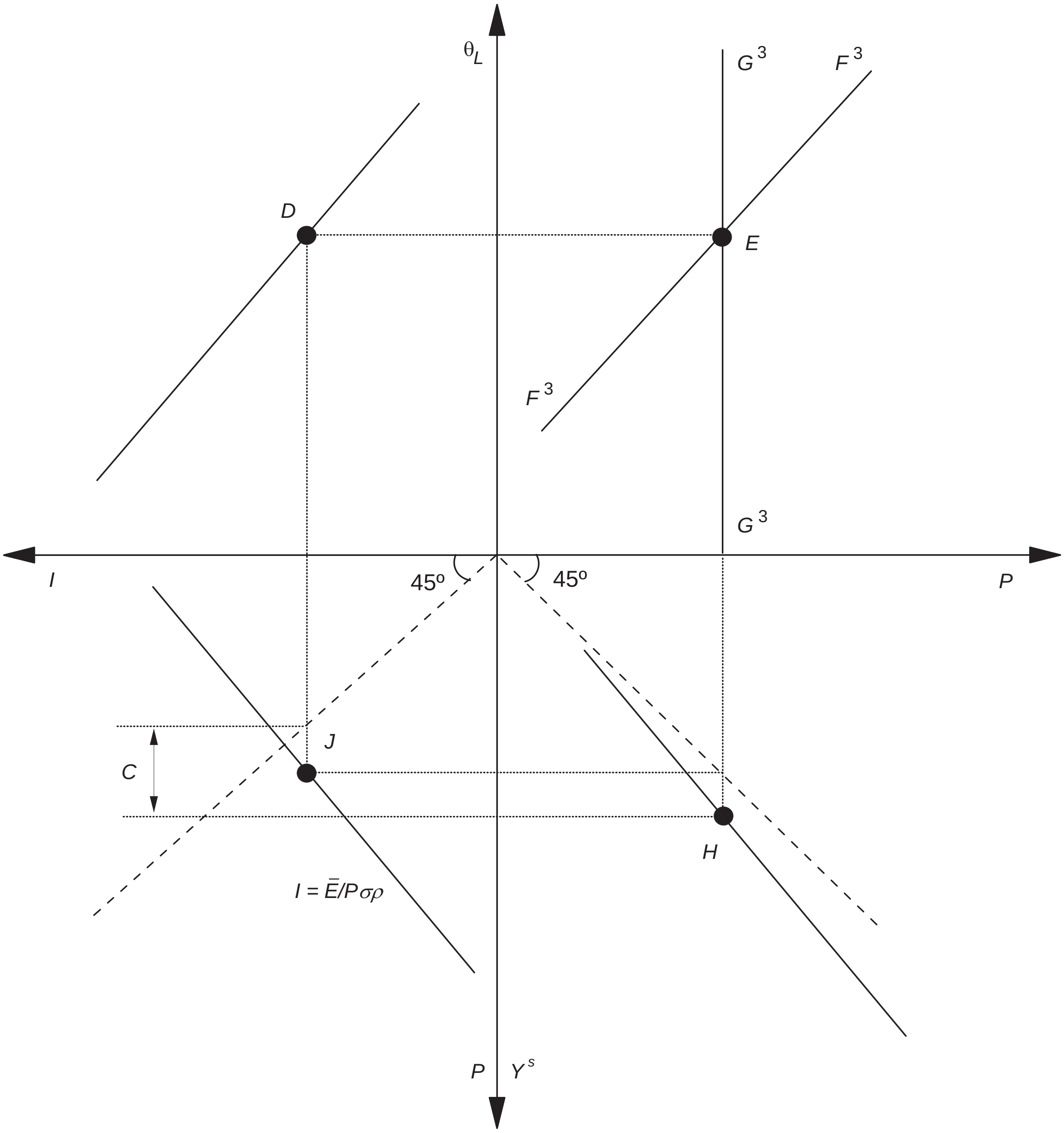


Figure 6
Negative Supply Shock
with Binding Capital Requirements
(Basel I Regime)

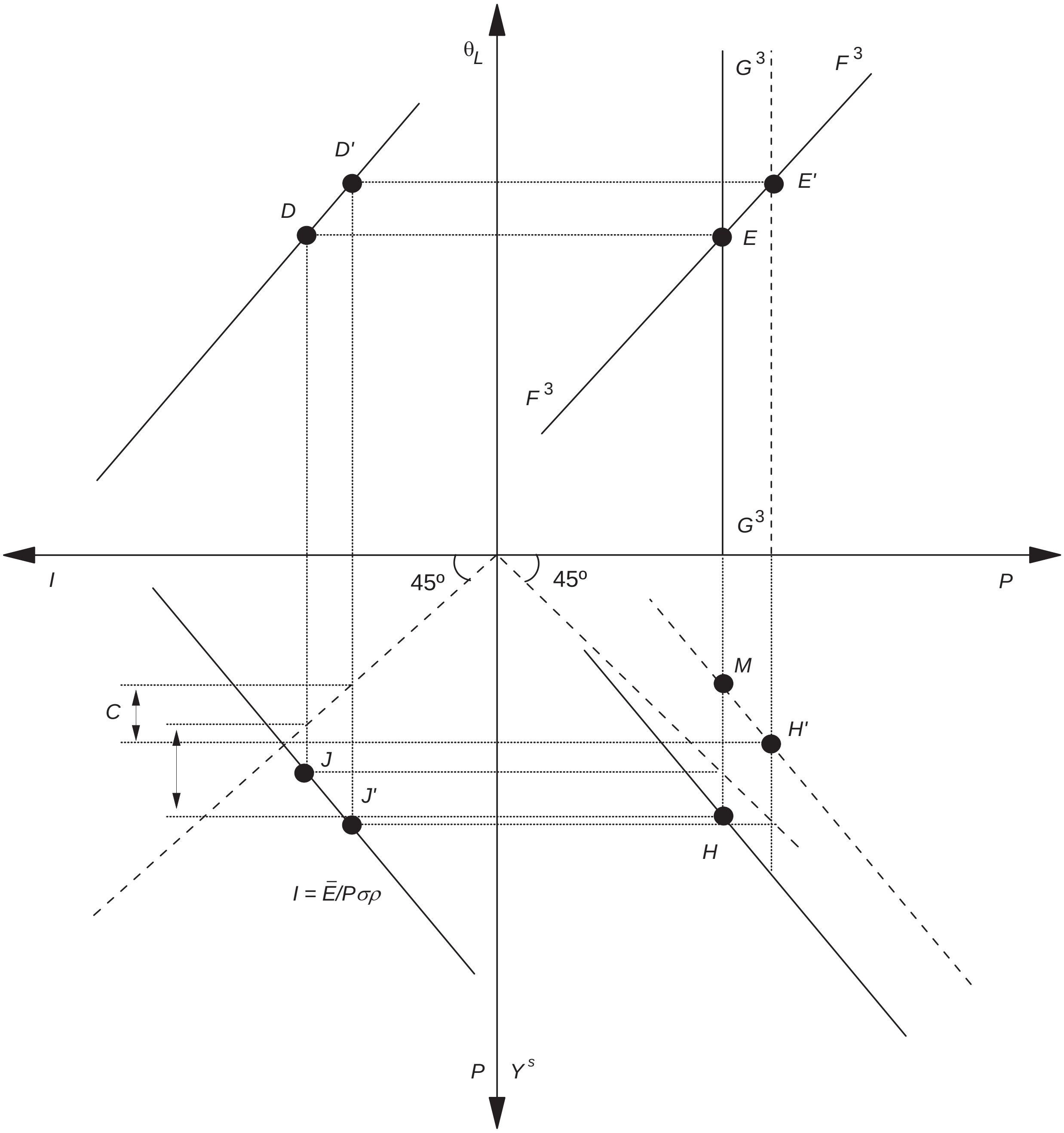


Figure 7
Increase in the Refinance Rate
with Binding Capital Requirements
(Basel I Regime)

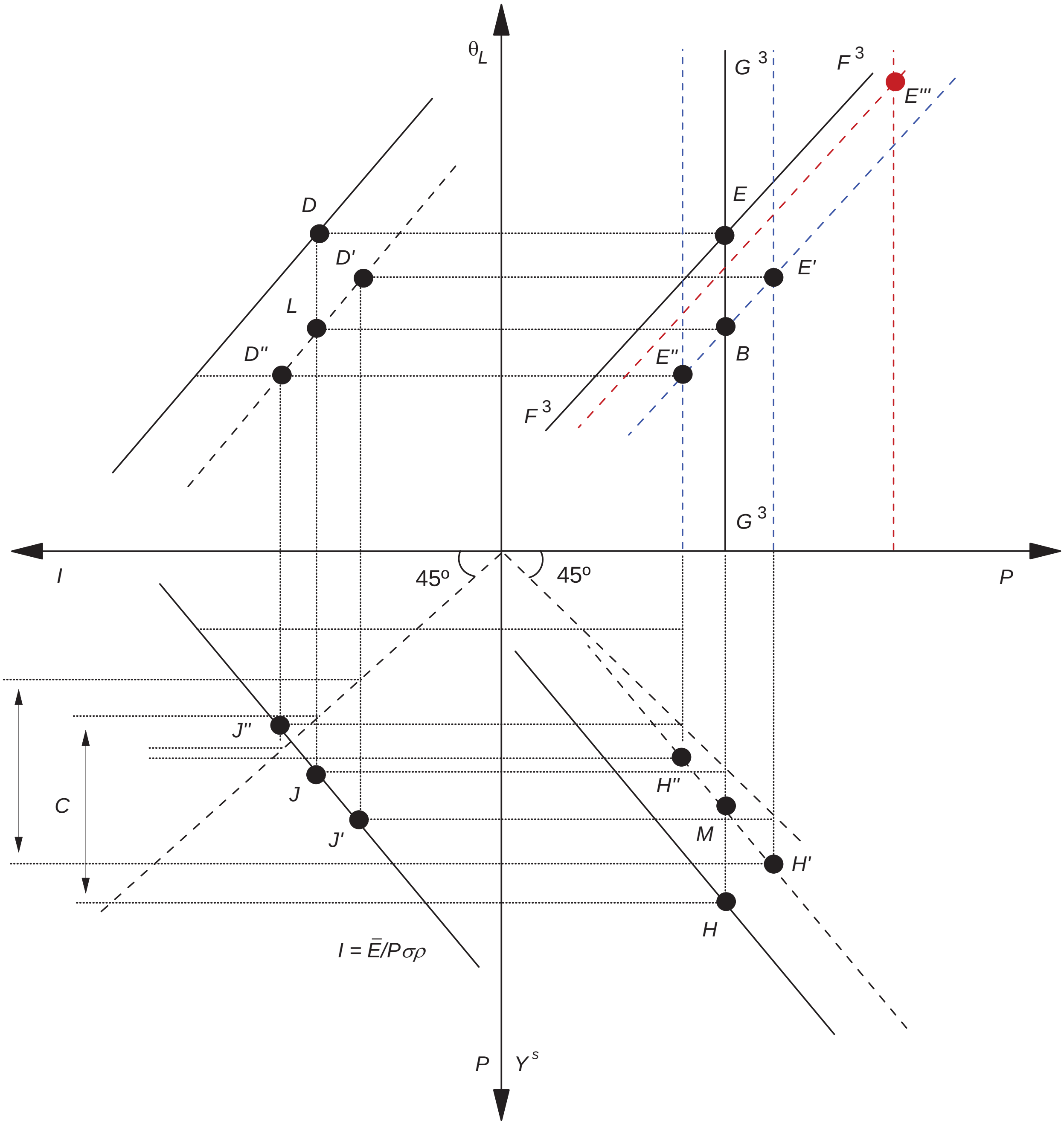


Figure 8
Increase in Capital Adequacy Ratio
with Binding Capital Requirements
(Basel I Regime)

