PRELIMINARY

LENGTHENING THE MATURITY OF BANK LOANS TO DEVELOPING COUNTRIES: THE OFFSETTING EFFECTS OF GOVERNMENT GUARANTEES AND CAPITAL REQUIREMENTS

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The massive build-up of short-term debt in emerging countries has been blamed by many as a key determinant of financial instability. Short-term loans provide banks with the option of adjusting lending decisions over time based on any new information released. A simple model is analyzed here to illustrate how the value of this option naturally rises when the volatility of project returns is high, as we would expect in an emerging market environment. If, on one hand, economists generally agree on the need to lengthen the maturity structure of capital flows to developing countries, on the other hand, though, exactly what incentives and policies could be set in place in order to achieve that goal remains largely an open question. Governments and multilaterals currently offer banks around the world a variety of incentives (including political risk insurance, guarantees from export credit agencies or multilateral institutions and in particular B-loans) with the purpose of attracting long-term finance to emerging economies especially for infrastructure projects. The main objective of the paper is to show both theoretically and empirically how these incentives to attract long-term bank finance to developing countries might largely be offset by the additional capital requirements required by Basle II on long-term loans. As a case study, VAR models are simulated using default data for the syndicated loan market. My findings suggest that the standard linear relationship between maturity and credit risk assumed by the Basle II framework might over-penalize in particular long-term project finance loans, as it neglects the significant risk mitigating effect of loan age on the term structure of cumulative default probabilities.

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1. Introduction

In many emerging economies, firms have very limited access to long-term finance either domestically or from abroad. A number of empirical studies (including Demirguc-Kunt and Maksimovic (1999) and Caprio and Demirguc-Kunt (1997)) have found that the lack of access to long-term finance may represent a major hurdle for economic growth.
Furthermore, recent research[1] has shown that economies with high levels of short-term debt (especially if denominated in foreign currency) are naturally more exposed to the possibility of sudden reversal of capital flows, which may lead to systemic crises as in the recent East Asian experience. In the words of Eichengreen and Hausman (1999), "the incompleteness of financial markets is at the root of financial fragility".
If, on one hand, economists generally agree on the need to lengthen the maturity structure of capital flows to developing countries, on the other hand, though, exactly what incentives and policies could be set in place in order to achieve that goal remains largely an open question.
Governments and multilaterals currently offer banks around the world a variety of incentives (including political risk insurance, guarantees from export credit agencies or multilateral institutions and in particular B-loans[2]) with the purpose of attracting long-term finance to emerging economies especially for infrastructure projects.
This paper analyzes these incentives from both a theoretical and empirical point of view. I construct a unique database of loans to Latin American firms in the 90's, and device a method to compare spread and maturity obtained by the same companies on B-loans (under the multilateral umbrella) with spread and maturity that would have been available to them if they had borrowed from syndicates of commercial banks at market terms (without the multilateral umbrella). This comparison allows me to implicitly extract the value of the "risk mitigation" provided by multilateral institutions in the case of B-loans[3]. To my knowledge, no such analysis exists so far either in the practitioners' or in the academic literature.
The main objective of the paper is to show both theoretically and empirically how these incentives to attract long-term bank finance to developing countries might largely be offset by the additional capital requirements required by Basle II on long-term loans. In other words, I argue that if, on one hand, G7 governments lament the volatility of short-term finance in emerging countries and appear to have policies in place to encourage banks to lengthen the maturity structure of their loans to LDCs, on the other hand, by agreeing to new

[1] Including for example Chang and Velasco (1999) and Rodrik and Velasco(1999).
[2] The World Bank (and in particular its private sector arm, the International Finance Corporation), the Inter-American Development Bank, the Asian Development Bank and other regional multilateral development banks offer long-term investors in developing countries an implicit form of political-risk insurance through the so-called B-loan program.
B-loans have been available since the 1960s channeling long-term bank loans to finance developmental projects in emerging countries. Under the typical A/B-loan structure, a multilateral development bank (MDB) is the lender of record to a borrowing company for the entire amount of a loan. The MDB keeps a portion of the asset (usually 25 to 40 percent) for its own account (the A-loan) and syndicates the remainder (B-loan) through separate participation agreements with commercial banks. The borrower's legal contract is solely with the MDB, which enjoys a de facto preferred creditor status in most countries. As a result, although participant private lenders bear, to the extent of their participations, the full credit risk associated with the project being financed, on the other hand they benefit from the preferred creditor's "umbrella" in the sense that other "political" risks (such as convertibility and transfer risk, sovereign rescheduling risk and moratorium risk) are effectively mitigated.
[3] a similar analysis could be extended to loan guarantees provided by export credit agencies or by political risk insurers.

capital regulation with significant capital relief for short-term debt across all classes of exposures, the net effect they produce on banks' incentives might actually be in favor of short-term lending as opposed to discouraging it.