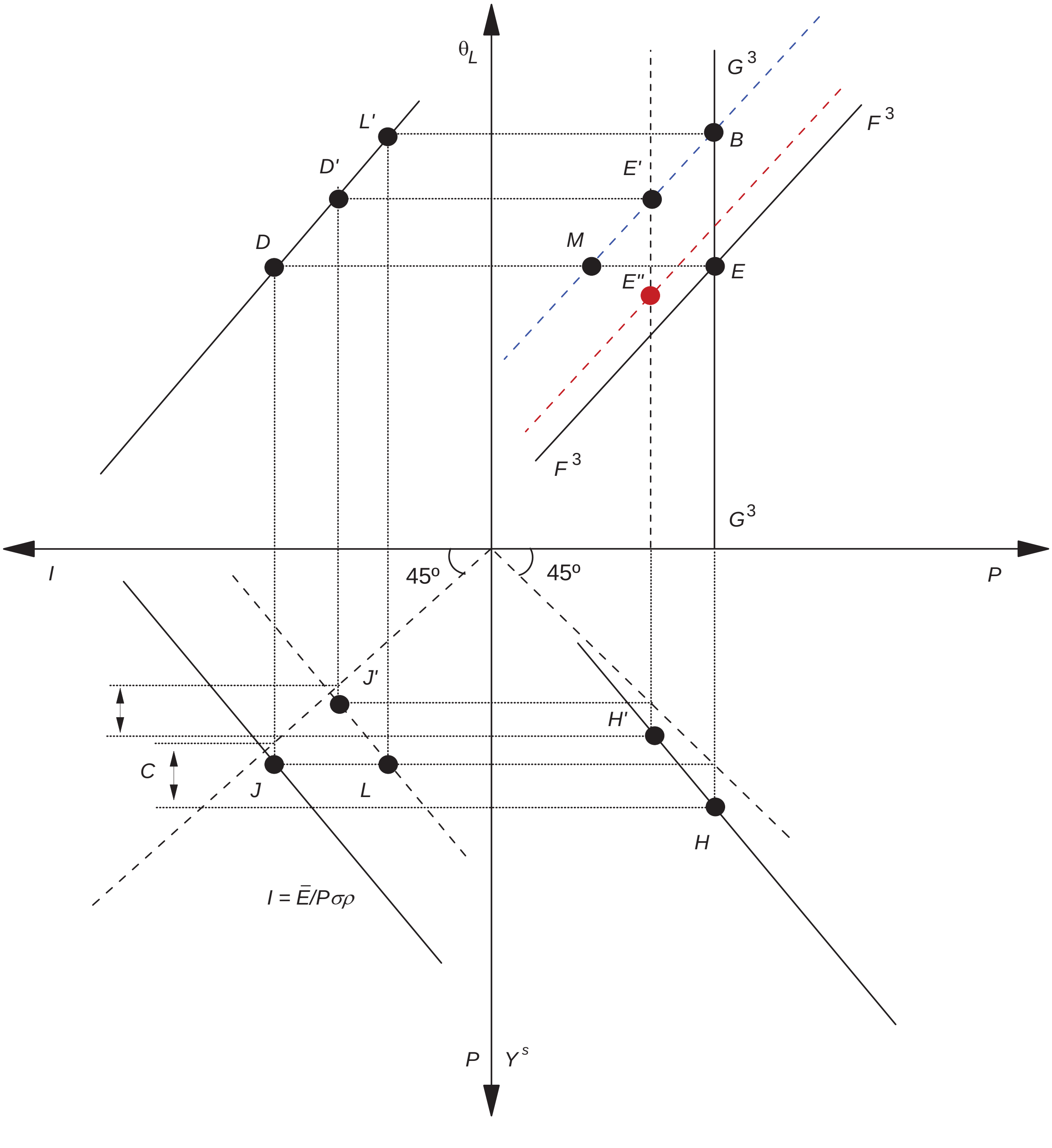


Figure 9
Macroeconomic Equilibrium
with Binding Capital Requirements
(Basel II Regime)

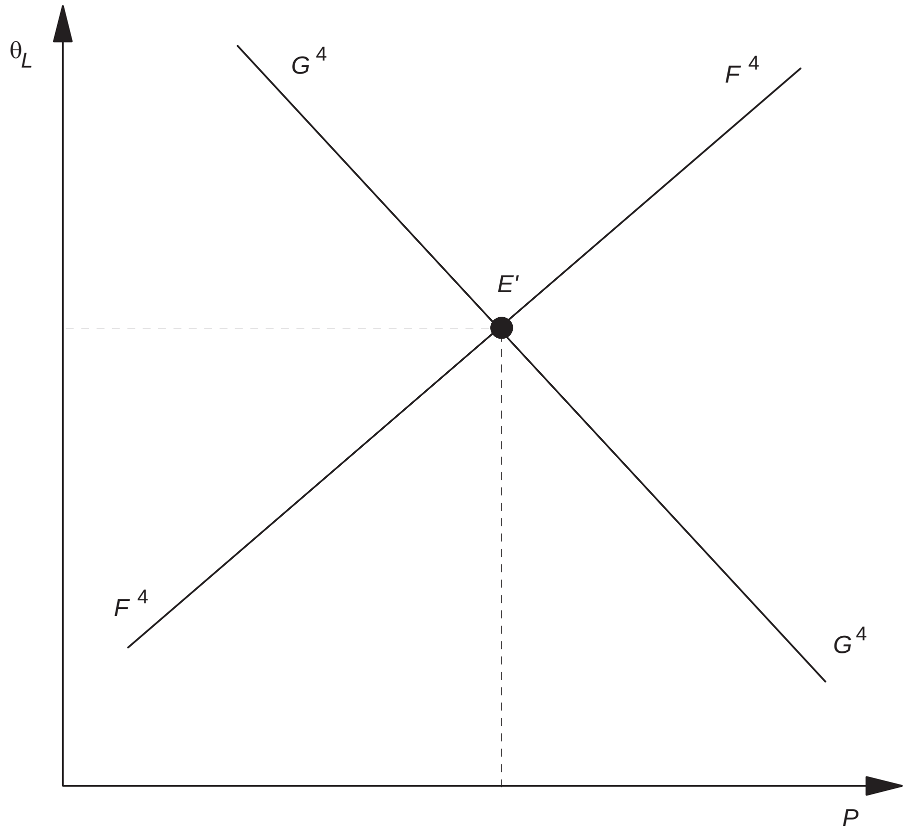


Figure 10
Negative Supply Shock
with Binding Capital Requirements
(Basel II Regime)

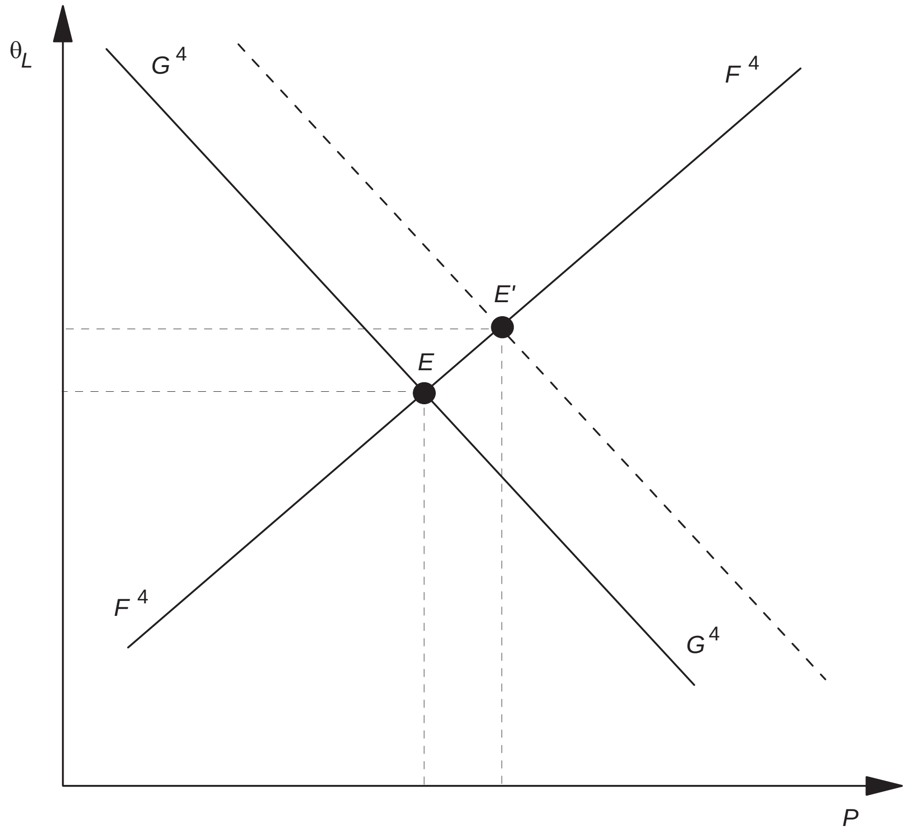


Figure 11
Increase in the Refinance Rate
with Binding Capital Requirements
(Basel II Regime)

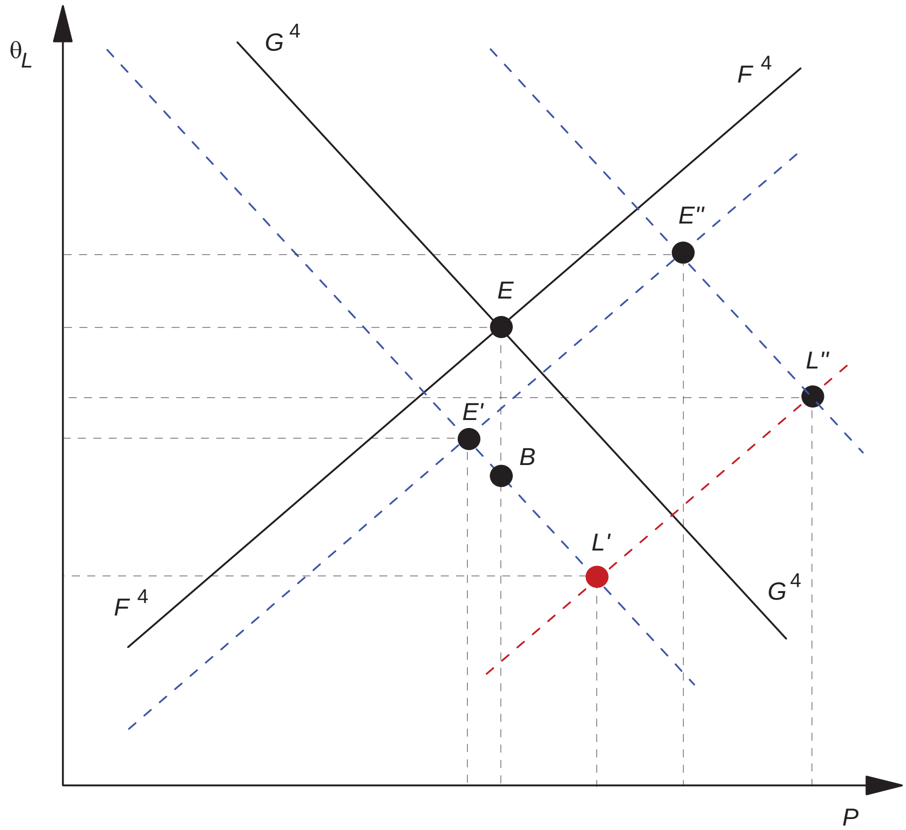
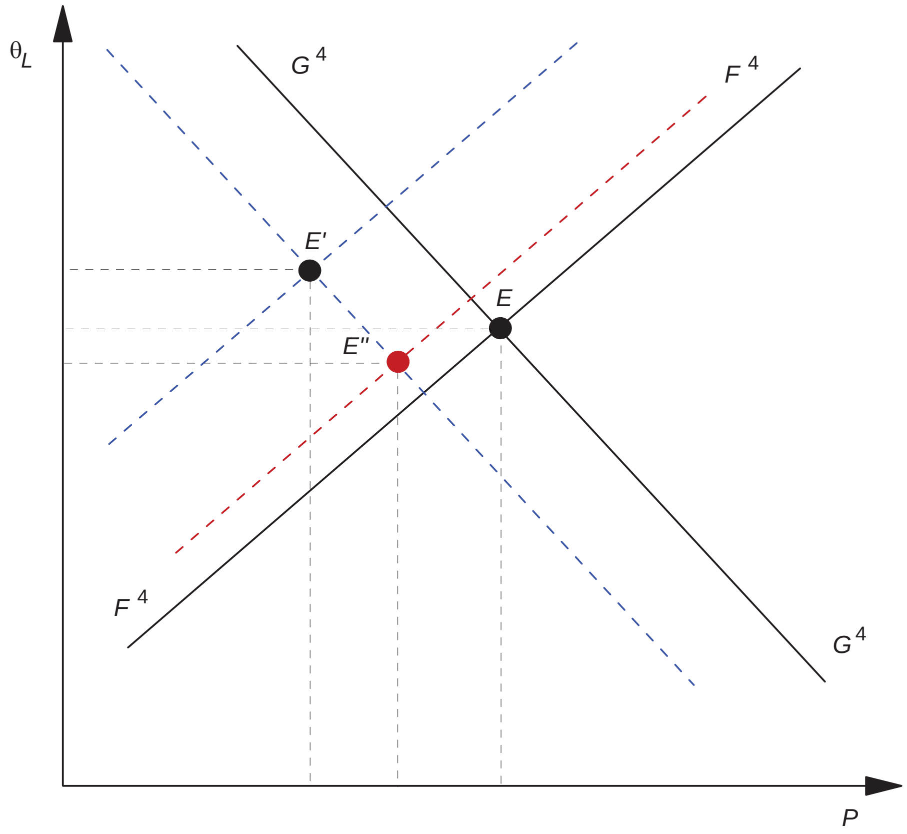


Figure 12
Increase in Capital Adequacy Ratio
with Binding Capital Requirements
(Basel II Regime)



Appendix

To solve the model, we consider separately the cases of nonbinding ($\bar{E} > E^R$) and binding ($\bar{E} = E^R$) capital requirements. In both cases we also discuss separately the two regulatory regimes.

Nonbinding Capital Requirements

The first step is to solve for the financial equilibrium condition, that is, the risk premium equation (18). Using (5), (6), and (17), and setting $\pi^a = 0$ for simplicity, this equation yields

$$\theta_L = g[\frac{\kappa Y^s(P; i_R, A)}{h[\varepsilon^L(1+\theta_L)i_R]}],$$

which does not depend directly on σ. Thus, this equilibrium condition is independent of the regulatory regime.

Solving the above expression for θ_L yields

$$\theta_L = FF(P; i_R, A), \tag{A1}$$

where

$$\Sigma = 1 + g'(\frac{\kappa Y^s}{h^2})\varepsilon^L i_R h' > 0,$$

$$FF_P = \frac{g'}{\Sigma}(\frac{\kappa Y_P^s}{h}) < 0,$$

$$FF_{i_R} = \frac{g'\kappa}{\Sigma}\left\{\frac{hY_{i_R}^s - Y^s h'\varepsilon^L(1+\theta_L)}{h^2}\right\} \lesseqgtr 0,$$

$$FF_A = \frac{g'}{\Sigma}\frac{\kappa Y_A^s}{h} < 0,$$

and $FF_\rho = 0$.

A rise in prices lowers the risk premium, because it stimulates (real) output and increases the effective value of firms' collateral relative to the (real) demand for longer-term loans (see Figures 1 to 4).

An increase in the refinance rate raises the cost of funds for the bank, and this is "passed on" directly to borrowers. This lowers the demand for loans for both working capital needs and investment. In turn, the fall in investment raises the collateral ratio (which tends to lower the risk premium), whereas the fall in output tends to reduce that ratio (and therefore to raise the premium). We assume in the text that the net effect of an increase in i_R is to *raise* the premium ($FF_{i_R} > 0$); in turn, this requires that

$$hY_{i_R}^s - Y^s h'\varepsilon^L(1+\theta_L) < 0,$$

or equivalently, with $1+\theta_L = i_L/\varepsilon^L i_R$ from (17),

$$\left|i_R Y_{i_R}^s / Y^s\right| > \left|i_L h'/h\right|,$$

or that the elasticity of output with respect to the refinance rate be higher (in absolute terms) than the elasticity of investment with respect to the lending rate. The "collateral" effect therefore dominates the "loan demand" effect. This condition may be quite appropriate for middle-income countries where bank loans are essential for short-term economic activity.

A positive supply shock raises output and the value of collateral, without affecting directly the level of investment; this tends to reduce the risk premium ($FF_A < 0$).

The second step is to solve the equilibrium condition of the goods market, (24).Using (5), (6), (12), (16), and (17), condition (24) can be written as, setting $\mu = \pi^a = 0$ and $\bar{W} = 1$ for simplicity,

$$Y^s(P; i_R, A) = \alpha_1 \frac{N^d(P; i_R, A)}{P} - \alpha_2 \varepsilon^D i_R f \left\{ \frac{\bar{E}}{\sigma \rho P h[\varepsilon^L (1+\theta_L) i_R]} \right\} \tag{A2}$$

$$+\alpha_3 (\frac{F_0^H}{P}) + h[\varepsilon^L (1+\theta_L) i_R].$$

This expression can be solved for the risk premium as a function of the goods price. The exact solution depends now on the capital requirements regime.

Basel I regime, $\sigma = \sigma_R$

With $\sigma = \sigma_R$, we have

$$\theta_L = GG^1(P; i_R, A, \rho), \tag{A3}$$

where

$$\Delta_1 = \left\{ 1 + \alpha_2 \varepsilon^D i_R f' \frac{\bar{E}}{\sigma_R \rho P h^2} \right\} \varepsilon^L i_R h',$$

$$GG_P^1 = \frac{1}{\Delta_1} \left\{ Y_P^s + \frac{\alpha_1}{P^2}(N^d - P N_P^d) - \alpha_2 \varepsilon^D i_R f' \frac{\bar{E}}{\sigma_R \rho P^2 h} + \alpha_3 (\frac{F_0^H}{P^2})] \right\},$$

$$GG_{i_R}^1 = \frac{1}{\Delta_1} \left\{ Y_{i_R}^s - \frac{\alpha_1}{P} N_{i_R}^d - \alpha_2 \varepsilon^D f + \frac{\alpha_2 \varepsilon^D i_R \varepsilon^L}{(1+\theta_L)^{-1}} f' \frac{\bar{E} h'}{\sigma_R \rho P h^2} + \varepsilon^L (1+\theta_L) h' \right\},$$

$$GG_A^1 = \frac{1}{\Delta_1}(Y_A^s - \frac{\alpha_1}{P} N_A^d),$$

$$GG_\rho^1 = -\frac{\alpha_2}{\Delta_1} \varepsilon^D i_R f' \frac{\bar{E}}{\sigma_R \rho^2 P h}.$$

In general, Δ_1 is ambiguous in sign. In the absence of a bank capital channel ($f' = 0$), or if the intertemporal substitution effect is not too strong (that is, α_2 small enough), we have $\Delta_1 < 0$. We assume that this is indeed the case in what follows.

The effect of an increase in prices on the risk premium, as measured by GG_P^1, can be decomposed as follows. A rise in prices tends to lower aggregate demand through a negative wealth effect on consumption. At the same time, it increases the nominal value of loans and thus capital requirements; the fall in the capital buffer raises the deposit rate, which (through intertemporal substitution) lowers consumption. However, the increase in P also boosts aggregate supply, by reducing the real (effective) wage, and may stimulate consumption, as a result of higher labor demand and distributed wage income.[36] The net effect depends on

[36]The net effect of distributed wage income on consumption depends on the sign of $PN_P^d - N^d$. Thus, a positive effect requires that $PN_P^d/N^d > 1$, or equivalently that the elasticity of labor demand with respect to prices be sufficiently high.

the shift in supply Y^s (which increases unambiguously) relative to aggregate demand (which depends on the behavior of private spending). It can readily be established that the supply effect always dominates the wage income effect. Given that consumption falls, an increase in prices creates excess supply at the initial level of investment. The risk premium must therefore fall to stimulate investment and restore equilibrium in the goods market. Thus, GG has a negative slope ($GG_P^1 < 0$, see Figures 1 to 4).

To establish this result more formally, first it can be shown that $Y_P^s + \alpha_1 P^{-2}(N^d - PN_P^d) > 0$. Indeed, with $\bar{W} = 1$, (3) and (4) yield $N^d = [\alpha AP/(1+i_R)]^{1/(1-\alpha)}K_0$, and $Y^s = [\alpha AP/(1+i_R)]^{\alpha/(1-\alpha)}K_0$. This implies that $N_P^d = N^d/(1-\alpha)P$ and $Y_P^s = \alpha Y^s/(1-\alpha)P$, so that $PN_P^d - N^d = \alpha N/(1-\alpha)$. Combining these last two expressions yields $Y_P^s - \alpha_1 P^{-2}(PN_1^d - N^d) = \alpha(Y^s - \alpha_1 P^{-1}N^d)/[(1-\alpha)P]$. From the above results, it can also be established that $Y^s - \alpha_1 P^{-1}N^d = K_0 P^{\alpha/(1-\alpha)}[\alpha A/(1+i_R)]^{1/(1-\alpha)}[\alpha^{-1}(1+i_R) - \alpha_1] > 0$, where the last inequality holds because $\alpha^{-1}(1+i_R) > \alpha^{-1} > 1 > \alpha_1$, or equivalently $1 + i_R > \alpha\alpha_1$, given that $\alpha, \alpha_1 \in (0,1)$. Now, given that

$$-\alpha_2 \varepsilon^D i_R f' \frac{\bar{E}}{\sigma_R \rho P^2 h} + \alpha_3 (\frac{F_0^H}{P^2})] > 0,$$

the expression in brackets in the definition of GG_P^1 is also positive. And because $\Delta_1 < 0$, we indeed have $GG_P^1 < 0$.