In fact, while the Basel Committee expressly seeks feedback on this issue[4], recently proposed capital regulation provides for a linearly-increasing charge for longer-maturity lending computed exposure by exposure, applicable across all asset classes in the IRB advanced approach.

Based on default data for syndicated loans published by Altman and Suggit(2000), I analyze the risk profile of sample portfolios using major credit risk models currently available to commercial banks (in particular KMV, CreditRiskPlus[5]). My findings suggest that the standard linear relationship between maturity and credit risk assumed by the Basle II framework might over-penalize in particular long-term project finance loans, as it neglects the significant risk mitigating effect of loan age on the term structure of cumulative default probabilities.

The maturity dimension of credit risk in the banking book might not appear a primary concern in the developed world, where liquid markets for asset-backed securities as well as long term bonds offer unlimited possibilities for efficient A&L management to hedge risks arising from maturity mismatches.

This is not the case, however, for developing countries[6]. Many of them lack adequate infrastructures in the telecommunications, energy, water and transportation sectors. As this sort of investments generally takes longer to generate revenues, they typically require long-term financing. This higher demand for long-term capital however seldom finds adequate supply in poorly regulated and often highly illiquid debt markets. Where access to capital markets is very limited, bank-firm long-term relationships provide a vital source of financing.

Therefore, the implications for developing countries of implementing a new capital regulation increasing the cost for banks of lending long-term need not be underestimated. As will be shown in detail in this paper, the maturity adjustment proposed by Basel II naturally provides banks with stronger incentives to restructure their long-term loans into sequences of short-term commitments retaining the option to renew them or not at each period in time.

Along with making the supply of financing to developing countries inherently more unstable (sudden reversals of funds are easier in a short-term contract framework), the overall availability of capital especially to infrastructure projects in LDCs might ultimately be reduced.

The rest of this paper is organized as follows. Section 2 reviews existing theory and evidence on the negative implications of short-term debt for the financial stability and growth of emerging economies. Section 3 reviews selected contributions in the literature on optimal debt maturity choice. Section 4 lays out a stylized model to illustrate the impact of volatility of project returns and of default risk on banks' optimal debt maturity choice. Section 5 contains the key empirical analysis of the paper and section 6 concludes.

[4] "..there is some concern that inclusion of an explicit maturity dimension in the advanced approach could lead to unintended and unwarranted reductions in the availability of longer-term bank lending. The Committee specifically welcomes comment in this area…" (Basel Committee, *The New Basel Capital Accord*, p.52)

[5] KMV's Portfolio Manager™ is a mark-to-market credit risk model based on the option pricing valuation approach originally proposed by Merton (*Journal of Finance*, 1974), whereas CreditRisk+™ is a default-mode model which applies an actuarial science framework to the analysis of default risk.

[6] As shown in figure 1, for much of the past decade emerging economies have on average been characterized by a higher ratio of short-term to total debt owed to commercial banks than the industrialized world.

2. Short-term lending to Developing Countries: Implications for Financial Stability and Growth

The 1990s have seen a boom in short-term lending by international banks to developing countries. As shown in figure 1, for much of the past decade emerging economies have on average been characterized by a higher ratio of short-term to total debt owed to commercial banks than the industrialized world.

In the years preceding the sudden reversal of capital flows associated with the East Asian crisis in 1997-98, nearly 60 percent of all outstanding international bank claims on developing countries had a remaining maturity of less than 1 year.

Figure 2 shows the same data disaggregated by region: while short-term lending to East Asian countries has substantially decreased since the 1997 crisis, the share of short-term debt owed to commercial banks in Latin America remains still dangerously high around 50% on average.

Many economists have noted how a rapid shortening of maturities of international bank loans to developing countries has also been observed in the years leading to many of the financial crises of the past couple of decades (see figure 3).

Brazil, Korea, Mexico, Russia and Thailand were among the top ten recipients of short-term loans during 1990-96. All of them have recently been hit by severe financial crises. As shown in figure 4, in each of these countries short-term debt exceeded international reserves available at the time immediately prior to the crisis (ratios were generally higher than 1, and close to 2 in the case of Russia). The magnitude of the reversal of capital flows during the crises is depicted in figure 5.