An increase in the refinance rate also has an ambiguous on the risk premium. First, it raises directly the deposit rate, which tends to lower consumption, as a result of the standard intertemporal effect; to maintain equilibrium in the goods market, investment must increase, and this in turn requires a fall in the risk premium. Second, by increasing directly the lending rate, it lowers investment; this tends to reduce capital requirements, thereby increasing the capital buffer, which in turn tends to lower the deposit rate and stimulate consumption. Third, it reduces also the supply of domestic goods (through its effect on the effective cost of labor, captured through $Y_{i_R}^s$) and labor income. The latter effect (captured by the term $\alpha_1 N_{i_R}^d$) compounds the direct negative effect on aggregate demand. If the capital buffer effect on consumption is so strong that aggregate demand rises, the goods market will be characterized unambiguously by excess demand; if so, then, the risk premium must increase to further reduce investment ($GG_{i_R}^1 < 0$). But if the net effect on aggregate demand is negative (a *sufficient* condition for that being that the direct cost effect of i_R on i_D dominates the indirect capital buffer effect), then both aggregate supply and aggregate demand fall, and the risk premium may either increase or fall to maintain equilibrium in the goods market.

In the absence of any intertemporal effect ($\alpha_2 = 0$), the direct and indirect effects of i_R on i_D do not operate, but the result may still be ambiguous. As before, the supply-side effect of i_R dominates the demand-side wage income effect, that is, $\left|Y_{i_R}^s\right| > \left|\alpha_1 N_{i_R}^d/P\right|$. Thus, because investment falls, both aggregate demand and aggregate supply fall. If aggregate supply falls by less (as can be expected in the short run), the risk premium will need to increase to dampen investment and eliminate excess demand ($GG_{i_R}^1 > 0$). Alternatively, it will have to fall ($GG_{i_R}^1 < 0$). Both cases are illustrated in Figure 3.

A positive supply shock raises output and wage income. Given that the supply-side effect dominates the demand-side effect ($Y_A^s > \alpha_1 N_A^d/P$), to eliminate the excess supply of goods at the initial level of prices necessitates an increase in aggregate demand, and this in turn requires a fall in the risk premium to stimulate investment ($GG_A^1 < 0$).

An increase in the capital adequacy ratio lowers the capital buffer and therefore raises the deposit rate, which in turn lowers consumption. To eliminate the excess supply of goods at the prevailing price, the risk premium must fall to stimulate investment ($GG^1_\rho < 0$).

To determine the general equilibrium effects of shocks, equations (A1) and (A3) must be solved simultaneously for θ_L and P. The equilibrium response to each shock can also be evaluated in the same way; for instance, the solution of a shock to A is

$$\begin{bmatrix} 1 & -FF_P \\ 1 & -GG^1_P \end{bmatrix} \begin{bmatrix} d\theta_L \\ dP \end{bmatrix} = \begin{bmatrix} FF_A \\ GG^1_A \end{bmatrix} dA,$$

which gives

$$\frac{d\theta_L}{dA} = \frac{FF_A GG^1_P - GG^1_A FF_P}{FF_P - GG^1_P}, \quad \frac{dP}{dA} = \frac{FF_A - GG^1_A}{FF_P - GG^1_P}.$$

Dynamic stability requires the slope of GG^1 to be steeper than the slope of FF (see Agénor and Montiel (2008*a*)); in turn, this imposes $|GG^1_P| > |FF_P|$ Thus, $FF_P - GG^1_P > 0$. However, $GG^1_A FF_P - FF_A GG^1_P$ is ambiguous, so $d\theta_L/dA \lesseqgtr 0$. Similarly, $GG^1_A - FF_A$ is ambiguous, so $dP/dA \lesseqgtr 0$ as well. A shock to ρ, by contrast, yields

$$\begin{bmatrix} 1 & -FF_P \\ 1 & -GG^1_P \end{bmatrix} \begin{bmatrix} d\theta_L \\ dP \end{bmatrix} = \begin{bmatrix} 0 \\ GG^1_\rho \end{bmatrix} dA,$$

which implies

$$\frac{d\theta_L}{d\rho} = \frac{GG^1_\rho FF_P}{FF_P - GG^1_P} > 0, \quad \frac{dP}{d\rho} = -\frac{GG^1_\rho}{FF_P - GG^1_P} < 0.$$

Similar results can be established for a shock to i_R.

Basel II regime, $\sigma = \sigma(\theta_L)$

With $\sigma = \sigma(\theta_L)$, and assuming that the initial value of σ is also σ_R in this case, the solution of the goods market equilibrium condition (A2) now yields

$$\theta_L = GG^2(P; i_R, A, \rho), \tag{A4}$$

where

$$\Delta_2 = \varepsilon^L i_R h' + \alpha_2 \varepsilon^D i_R f' \frac{\bar{E}}{\rho P(\sigma_R h)^2}[\sigma' h + \sigma_R \varepsilon^L i_R h'],$$

$$GG^2_j = GG^1_j(\frac{\Delta_1}{\Delta_2}), \quad j = P, i_R, A, \rho.$$

Again, in the absence of the bank capital channel ($f' = 0$), or if the intertemporal substitution effect is not too strong (that is, α_2 small enough), we will also have $\Delta_2 < 0$.[37] If this condition is satisfied, the sign of the derivatives given earlier does not change. However, it can also be established that, given that $\sigma' > 0$, $|\Delta_2| > |\Delta_1|$, which implies that curve G^2G^2 is now flatter (see Figure 1).

Equations (A1) and (A3), or (A1) and (A4), can be solved simultaneously for the equilibrium values of the risk premium and the price level under non-binding capital requirements, and to analyze the impact of shocks on these variables, as illustrated above.

[37] In fact, $\Delta_1 < 0$ implies that $\Delta_2 < 0$.

Binding Capital Requirements

Under a binding capital requirement ($\bar{E} = E^R$), and given that $f(1) = 1$, the capital buffer effect disappears; however, the goods market equilibrium condition is still dependent on the regulatory regime. Indeed, from (29), $I = \bar{E}/P\sigma\rho$. Substituting this expression, together with (12) and (16) in condition (24) yields, instead of (A2),

$$Y^s(P; i_R, A) = \alpha_1 \frac{N^d(P; i_R, A)}{P} - \alpha_2 \varepsilon^D i_R \tag{A5}$$

$$+\alpha_3(\frac{F_0^H}{P}) + \frac{\bar{E}}{P\sigma\rho},$$

whose solution depends on the regulatory regime.

Regarding the financial equilibrium condition, and as noted in the text, under a binding capital requirement the risk premium is determined by combining (30) and (31):

$$\theta_L = (\frac{1}{\varepsilon^L i_R}) h^{-1}(\frac{\bar{E}}{P\sigma\rho}) - 1, \tag{A6}$$

whose solution also depends on the regulatory regime.

Basel I regime, $\sigma = \sigma_R$

If $\sigma = \sigma_R$, equation (A5) is independent of θ_L. The GG curve is now a vertical line at

$$P = GG^3(i_R, A, \rho),$$

where

$$\Delta_3 = Y_P^s + \frac{\alpha_1}{P^2}(N^d - PN_P^d) + \alpha_3(\frac{F_0^H}{P^2}) + \frac{\bar{E}}{P^2\sigma\rho},$$

$$GG_{i_R}^3 = \frac{1}{\Delta_3}\left\{\frac{\alpha_1}{P} N_{i_R}^d - Y_{i_R}^s - \alpha_2 \varepsilon^D\right\},$$

$$GG_A^3 = \frac{1}{\Delta_3}(\frac{\alpha_1}{P} N_A^d - Y_A^s),$$

$$GG_\rho^3 = -\frac{1}{\Delta_3}(\frac{\bar{E}}{P\sigma\rho^2}).$$

As before, it can be establish thaht $Y_P^s + \alpha_1 P^{-2}(N^d - PN_P^d) > 0$; given that $\alpha_3 P^{-2} F_0^H + \bar{E}/P^2\sigma\rho > 0$, we have $\Delta_3 > 0$. However, even so the effect of i_R is ambiguous. On the one hand, an increase in the refinance rate induces consumers to spend less today; on the other, the increase in the effective cost of labor depresses output–which lowers labor income and thus consumption. Thus, both aggregate supply and demand fall (as a result only of a drop in consumption, given that investment does not change).[38] If aggregate supply falls by less (more), the price level will need to increase (fall) to dampen investment and eliminate excess demand (supply); thus $GG_{i_R}^3 > 0$ ($GG_{i_R}^3 < 0$). Both cases are illustrated in Figure 7.

[38] In the absence of any intertemporal effect ($\alpha_2 = 0$), the assumption $\alpha > \alpha_1$ is sufficient to ensure that $GG_{i_R}^3 < 0$.

A positive supply shock raises excess supply and requires a fall in the price level to stimulate consumption (through the wealth effect) and investment ($GG^3_A < 0$). An increase in the capital adequacy ratio lowers investment and requires also a lower price level to offset the impact on investment, stimulate consumption, and reduce output ($GG^3_\rho < 0$).

Regarding the financial market equilibrium condition (A6), under Basel I we have

$$\theta_L = FF^3(P; i_R, \sigma_R, \rho), \tag{A7}$$

where

$$FF^3_P = -(\frac{1}{\varepsilon^L i_R})h^{-1\prime}(\frac{\bar{E}}{P^2\sigma_R\rho}) > 0,$$

$$FF^3_{i_R} = -\frac{h^{-1}}{(\varepsilon^L i_R)^2} < 0,$$

$$FF^3_\rho = -(\frac{1}{\varepsilon^L i_R})h^{-1\prime}(\frac{\bar{E}}{P\sigma_R\rho^2}) > 0,$$

An increase in the price level raises the value of investment; with a binding (nominal) capital requirement, real investment must fall. In turn, this requires a higher risk premium ($FF^3_P > 0$, see Figures 5 to 8). An increase in the refinance rate exerts a direct negative effect on real investment; with a binding capital requirement and a given price level, the risk premium must fall to offset this effect and keep investment at its initial value ($FF^3_{i_R} < 0$). An increase in the capital adequacy ratio requires real investment to fall given the capital requirement, and this in turn entails an increase in the risk premium ($FF^3_\rho > 0$). A supply shock no longer affects directly the premium, given that collateral does not play any direct role ($FF^3_A = 0$).