Rodrik and Velasco (1999) run probit regressions for 32 emerging economies over the period 1988-1998 and find that the share of short-term debt and in particular its ratio over reserves represent significant determinants of the probability of a sudden reversal of capital flows. In particular, countries with short-term liabilities to foreign banks that exceed reserves are found to be three times more prone to financial crises.

Similarly, in their analysis of the East Asian crisis Furman and Stiglitz (1998) write: "The ability of this variable, by itself, to predict the crises of 1997, is remarkable".

The theory underlying this empirical result has been outlined in a number of papers including among others McKinnon and Pill (1998) and Chang and Velasco (1999).

One of the central conclusions is that, when a developing country – with limited access to world capital markets - accumulates short-term external-debt exceeding the level of its foreign exchange reserves, a fundamental illiquidity problem arises that can be sufficient in itself to trigger a self-fulfilling crisis.

In fact, the maturity mismatch between long-term (local-currency) assets backing short-term (foreign-currency) obligations is such that, in case foreign investors fail to roll over their loans due to a confidence crisis, assets will have to be liquidated at a discount and the country might not be able to service its debt obligations. The higher a country's short-term exposure relative to its reserves, the higher the probability of a run.

While economists generally agree that excessive short-term indebtedness might lead to financial fragility, there is also some evidence that the scarce supply of long-term finance in developing countries can represent a major hurdle for economic growth.

Analyzing firm-level data for thirty countries, Demirguc-Kunt and Maksimovic (1999) find that a better access to long-term finance (and long-term contracting in general) is associated with a higher proportion of firms growing at a faster rate than they could attain by relying on their internal sources and short-term credit alone[7].

In particular, the availability of long-term funds is critical for financing infrastructure projects. In fact, they are typically characterized by up-front investments whose costs may take 10 to 30 years to recoup and risky revenue streams stretching far out into the future.

In recent years, over 42 percent of short-term syndicated loans to emerging markets has gone to financial institutions whereas the share contracted by oil and gas enterprises has decreased substantially. Infrastructure investment has attracted only 12% of total external gross flows in 1996.

"Almost without exception, project appraisal reports take the position that in developing countries there is an inadequate supply of long-term (and foreign exchange) financing .." (Long, 1983)

Estimates of developing countries' infrastructure needs are huge, although difficult to quantify. Average annual infrastructure investment requirements for East Asia and Latin America between 1995 and 2005 are estimated around \$150 billion and \$70 billion, respectively, of which 25 to 40% is expected to come from foreign sources.

The existence of large unmet infrastructure financing needs in developing countries have led governments to intervene with an array of mechanisms to attract long-term finance. As shown by the examples in table 1, they include bilateral or multilateral guarantees, grants, equity or subordinated debt contributions, preferential tax treatment, etc..

If excessive short-term debt is associated with greater financial fragility and may represent a hurdle for economic development, why have developing countries accumulated so much short-term debt in the last decade ? Why don't they attract instead more long-term loans to finance their huge infrastructure needs ? As we will see in the following section, a more relevant question is probably: why do international lenders predominantly invest in LDCs only at short maturities ?

The debate among economists over the causes for the surge in short-term lending to developing countries in the 1990s has produced no single answer to these questions. Rather, a number of structural, cyclical and policy factors have been identified operating both inside ("pull factors") and outside ("push factors") the developing world (see table 2 for a brief synopsis). The following section will discuss selected contributions in the literature that have dealt with the choice of long-term vs. short-term debt. It will also help us define the scope for the analysis carried out in the rest of paper.

3. Bank Capital Regulation and Optimal Debt Maturity Choice: Some references in the literature.

There is a vast literature in corporate finance on optimal debt maturity choice. We refer the reader to Ravid (1996) for a comprehensive survey. Here we will simply mention that, since Stiglitz(1974) extended Modigliani and Miller's (1958) contribution to formally establish debt maturity irrelevance in perfect markets, the literature has identified a variety of imperfections in capital markets that can explain why the choice of maturity in fact matters.

[7] The two proxies they use to characterize better access to long term finance are the ICRG law and order index (which they find in a separate study to be a good predictor of the use of long-term debt) and the mean ratio of long-term debt to total assets actually appearing on the balance sheets of firms in each country.