Basel II regime, $\sigma = \sigma(\theta_L)$

Under the Basel II regime, the solution of (A5) can be written in a form similar to (A3):

$$\theta_L = GG^4(P; i_R, A, \rho),$$

where

$$\Delta_4 = -\frac{\bar{E}\sigma'}{P\sigma_R^2\rho} < 0,$$

$$GG^4_P = \frac{1}{\Delta_4}\left\{Y^s_P + \frac{\alpha_1}{P^2}(N^d - PN^d_P) + \alpha_3(\frac{F^H_0}{P^2}) + \frac{\bar{E}}{P^2\sigma_R\rho}\right\} = \frac{\Delta_3}{\Delta_4},$$

$$GG^4_{i_R} = \frac{1}{\Delta_4}(Y^s_{i_R} - \frac{\alpha_1}{P}N^d_{i_R} - \alpha_2\varepsilon^D),$$

$$GG^4_A = \frac{1}{\Delta_4}(Y^s_A - \frac{\alpha_1}{P}N^d_A) < 0,$$

$$GG^4_\rho = \frac{1}{\Delta_4}(\frac{\bar{E}}{P\sigma_R\rho^2}) < 0.$$

Given that $\Delta_3 > 0$ and $\Delta_4 < 0$, we have $GG^4_P < 0$ (see Figures 9 to 12). Thus, an increase in the price level, which lowers consumption and investment, requires a lower risk premium to raise investment back. An increase in i_R also has ambiguous effects, for reasons similar to those discussed before; in Figure 11, we consider both $GG^4_{i_R} < 0$ and $GG^4_{i_R} > 0$. A positive supply shock creates again excess supply, which requires a reduction in the risk premium to lower the risk weight and "relax" the binding capital requirement, stimulate investment, and restore equilibrium in the goods market ($GG^4_A < 0$). An increase in the capital adequacy ratio "tightens" the capital requirement, forcing a fall in investment—and therefore an offsetting drop in the risk premium ($GG^4_\rho < 0$).

From the financial market equilibrium condition (A6), under Basel II, we now have

$$\theta_L = FF^4(P; i_R, \rho), \tag{A8}$$

where

$$\Sigma_4 = 1 + (\frac{1}{\varepsilon^L i_R})h^{-1\prime}(\frac{\bar{E}}{P\sigma_R^2\rho})\sigma' \lesseqgtr 0,$$

$$FF^4_P = -\frac{1}{\Sigma_4}(\frac{1}{\varepsilon^L i_R})h^{-1\prime}(\frac{\bar{E}}{P^2\sigma_R\rho}) = \frac{FF^3_P}{\Sigma_4},$$

$$FF^4_{i_R} = -\frac{h^{-1}}{\Sigma_4(\varepsilon^L i_R)^2} = \frac{FF^3_{i_R}}{\Sigma_4},$$

$$FF^4_\rho = -\frac{1}{\Sigma_4}(\frac{1}{\varepsilon^L i_R})h^{-1\prime}(\frac{\bar{E}}{P\sigma_R\rho^2}) = \frac{FF^3_\rho}{\Sigma_4},$$

and $FF^4_A = 0$.

Assuming that $\Sigma_4 > 0$ (or equivalently that σ' is not too large) implies that $FF^4_P > 0$ (see Figures 9 to 12), $FF^4_{i_R} < 0$, and $FF^4_\rho > 0$, as under the Basel I regime. In addition, we also have $|\Sigma_4| < 1$; now the slope of FF is steeper than under Basel I, or equivalently $|FF^4_P| > |FF^3_P|$.

Banco Central do Brasil

Trabalhos para Discussão

Os Trabalhos para Discussão podem ser acessados na internet, no formato PDF, no endereço: http://www.bc.gov.br

Working Paper Series

Working Papers in PDF format can be downloaded from: http://www.bc.gov.br

1	**Implementing Inflation Targeting in Brazil** *Joel Bogdanski, Alexandre Antonio Tombini and Sérgio Ribeiro da Costa Werlang*	Jul/2000
2	**Política Monetária e Supervisão do Sistema Financeiro Nacional no Banco Central do Brasil** *Eduardo Lundberg*	Jul/2000
	Monetary Policy and Banking Supervision Functions on the Central Bank *Eduardo Lundberg*	Jul/2000
3	**Private Sector Participation: a Theoretical Justification of the Brazilian Position** *Sérgio Ribeiro da Costa Werlang*	Jul/2000
4	**An Information Theory Approach to the Aggregation of Log-Linear Models** *Pedro H. Albuquerque*	Jul/2000
5	**The Pass-Through from Depreciation to Inflation: a Panel Study** *Ilan Goldfajn and Sérgio Ribeiro da Costa Werlang*	Jul/2000
6	**Optimal Interest Rate Rules in Inflation Targeting Frameworks** *José Alvaro Rodrigues Neto, Fabio Araújo and Marta Baltar J. Moreira*	Jul/2000
7	**Leading Indicators of Inflation for Brazil** *Marcelle Chauvet*	Sep/2000
8	**The Correlation Matrix of the Brazilian Central Bank's Standard Model for Interest Rate Market Risk** *José Alvaro Rodrigues Neto*	Sep/2000
9	**Estimating Exchange Market Pressure and Intervention Activity** *Emanuel-Werner Kohlscheen*	Nov/2000
10	**Análise do Financiamento Externo a uma Pequena Economia Aplicação da Teoria do Prêmio Monetário ao Caso Brasileiro: 1991–1998** *Carlos Hamilton Vasconcelos Araújo e Renato Galvão Flôres Júnior*	Mar/2001
11	**A Note on the Efficient Estimation of Inflation in Brazil** *Michael F. Bryan and Stephen G. Cecchetti*	Mar/2001
12	**A Test of Competition in Brazilian Banking** *Márcio I. Nakane*	Mar/2001

13	**Modelos de Previsão de Insolvência Bancária no Brasil** *Marcio Magalhães Janot*	Mar/2001
14	**Evaluating Core Inflation Measures for Brazil** *Francisco Marcos Rodrigues Figueiredo*	Mar/2001
15	**Is It Worth Tracking Dollar/Real Implied Volatility?** *Sandro Canesso de Andrade and Benjamin Miranda Tabak*	Mar/2001
16	**Avaliação das Projeções do Modelo Estrutural do Banco Central do Brasil para a Taxa de Variação do IPCA** *Sergio Afonso Lago Alves*	Mar/2001
	Evaluation of the Central Bank of Brazil Structural Model's Inflation Forecasts in an Inflation Targeting Framework *Sergio Afonso Lago Alves*	Jul/2001
17	**Estimando o Produto Potencial Brasileiro: uma Abordagem de Função de Produção** *Tito Nícias Teixeira da Silva Filho*	Abr/2001
	Estimating Brazilian Potential Output: a Production Function Approach *Tito Nícias Teixeira da Silva Filho*	Aug/2002
18	**A Simple Model for Inflation Targeting in Brazil** *Paulo Springer de Freitas and Marcelo Kfoury Muinhos*	Apr/2001
19	**Uncovered Interest Parity with Fundamentals: a Brazilian Exchange Rate Forecast Model** *Marcelo Kfoury Muinhos, Paulo Springer de Freitas and Fabio Araújo*	May/2001
20	**Credit Channel without the LM Curve** *Victorio Y. T. Chu and Márcio I. Nakane*	May/2001
21	**Os Impactos Econômicos da CPMF: Teoria e Evidência** *Pedro H. Albuquerque*	Jun/2001
22	**Decentralized Portfolio Management** *Paulo Coutinho and Benjamin Miranda Tabak*	Jun/2001
23	**Os Efeitos da CPMF sobre a Intermediação Financeira** *Sérgio Mikio Koyama e Márcio I. Nakane*	Jul/2001
24	**Inflation Targeting in Brazil: Shocks, Backward-Looking Prices, and IMF Conditionality** *Joel Bogdanski, Paulo Springer de Freitas, Ilan Goldfajn and Alexandre Antonio Tombini*	Aug/2001
25	**Inflation Targeting in Brazil: Reviewing Two Years of Monetary Policy 1999/00** *Pedro Fachada*	Aug/2001
26	**Inflation Targeting in an Open Financially Integrated Emerging Economy: the Case of Brazil** *Marcelo Kfoury Muinhos*	Aug/2001
27	**Complementaridade e Fungibilidade dos Fluxos de Capitais Internacionais** *Carlos Hamilton Vasconcelos Araújo e Renato Galvão Flôres Júnior*	Set/2001

28	**Regras Monetárias e Dinâmica Macroeconômica no Brasil: uma Abordagem de Expectativas Racionais** *Marco Antonio Bonomo e Ricardo D. Brito*	Nov/2001
29	**Using a Money Demand Model to Evaluate Monetary Policies in Brazil** *Pedro H. Albuquerque and Solange Gouvêa*	Nov/2001
30	**Testing the Expectations Hypothesis in the Brazilian Term Structure of Interest Rates** *Benjamin Miranda Tabak and Sandro Canesso de Andrade*	Nov/2001
31	**Algumas Considerações sobre a Sazonalidade no IPCA** *Francisco Marcos R. Figueiredo e Roberta Blass Staub*	Nov/2001
32	**Crises Cambiais e Ataques Especulativos no Brasil** *Mauro Costa Miranda*	Nov/2001
33	**Monetary Policy and Inflation in Brazil (1975-2000): a VAR Estimation** *André Minella*	Nov/2001
34	**Constrained Discretion and Collective Action Problems: Reflections on the Resolution of International Financial Crises** *Arminio Fraga and Daniel Luiz Gleizer*	Nov/2001
35	**Uma Definição Operacional de Estabilidade de Preços** *Tito Nícias Teixeira da Silva Filho*	Dez/2001
36	**Can Emerging Markets Float? Should They Inflation Target?** *Barry Eichengreen*	Feb/2002
37	**Monetary Policy in Brazil: Remarks on the Inflation Targeting Regime, Public Debt Management and Open Market Operations** *Luiz Fernando Figueiredo, Pedro Fachada and Sérgio Goldenstein*	Mar/2002
38	**Volatilidade Implícita e Antecipação de Eventos de *Stress*: um Teste para o Mercado Brasileiro** *Frederico Pechir Gomes*	Mar/2002
39	**Opções sobre Dólar Comercial e Expectativas a Respeito do Comportamento da Taxa de Câmbio** *Paulo Castor de Castro*	Mar/2002
40	**Speculative Attacks on Debts, Dollarization and Optimum Currency Areas** *Aloisio Araujo and Márcia Leon*	Apr/2002
41	**Mudanças de Regime no Câmbio Brasileiro** *Carlos Hamilton V. Araújo e Getúlio B. da Silveira Filho*	Jun/2002
42	**Modelo Estrutural com Setor Externo: Endogenização do Prêmio de Risco e do Câmbio** *Marcelo Kfoury Muinhos, Sérgio Afonso Lago Alves e Gil Riella*	Jun/2002
43	**The Effects of the Brazilian ADRs Program on Domestic Market Efficiency** *Benjamin Miranda Tabak and Eduardo José Araújo Lima*	Jun/2002

44	**Estrutura Competitiva, Produtividade Industrial e Liberação Comercial no Brasil** *Pedro Cavalcanti Ferreira e Osmani Teixeira de Carvalho Guillén*	Jun/2002
45	**Optimal Monetary Policy, Gains from Commitment, and Inflation Persistence** *André Minella*	Aug/2002
46	**The Determinants of Bank Interest Spread in Brazil** *Tarsila Segalla Afanasieff, Priscilla Maria Villa Lhacer and Márcio I. Nakane*	Aug/2002
47	**Indicadores Derivados de Agregados Monetários** *Fernando de Aquino Fonseca Neto e José Albuquerque Júnior*	Set/2002
48	**Should Government Smooth Exchange Rate Risk?** *Ilan Goldfajn and Marcos Antonio Silveira*	Sep/2002
49	**Desenvolvimento do Sistema Financeiro e Crescimento Econômico no Brasil: Evidências de Causalidade** *Orlando Carneiro de Matos*	Set/2002
50	**Macroeconomic Coordination and Inflation Targeting in a Two-Country Model** *Eui Jung Chang, Marcelo Kfoury Muinhos and Joanílio Rodolpho Teixeira*	Sep/2002
51	**Credit Channel with Sovereign Credit Risk: an Empirical Test** *Victorio Yi Tson Chu*	Sep/2002
52	**Generalized Hyperbolic Distributions and Brazilian Data** *José Fajardo and Aquiles Farias*	Sep/2002
53	**Inflation Targeting in Brazil: Lessons and Challenges** *André Minella, Paulo Springer de Freitas, Ilan Goldfajn and Marcelo Kfoury Muinhos*	Nov/2002
54	**Stock Returns and Volatility** *Benjamin Miranda Tabak and Solange Maria Guerra*	Nov/2002
55	**Componentes de Curto e Longo Prazo das Taxas de Juros no Brasil** *Carlos Hamilton Vasconcelos Araújo e Osmani Teixeira de Carvalho de Guillén*	Nov/2002
56	**Causality and Cointegration in Stock Markets: the Case of Latin America** *Benjamin Miranda Tabak and Eduardo José Araújo Lima*	Dec/2002
57	**As Leis de Falência: uma Abordagem Econômica** *Aloisio Araujo*	Dez/2002
58	**The Random Walk Hypothesis and the Behavior of Foreign Capital Portfolio Flows: the Brazilian Stock Market Case** *Benjamin Miranda Tabak*	Dec/2002
59	**Os Preços Administrados e a Inflação no Brasil** *Francisco Marcos R. Figueiredo e Thaís Porto Ferreira*	Dez/2002
60	**Delegated Portfolio Management** *Paulo Coutinho and Benjamin Miranda Tabak*	Dec/2002

61	**O Uso de Dados de Alta Freqüência na Estimação da Volatilidade e do Valor em Risco para o Ibovespa** *João Maurício de Souza Moreira e Eduardo Facó Lemgruber*	Dez/2002
62	**Taxa de Juros e Concentração Bancária no Brasil** *Eduardo Kiyoshi Tonooka e Sérgio Mikio Koyama*	Fev/2003
63	**Optimal Monetary Rules: the Case of Brazil** *Charles Lima de Almeida, Marco Aurélio Peres, Geraldo da Silva e Souza and Benjamin Miranda Tabak*	Feb/2003
64	**Medium-Size Macroeconomic Model for the Brazilian Economy** *Marcelo Kfoury Muinhos and Sergio Afonso Lago Alves*	Feb/2003
65	**On the Information Content of Oil Future Prices** *Benjamin Miranda Tabak*	Feb/2003
66	**A Taxa de Juros de Equilíbrio: uma Abordagem Múltipla** *Pedro Calhman de Miranda e Marcelo Kfoury Muinhos*	Fev/2003
67	**Avaliação de Métodos de Cálculo de Exigência de Capital para Risco de Mercado de Carteiras de Ações no Brasil** *Gustavo S. Araújo, João Maurício S. Moreira e Ricardo S. Maia Clemente*	Fev/2003
68	**Real Balances in the Utility Function: Evidence for Brazil** *Leonardo Soriano de Alencar and Márcio I. Nakane*	Feb/2003
69	**r-filters: a Hodrick-Prescott Filter Generalization** *Fabio Araújo, Marta Baltar Moreira Areosa and José Alvaro Rodrigues Neto*	Feb/2003
70	**Monetary Policy Surprises and the Brazilian Term Structure of Interest Rates** *Benjamin Miranda Tabak*	Feb/2003
71	**On Shadow-Prices of Banks in Real-Time Gross Settlement Systems** *Rodrigo Penaloza*	Apr/2003
72	**O Prêmio pela Maturidade na Estrutura a Termo das Taxas de Juros Brasileiras** *Ricardo Dias de Oliveira Brito, Angelo J. Mont'Alverne Duarte e Osmani Teixeira de C. Guillen*	Maio/2003
73	**Análise de Componentes Principais de Dados Funcionais – uma Aplicação às Estruturas a Termo de Taxas de Juros** *Getúlio Borges da Silveira e Octavio Bessada*	Maio/2003
74	**Aplicação do Modelo de Black, Derman & Toy à Precificação de Opções Sobre Títulos de Renda Fixa** *Octavio Manuel Bessada Lion, Carlos Alberto Nunes Cosenza e César das Neves*	Maio/2003
75	**Brazil's Financial System: Resilience to Shocks, no Currency Substitution, but Struggling to Promote Growth** *Ilan Goldfajn, Katherine Hennings and Helio Mori*	Jun/2003

76	**Inflation Targeting in Emerging Market Economies** *Arminio Fraga, Ilan Goldfajn and André Minella*	Jun/2003
77	**Inflation Targeting in Brazil: Constructing Credibility under Exchange Rate Volatility** *André Minella, Paulo Springer de Freitas, Ilan Goldfajn and Marcelo Kfoury Muinhos*	Jul/2003
78	**Contornando os Pressupostos de Black & Scholes: Aplicação do Modelo de Precificação de Opções de Duan no Mercado Brasileiro** *Gustavo Silva Araújo, Claudio Henrique da Silveira Barbedo, Antonio Carlos Figueiredo, Eduardo Facó Lemgruber*	Out/2003
79	**Inclusão do Decaimento Temporal na Metodologia Delta-Gama para o Cálculo do VaR de Carteiras Compradas em Opções no Brasil** *Claudio Henrique da Silveira Barbedo, Gustavo Silva Araújo, Eduardo Facó Lemgruber*	Out/2003
80	**Diferenças e Semelhanças entre Países da América Latina: uma Análise de *Markov Switching* para os Ciclos Econômicos de Brasil e Argentina** *Arnildo da Silva Correa*	Out/2003
81	**Bank Competition, Agency Costs and the Performance of the Monetary Policy** *Leonardo Soriano de Alencar and Márcio I. Nakane*	Jan/2004
82	**Carteiras de Opções: Avaliação de Metodologias de Exigência de Capital no Mercado Brasileiro** *Cláudio Henrique da Silveira Barbedo e Gustavo Silva Araújo*	Mar/2004
83	**Does Inflation Targeting Reduce Inflation? An Analysis for the OECD Industrial Countries** *Thomas Y. Wu*	May/2004
84	**Speculative Attacks on Debts and Optimum Currency Area: a Welfare Analysis** *Aloisio Araujo and Marcia Leon*	May/2004
85	**Risk Premia for Emerging Markets Bonds: Evidence from Brazilian Government Debt, 1996-2002** *André Soares Loureiro and Fernando de Holanda Barbosa*	May/2004
86	**Identificação do Fator Estocástico de Descontos e Algumas Implicações sobre Testes de Modelos de Consumo** *Fabio Araujo e João Victor Issler*	Maio/2004
87	**Mercado de Crédito: uma Análise Econométrica dos Volumes de Crédito Total e Habitacional no Brasil** *Ana Carla Abrão Costa*	Dez/2004
88	**Ciclos Internacionais de Negócios: uma Análise de Mudança de Regime Markoviano para Brasil, Argentina e Estados Unidos** *Arnildo da Silva Correa e Ronald Otto Hillbrecht*	Dez/2004
89	**O Mercado de *Hedge* Cambial no Brasil: Reação das Instituições Financeiras a Intervenções do Banco Central** *Fernando N. de Oliveira*	Dez/2004

90	**Bank Privatization and Productivity: Evidence for Brazil** *Márcio I. Nakane and Daniela B. Weintraub*	Dec/2004
91	**Credit Risk Measurement and the Regulation of Bank Capital and Provision Requirements in Brazil – a Corporate Analysis** *Ricardo Schechtman, Valéria Salomão Garcia, Sergio Mikio Koyama and Guilherme Cronemberger Parente*	Dec/2004
92	**Steady-State Analysis of an Open Economy General Equilibrium Model for Brazil** *Mirta Noemi Sataka Bugarin, Roberto de Goes Ellery Jr., Victor Gomes Silva, Marcelo Kfoury Muinhos*	Apr/2005
93	**Avaliação de Modelos de Cálculo de Exigência de Capital para Risco Cambial** *Claudio H. da S. Barbedo, Gustavo S. Araújo, João Maurício S. Moreira e Ricardo S. Maia Clemente*	Abr/2005
94	**Simulação Histórica Filtrada: Incorporação da Volatilidade ao Modelo Histórico de Cálculo de Risco para Ativos Não-Lineares** *Claudio Henrique da Silveira Barbedo, Gustavo Silva Araújo e Eduardo Facó Lemgruber*	Abr/2005
95	**Comment on Market Discipline and Monetary Policy by Carl Walsh** *Maurício S. Bugarin and Fábia A. de Carvalho*	Apr/2005
96	**O que É Estratégia: uma Abordagem Multiparadigmática para a Disciplina** *Anthero de Moraes Meirelles*	Ago/2005
97	**Finance and the Business Cycle: a Kalman Filter Approach with Markov Switching** *Ryan A. Compton and Jose Ricardo da Costa e Silva*	Aug/2005
98	**Capital Flows Cycle: Stylized Facts and Empirical Evidences for Emerging Market Economies** *Helio Mori e Marcelo Kfoury Muinhos*	Aug/2005
99	**Adequação das Medidas de Valor em Risco na Formulação da Exigência de Capital para Estratégias de Opções no Mercado Brasileiro** *Gustavo Silva Araújo, Claudio Henrique da Silveira Barbedo,e Eduardo Facó Lemgruber*	Set/2005
100	**Targets and Inflation Dynamics** *Sergio A. L. Alves and Waldyr D. Areosa*	Oct/2005
101	**Comparing Equilibrium Real Interest Rates: Different Approaches to Measure Brazilian Rates** *Marcelo Kfoury Muinhos and Márcio I. Nakane*	Mar/2006
102	**Judicial Risk and Credit Market Performance: Micro Evidence from Brazilian Payroll Loans** *Ana Carla A. Costa and João M. P. de Mello*	Apr/2006
103	**The Effect of Adverse Supply Shocks on Monetary Policy and Output** *Maria da Glória D. S. Araújo, Mirta Bugarin, Marcelo Kfoury Muinhos and Jose Ricardo C. Silva*	Apr/2006