To name only a few examples: Barnea, Haugen and Senbet(1980) show that short-term debt can resolve debt-related agency problems; Stiglitz and Rey(1993) have further demonstrated the disciplinary role of short-term lending; Flannery(1986) lays out a signaling model in which good firms may distinguish themselves by issuing short-term debt, provided there are issuing costs.

More recently, Dewatripont and Maskin(1995) and Chang and Velasco(1999) have offered interesting explanations of why banks might prefer short-term lending even if that is not optimal from a social perspective.

Dewatripont and Maskin(1995) explain the shortage of long-term finance in terms of a coordination failure among decentralized banks. In their model, long-term projects involve large sunk costs requiring co-financing by several banks. The profitability of the investment depends crucially on the amount of monitoring provided jointly by the co-financing banks. This generates a free-rider problem, as each bank will only offer a limited monitoring effort knowing that part of the marginal return from this effort will accrue to the other banks in the co-financing pool. Insufficient monitoring jeopardizes project profitability and discourages banks from long-term lending.

The preference for short-term debt is analyzed by Chang and Velasco (1999) in a simple model of the joint determination of debt maturity and the term structure of interest rates. They assume that, in case of a liquidity crisis, the first creditor who withdraws her funds will be paid in full and remaining debt obligations will be serviced sequentially until available funds are exhausted. This apparently makes short-term lending an attractive option. In reality, though, the increase in short-term debt exposure exacerbates illiquidity problems, as repayment of short-term obligations might require costly liquidation of assets in case of a run. On a risk-adjusted basis, therefore, short-term debt need not be desirable. Moreover, short-term borrowers inflict a negative externality on long-term borrowers by reducing the probability that long-term debt will be serviced in case of a run. This will be reflected in the endogenous term structure of interest rates.

In sum, Chang and Velasco (1999)'s model predicts that an even mildly risk-averse borrower in developing countries, who internalizes the social costs of short-term debt exposure, would strictly prefer long-term obligations.

By focusing on the undistorted optimal choice of maturity from the borrower's perspective, their model does not explain the actual bias towards short-term borrowing observed in developing countries. On the other hand, they recognize that many distortions could lead local borrowers to prefer short-term loans beyond the level that is socially desirable, including biases in the local tax and regulatory structure and the moral hazard induced by the expectations of government bailouts.

In general, most of the corporate finance literature models the issue of optimal debt maturity choice from the perspective of the borrower, having to choose the right mix of financing based on macro-economic, institutional as well as firm-specific constraints.

This paper attempts to provide a simple theoretical framework to model optimal debt maturity choice from the perspectives of the incentives facing the lender as opposed to focusing on the borrower. This is based on the belief that the binding constraint in cross-border capital markets in developing countries is more likely to reside on the supply side.

The empirical literature has brought a number of elements to bear in the choice of maturity, such as firm size, leverage ratios, tax codes, debt seniority, bankruptcy costs, etc..

This paper focuses on one element that has been largely neglected by the theoretical as well as the empirical literature, i.e. the impact of bank capital regulation on banks' incentives for optimal maturity choice.

The recent discussion on the reform of the Basle Capital Adequacy framework has fueled a rich production in the banking literature focusing, on one hand, on the market imperfections justifying banking regulation and, on the other hand, on various possible alternatives for regulators of setting capital standards or pricing deposit insurance in order to restore the social optimum. See Santos(2000) for a recent survey of the literature on bank capital regulation.

However there is a visible vacuum in the literature as to the link between bank capital regulation and debt maturity choice. Recent studies by Gordy(2003) and Kalkbrener, M. and L. Overbeck (2002) have relied on VAR credit risk models to empirically analyze the relationship between regulatory capital requirements and maturity. Their focus is on calibrating capital requirements that correspond to the risk profile implied by portfolios of given maturities. Conversely, this paper will show how the choice of optimal portfolio maturity can itself be affected by the incentives generated by alternative calibrations of capital requirements.

The following section will develop the basic theoretical intuition that will serve as the basis for the empirical analysis of section 5.

4. Long-Term vs. Short-Term Lending: A Stylized Model.

Assume a 2-period competitive setting[8] populated by a large number of banks whose initial total endowment is \$1. They face the choice of lending to either one of 2 types of firms (that we will denote for simplicity type A or type B as described below) [9]. Alternatively, banks could simply buy T-bills yielding a per-period interest rate equal to r_{min}.

Type A firms invest in a long-term project[10] that lasts for 2 periods. At the beginning of period 1, it is common knowledge that the long-term project requires 1\$ bank finance and yields a return of $(1 + R)^2$ only at the end of the second period.