104	**Extração de Informação de Opções Cambiais no Brasil** *Eui Jung Chang e Benjamin Miranda Tabak*	Abr/2006
105	**Representing Roommate's Preferences with Symmetric Utilities** *José Alvaro Rodrigues Neto*	Apr/2006
106	**Testing Nonlinearities Between Brazilian Exchange Rates and Inflation Volatilities** *Cristiane R. Albuquerque and Marcelo Portugal*	May/2006
107	**Demand for Bank Services and Market Power in Brazilian Banking** *Márcio I. Nakane, Leonardo S. Alencar and Fabio Kanczuk*	Jun/2006
108	**O Efeito da Consignação em Folha nas Taxas de Juros dos Empréstimos Pessoais** *Eduardo A. S. Rodrigues, Victorio Chu, Leonardo S. Alencar e Tony Takeda*	Jun/2006
109	**The Recent Brazilian Disinflation Process and Costs** *Alexandre A. Tombini and Sergio A. Lago Alves*	Jun/2006
110	**Fatores de Risco e o *Spread* Bancário no Brasil** *Fernando G. Bignotto e Eduardo Augusto de Souza Rodrigues*	Jul/2006
111	**Avaliação de Modelos de Exigência de Capital para Risco de Mercado do Cupom Cambial** *Alan Cosme Rodrigues da Silva, João Maurício de Souza Moreira e Myrian Beatriz Eiras das Neves*	Jul/2006
112	**Interdependence and Contagion: an Analysis of Information Transmission in Latin America's Stock Markets** *Angelo Marsiglia Fasolo*	Jul/2006
113	**Investigação da Memória de Longo Prazo da Taxa de Câmbio no Brasil** *Sergio Rubens Stancato de Souza, Benjamin Miranda Tabak e Daniel O. Cajueiro*	Ago/2006
114	**The Inequality Channel of Monetary Transmission** *Marta Areosa and Waldyr Areosa*	Aug/2006
115	**Myopic Loss Aversion and House-Money Effect Overseas: an Experimental Approach** *José L. B. Fernandes, Juan Ignacio Peña and Benjamin M. Tabak*	Sep/2006
116	**Out-Of-The-Money Monte Carlo Simulation Option Pricing: the Join Use of Importance Sampling and Descriptive Sampling** *Jaqueline Terra Moura Marins, Eduardo Saliby and Joséte Florencio dos Santos*	Sep/2006
117	**An Analysis of Off-Site Supervision of Banks' Profitability, Risk and Capital Adequacy: a Portfolio Simulation Approach Applied to Brazilian Banks** *Theodore M. Barnhill, Marcos R. Souto and Benjamin M. Tabak*	Sep/2006
118	**Contagion, Bankruptcy and Social Welfare Analysis in a Financial Economy with Risk Regulation Constraint** *Aloísio P. Araújo and José Valentim M. Vicente*	Oct/2006

119	**A Central de Risco de Crédito no Brasil: uma Análise de Utilidade de Informação** *Ricardo Schechtman*	Out/2006
120	**Forecasting Interest Rates: an Application for Brazil** *Eduardo J. A. Lima, Felipe Luduvice and Benjamin M. Tabak*	Oct/2006
121	**The Role of Consumer's Risk Aversion on Price Rigidity** *Sergio A. Lago Alves and Mirta N. S. Bugarin*	Nov/2006
122	**Nonlinear Mechanisms of the Exchange Rate Pass-Through: a Phillips Curve Model With Threshold for Brazil** *Arnildo da Silva Correa and André Minella*	Nov/2006
123	**A Neoclassical Analysis of the Brazilian "Lost-Decades"** *Flávia Mourão Graminho*	Nov/2006
124	**The Dynamic Relations between Stock Prices and Exchange Rates: Evidence for Brazil** *Benjamin M. Tabak*	Nov/2006
125	**Herding Behavior by Equity Foreign Investors on Emerging Markets** *Barbara Alemanni and José Renato Haas Ornelas*	Dec/2006
126	**Risk Premium: Insights over the Threshold** *José L. B. Fernandes, Augusto Hasman and Juan Ignacio Peña*	Dec/2006
127	**Uma Investigação Baseada em Reamostragem sobre Requerimentos de Capital para Risco de Crédito no Brasil** *Ricardo Schechtman*	Dec/2006
128	**Term Structure Movements Implicit in Option Prices** *Caio Ibsen R. Almeida and José Valentim M. Vicente*	Dec/2006
129	**Brazil: Taming Inflation Expectations** *Afonso S. Bevilaqua, Mário Mesquita and André Minella*	Jan/2007
130	**The Role of Banks in the Brazilian Interbank Market: Does Bank Type Matter?** *Daniel O. Cajueiro and Benjamin M. Tabak*	Jan/2007
131	**Long-Range Dependence in Exchange Rates: the Case of the European Monetary System** *Sergio Rubens Stancato de Souza, Benjamin M. Tabak and Daniel O. Cajueiro*	Mar/2007
132	**Credit Risk Monte Carlo Simulation Using Simplified Creditmetrics' Model: the Joint Use of Importance Sampling and Descriptive Sampling** *Jaqueline Terra Moura Marins and Eduardo Saliby*	Mar/2007
133	**A New Proposal for Collection and Generation of Information on Financial Institutions' Risk: the Case of Derivatives** *Gilneu F. A. Vivan and Benjamin M. Tabak*	Mar/2007
134	**Amostragem Descritiva no Apreçamento de Opções Européias através de Simulação Monte Carlo: o Efeito da Dimensionalidade e da Probabilidade de Exercício no Ganho de Precisão** *Eduardo Saliby, Sergio Luiz Medeiros Proença de Gouvêa e Jaqueline Terra Moura Marins*	Abr/2007

135	**Evaluation of Default Risk for the Brazilian Banking Sector** *Marcelo Y. Takami and Benjamin M. Tabak*	May/2007
136	**Identifying Volatility Risk Premium from Fixed Income Asian Options** *Caio Ibsen R. Almeida and José Valentim M. Vicente*	May/2007
137	**Monetary Policy Design under Competing Models of Inflation Persistence** *Solange Gouvea e Abhijit Sen Gupta*	May/2007
138	**Forecasting Exchange Rate Density Using Parametric Models: the Case of Brazil** *Marcos M. Abe, Eui J. Chang and Benjamin M. Tabak*	May/2007
139	**Selection of Optimal Lag Length inCointegrated VAR Models with Weak Form of Common Cyclical Features** *Carlos Enrique Carrasco Gutiérrez, Reinaldo Castro Souza and Osmani Teixeira de Carvalho Guillén*	Jun/2007
140	**Inflation Targeting, Credibility and Confidence Crises** *Rafael Santos and Aloísio Araújo*	Aug/2007
141	**Forecasting Bonds Yields in the Brazilian Fixed income Market** *Jose Vicente and Benjamin M. Tabak*	Aug/2007
142	**Crises Análise da Coerência de Medidas de Risco no Mercado Brasileiro de Ações e Desenvolvimento de uma Metodologia Híbrida para o *Expected Shortfall*** *Alan Cosme Rodrigues da Silva, Eduardo Facó Lemgruber, José Alberto Rebello Baranowski e Renato da Silva Carvalho*	Ago/2007
143	**Price Rigidity in Brazil: Evidence from CPI Micro Data** *Solange Gouvea*	Sep/2007
144	**The Effect of Bid-Ask Prices on Brazilian Options Implied Volatility: a Case Study of Telemar Call Options** *Claudio Henrique da Silveira Barbedo and Eduardo Facó Lemgruber*	Oct/2007
145	**The Stability-Concentration Relationship in the Brazilian Banking System** *Benjamin Miranda Tabak, Solange Maria Guerra, Eduardo José Araújo Lima and Eui Jung Chang*	Oct/2007
146	**Movimentos da Estrutura a Termo e Critérios de Minimização do Erro de Previsão em um Modelo Paramétrico Exponencial** *Caio Almeida, Romeu Gomes, André Leite e José Vicente*	Out/2007
147	**Explaining Bank Failures in Brazil: Micro, Macro and Contagion Effects (1994-1998)** *Adriana Soares Sales and Maria Eduarda Tannuri-Pianto*	Oct/2007
148	**Um Modelo de Fatores Latentes com Variáveis Macroeconômicas para a Curva de Cupom Cambial** *Felipe Pinheiro, Caio Almeida e José Vicente*	Out/2007
149	**Joint Validation of Credit Rating PDs under Default Correlation** *Ricardo Schechtman*	Oct/2007

150	**A Probabilistic Approach for Assessing the Significance of Contextual Variables in Nonparametric Frontier Models: an Application for Brazilian Banks** *Roberta Blass Staub and Geraldo da Silva e Souza*	Oct/2007
151	**Building Confidence Intervals with Block Bootstraps for the Variance Ratio Test of Predictability** *Eduardo José Araújo Lima and Benjamin Miranda Tabak*	Nov/2007
152	**Demand for Foreign Exchange Derivatives in Brazil: Hedge or Speculation?** *Fernando N. de Oliveira and Walter Novaes*	Dec/2007
153	**Aplicação da Amostragem por Importância à Simulação de Opções Asiáticas Fora do Dinheiro** *Jaqueline Terra Moura Marins*	Dez/2007
154	**Identification of Monetary Policy Shocks in the Brazilian Market for Bank Reserves** *Adriana Soares Sales and Maria Tannuri-Pianto*	Dec/2007
155	**Does Curvature Enhance Forecasting?** *Caio Almeida, Romeu Gomes, André Leite and José Vicente*	Dec/2007
156	**Escolha do Banco e Demanda por Empréstimos: um Modelo de Decisão em Duas Etapas Aplicado para o Brasil** *Sérgio Mikio Koyama e Márcio I. Nakane*	Dez/2007
157	**Is the Investment-Uncertainty Link Really Elusive? The Harmful Effects of Inflation Uncertainty in Brazil** *Tito Nícias Teixeira da Silva Filho*	Jan/2008
158	**Characterizing the Brazilian Term Structure of Interest Rates** *Osmani T. Guillen and Benjamin M. Tabak*	Feb/2008
159	**Behavior and Effects of Equity Foreign Investors on Emerging Markets** *Barbara Alemanni and José Renato Haas Ornelas*	Feb/2008
160	**The Incidence of Reserve Requirements in Brazil: Do Bank Stockholders Share the Burden?** *Fábia A. de Carvalho and Cyntia F. Azevedo*	Feb/2008
161	**Evaluating Value-at-Risk Models via Quantile Regressions** *Wagner P. Gaglianone, Luiz Renato Lima and Oliver Linton*	Feb/2008
162	**Balance Sheet Effects in Currency Crises: Evidence from Brazil** *Marcio M. Janot, Márcio G. P. Garcia and Walter Novaes*	Apr/2008
163	**Searching for the Natural Rate of Unemployment in a Large Relative Price Shocks' Economy: the Brazilian Case** *Tito Nícias Teixeira da Silva Filho*	May/2008
164	**Foreign Banks' Entry and Departure: the recent Brazilian experience (1996-2006)** *Pedro Fachada*	Jun/2008
165	**Avaliação de Opções de Troca e Opções de *Spread* Européias e Americanas** *Giuliano Carrozza Uzêda Iorio de Souza, Carlos Patrício Samanez e Gustavo Santos Raposo*	Jul/2008

166	**Testing Hyperinflation Theories Using the Inflation Tax Curve: a case study** *Fernando de Holanda Barbosa and Tito Nícias Teixeira da Silva Filho*	Jul/2008
167	**O Poder Discriminante das Operações de Crédito das Instituições Financeiras Brasileiras** *Clodoaldo Aparecido Annibal*	Jul/2008
168	**An Integrated Model for Liquidity Management and Short-Term Asset Allocation in Commercial Banks** *Wenersamy Ramos de Alcântara*	Jul/2008
169	**Mensuração do Risco Sistêmico no Setor Bancário com Variáveis Contábeis e Econômicas** *Lucio Rodrigues Capelletto, Eliseu Martins e Luiz João Corrar*	Jul/2008
170	**Política de Fechamento de Bancos com Regulador Não-Benevolente: Resumo e Aplicação** *Adriana Soares Sales*	Jul/2008
171	**Modelos para a Utilização das Operações de Redesconto pelos Bancos com Carteira Comercial no Brasil** *Sérgio Mikio Koyama e Márcio Issao Nakane*	Ago/2008
172	**Combining Hodrick-Prescott Filtering with a Production Function Approach to Estimate Output Gap** *Marta Areosa*	Aug/2008
173	**Exchange Rate Dynamics and the Relationship between the Random Walk Hypothesis and Official Interventions** *Eduardo José Araújo Lima and Benjamin Miranda Tabak*	Aug/2008
174	**Foreign Exchange Market Volatility Information: an investigation of real-dollar exchange rate** *Frederico Pechir Gomes, Marcelo Yoshio Takami and Vinicius Ratton Brandi*	Aug/2008
175	**Evaluating Asset Pricing Models in a Fama-French Framework** *Carlos Enrique Carrasco Gutierrez and Wagner Piazza Gaglianone*	Dec/2008
176	**Fiat Money and the Value of Binding Portfolio Constraints** *Mário R. Páscoa, Myrian Petrassi and Juan Pablo Torres-Martínez*	Dec/2008
177	**Preference for Flexibility and Bayesian Updating** *Gil Riella*	Dec/2008
178	**An Econometric Contribution to the Intertemporal Approach of the Current Account** *Wagner Piazza Gaglianone and João Victor Issler*	Dec/2008
179	**Are Interest Rate Options Important for the Assessment of Interest Rate Risk?** *Caio Almeida and José Vicente*	Dec/2008
180	**A Class of Incomplete and Ambiguity Averse Preferences** *Leandro Nascimento and Gil Riella*	Dec/2008
181	**Monetary Channels in Brazil through the Lens of a Semi-Structural Model** *André Minella and Nelson F. Souza-Sobrinho*	Apr/2009

182	**Avaliação de Opções Americanas com Barreiras Monitoradas de Forma Discreta** *Giuliano Carrozza Uzêda Iorio de Souza e Carlos Patrício Samanez*	Abr/2009
183	**Ganhos da Globalização do Capital Acionário em Crises Cambiais** *Marcio Janot e Walter Novaes*	Abr/2009
184	**Behavior Finance and Estimation Risk in Stochastic Portfolio Optimization** *José Luiz Barros Fernandes, Juan Ignacio Peña and Benjamin Miranda Tabak*	Apr/2009
185	**Market Forecasts in Brazil: performance and determinants** *Fabia A. de Carvalho and André Minella*	Apr/2009
186	**Previsão da Curva de Juros: um modelo estatístico com variáveis macroeconômicas** *André Luís Leite, Romeu Braz Pereira Gomes Filho e José Valentim Machado Vicente*	Maio/2009
187	**The Influence of Collateral on Capital Requirements in the Brazilian Financial System: an approach through historical average and logistic regression on probability of default** *Alan Cosme Rodrigues da Silva, Antônio Carlos Magalhães da Silva, Jaqueline Terra Moura Marins, Myrian Beatriz Eiras da Neves and Giovani Antonio Silva Brito*	Jun/2009
188	**Pricing Asian Interest Rate Options with a Three-Factor HJM Model** *Claudio Henrique da Silveira Barbedo, José Valentim Machado Vicente and Octávio Manuel Bessada Lion*	Jun/2009
189	**Linking Financial and Macroeconomic Factors to Credit Risk Indicators of Brazilian Banks** *Marcos Souto, Benjamin M. Tabak and Francisco Vazquez*	Jul/2009
190	**Concentração Bancária, Lucratividade e Risco Sistêmico: uma abordagem de contágio indireto** *Bruno Silva Martins e Leonardo S. Alencar*	Set/2009
191	**Concentração e Inadimplência nas Carteiras de Empréstimos dos Bancos Brasileiros** *Patricia L. Tecles, Benjamin M. Tabak e Roberta B. Staub*	Set/2009
192	**Inadimplência do Setor Bancário Brasileiro: uma avaliação de suas medidas** *Clodoaldo Aparecido Annibal*	Set/2009
193	***Loss Given Default*: um estudo sobre perdas em operações prefixadas no mercado brasileiro** *Antonio Carlos Magalhães da Silva, Jaqueline Terra Moura Marins e Myrian Beatriz Eiras das Neves*	Set/2009
194	**Testes de Contágio entre Sistemas Bancários – A crise do *subprime*** *Benjamin M. Tabak e Manuela M. de Souza*	Set/2009
195	**From Default Rates to Default Matrices: a complete measurement of Brazilian banks' consumer credit delinquency** *Ricardo Schechtman*	Oct/2009

196 **The role of macroeconomic variables in sovereign risk** Oct/2009
Marco S. Matsumura and José Valentim Vicente

197 **Forecasting the Yield Curve for Brazil** Nov/2009
Daniel O. Cajueiro, Jose A. Divino and Benjamin M. Tabak

198 **Impacto dos *Swaps* Cambiais na Curva de Cupom Cambial: uma análise segundo a regressão de componentes principais** Nov/2009
Alessandra Pasqualina Viola, Margarida Sarmiento Gutierrez, Octávio Bessada Lion e Cláudio Henrique Barbedo

199 **Delegated Portfolio Management and Risk Taking Behavior** Dec/2009
José Luiz Barros Fernandes, Juan Ignacio Peña and Benjamin Miranda Tabak

200 **Evolution of Bank Efficiency in Brazil: A DEA Approach** Dec/2009
Roberta B. Staub, Geraldo Souza and Benjamin M. Tabak

201 **Efeitos da Globalização na Inflação Brasileira** Jan/2010
Rafael Santos e Márcia S. Leon

202 **Considerações sobre a Atuação do Banco Central na Crise de 2008** Mar/2010
Mário Mesquita e Mario Torós

203 **Hiato do Produto e PIB no Brasil: uma Análise de Dados em Tempo Real** Abr/2010
Rafael Tiecher Cusinato, André Minella e Sabino da Silva Pôrto Júnior

204 **Fiscal and monetary policy interaction: a simulation based analysis of a two-country New Keynesian DSGE model with heterogeneous households** Apr/2010
Marcos Valli and Fabia A. de Carvalho

205 **Model selection, estimation and forecasting in VAR models with short-run and long-run restrictions** Apr/2010
George Athanasopoulos, Osmani Teixeira de Carvalho Guillén, João Victor Issler and Farshid Vahid

206 **Fluctuation Dynamics in US interest rates and the role of monetary policy** Apr/2010
Daniel Oliveira Cajueiro and Benjamin M. Tabak

207 **Brazilian Strategy for Managing the Risk of Foreign Exchange Rate Exposure During a Crisis** Apr/2010
Antonio Francisco A. Silva Jr.

208 **Correlação de *default*: uma investigação empírica de créditos de varejo no Brasil** Maio/2010
Antonio Carlos Magalhães da Silva, Arnildo da Silva Correa, Jaqueline Terra Moura Marins e Myrian Beatriz Eiras das Neves

209 **Produção Industrial no Brasil: uma análise de dados em tempo real** Maio/2010
Rafael Tiecher Cusinato, André Minella e Sabino da Silva Pôrto Júnior

210 **Determinants of Bank Efficiency: the case of Brazil** May/2010
Patricia Tecles and Benjamin M. Tabak

211	**Pessimistic Foreign Investors and Turmoil in Emerging Markets: the case of Brazil in 2002** *Sandro C. Andrade and Emanuel Kohlscheen*	Aug/2010
212	**The Natural Rate of Unemployment in Brazil, Chile, Colombia and Venezuela: some results and challenges** *Tito Nícias Teixeira da Silva*	Sep/2010
213	**Estimation of Economic Capital Concerning Operational Risk in a Brazilian banking industry case** *Helder Ferreira de Mendonça, Délio José Cordeiro Galvão and Renato Falci Villela Loures*	Oct/2010
214	**Do Inflation-linked Bonds Contain Information about Future Inflation?** *José Valentim Machado Vicente and Osmani Teixeira de Carvalho Guillen*	Oct/2010
215	**The Effects of Loan Portfolio Concentration on Brazilian Banks' Return and Risk** *Benjamin M. Tabak, Dimas M. Fazio and Daniel O. Cajueiro*	Oct/2010
216	**Cyclical Effects of Bank Capital Buffers with Imperfect Credit Markets: international evidence** *A.R. Fonseca, F. González and L. Pereira da Silva*	Oct/2010
217	**Financial Stability and Monetary Policy – The case of Brazil** *Benjamin M. Tabak, Marcela T. Laiz and Daniel O. Cajueiro*	Oct/2010
218	**The Role of Interest Rates in the Brazilian Business Cycles** *Nelson F. Souza-Sobrinho*	Oct/2010
219	**The Brazilian Interbank Network Structure and Systemic Risk** *Edson Bastos e Santos and Rama Cont*	Oct/2010
220	**Eficiência Bancária e Inadimplência: testes de Causalidade** *Benjamin M. Tabak, Giovana L. Craveiro e Daniel O. Cajueiro*	Out/2010
221	**Financial Instability and Credit Constraint: evidence from the cost of bank financing** *Bruno S. Martins*	Nov/2010
222	**O Comportamento Cíclico do Capital dos Bancos Brasileiros** *R. A. Ferreira, A. C. Noronha, B. M. Tabak e D. O. Cajueiro*	Nov/2010
223	**Forecasting the Yield Curve with Linear Factor Models** *Marco Shinobu Matsumura, Ajax Reynaldo Bello Moreira and José Valentim Machado Vicente*	Nov/2010
224	**Emerging Floaters: pass-throughs and (some) new commodity currencies** *Emanuel Kohlscheen*	Nov/2010
225	**Expectativas Inflacionárias e Inflação Implícita no Mercado Brasileiro** *Flávio de Freitas Val, Claudio Henrique da Silveira Barbedo e Marcelo Verdini Maia*	Nov/2010
226	**A Macro Stress Test Model of Credit Risk for the Brazilian Banking Sector** *Francisco Vazquez, Benjamin M.Tabak and Marcos Souto*	Nov/2010

227	**Uma Nota sobre Erros de Previsão da Inflação de Curto Prazo** *Emanuel Kohlscheen*	Nov/2010
228	**Forecasting Brazilian Inflation Using a Large Data Set** *Francisco Marcos Rodrigues Figueiredo*	Dec/2010
229	**Financial Fragility in a General Equilibrium Model: the Brazilian case** *Benjamin M. Tabak, Daniel O. Cajueiro and Dimas M. Fazio*	Dec/2010
230	**Is Inflation Persistence Over?** *Fernando N. de Oliveira and Myrian Petrassi*	Dec/2010
231	**Capital Requirements and Business Cycles with Credit Market Imperfections** *P. R. Agénor, K. Alper and L. Pereira da Silva*	Jan/2011
232	**Modeling Default Probabilities: the case of Brazil** *Benjamin M. Tabak, Daniel O. Cajueiro and A. Luduvice*	Jan/2011
233	**Emerging Floaters: pass-throughs and (some) new commodity currencies** *Emanuel Kohlscheen*	Jan/2011