Banks also know that if they decide to fund the long-term project, they will have no possibility of renegotiating the terms of the loan at a later date. We will assume for simplicity that, if banks choose to lend long-term, they will not be able to cash out either principal or interest before the end of the 2nd period.

Assume that the interest rate prevailing in the long-term market at the beginning of period 1 is equal to R. That will extract the full revenue that is expected to accrue from the project at the end of the second period, i.e. $(1+R)^2$. In other words, competition among Type A firms will drive their expected profits to zero.[11]

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8 For an analysis of how imperfect competition affects banks' optimal maturity choice, see Granero(1997).

9 For the purpose of contrasting the two options of lending long-term vs. short-term, we will simply assume in this stylized model that banks cannot mix short-term and long-term loans in their portfolio. For a more detailed model explaining optimal combinations of short-term and long-term lending see Stiglitz and Rey(1993).

10 Alternatively, we can think of a large number of identical projects that need a total start-up investment of \$1. Given our focus here on the comparison between investing in long-term vs. short-term projects, we only need heterogeneity between and not within the two types of projects.

11 We could alternatively assume that firms are left with a positive reservation utility, but that should not affect our results.

Assume now that at the end of the first period, after the contract has been signed, the news is released that the long-term project will actually yield a return[12] of $(1+R+\varepsilon)^2$, where ε is a random number drawn from a normal distribution with zero mean and variance σ.
This means that the project performance will be higher (if $\varepsilon>0$) or lower (if $\varepsilon<0$) than expected. However, given that the lending charges are set in a long-term contract and cannot be renegotiated, banks will not be able to re-optimize their lending strategy.
In case the project turns out to yield a higher return than expected ($\varepsilon>0$), borrowing firms will be left with a positive profit. Conversely, if $\varepsilon<0$ then the loan will go into default[13] and banks will only be able to collect at the end of period 2: $(1 + R + \varepsilon)^2 < (1 + R)^2$.
Summarizing, the total pay-off to banks at the end of period 2 from the long-term option can be written as follows:

$$\pi^{LT} = \min \{ (1+R)^2 ,\ (1+R+\varepsilon)^2 \} \qquad (1)$$

with $\varepsilon \sim N(0,\sigma)$.

TIMELINE OF LONG-TERM PROJECT – TYPE A FIRMS

Period 1		Period 2
Banks lend \$1 at interest rate R Type A firms invest \$1 in long-term project	ε is known but no renegotiation is allowed	Type A firms obtain returns from project equal to: $(1+R+\varepsilon)^2$ and pay back to Banks: $\min\{(1+R+\varepsilon)^2, (1+R)^2\}$

[12] To make things more realistic, throughout this section we should write more precisely $\max\{0, (1+R+\varepsilon)\}$ as opposed to only $(1+R+\varepsilon)$. In other words, we need to ensure the non-negativity of returns since the worst that could happen to a limited-liability bank/firm is to lose the investment in full and obtain \$ 0 from the project.
By defining ε as normally distributed, we are allowing it to vary over the whole spectrum of real numbers. However, ε is centered around 0 and if we restrict ourselves to reasonable values of σ (as we do for example in our numerical example), it will almost always be the case that $\varepsilon > -(1+R)$, which makes $\max\{0,(1+R+\varepsilon)\}=(1+R+\varepsilon)$. Similarly, to be precise we should fix an upper bound on ε as no investment can realistically give infinite returns. An alternative could be to assume for ε a uniform distribution with finite boundaries.

[13] We could alternatively assume that firms have extra capital reserves $x>0$ that can be used to service the debt in case project revenues fall below expectations. That would not change the key results we are presenting here.

Type B firms, instead, invest in a sequence of 2 short-term projects[10] each one lasting for 1 period only. At the beginning of period 1, it is common knowledge that short-term projects require 1$ bank finance to get started and yield a per-period return of (1+r) with r < R.

Banks also know that, if they choose to lend short-term, they will commit only for 1 period. At the end of the first period, they will be able to decide whether to roll over the loan for another period or not. In case they decide to do so, banks will also have the chance to re-contract the interest rate at that time.

The interest rate prevailing in the short-term market at the beginning of period 1, is equal to r. That will extract the full revenue that is expected to be generated by the project. In other words, similarly as in the previous case, competition among type B firms will drive their expected profits to zero[14].

Assume now like before that at the end of the first period, the news is released that the short-term project will actually yield a return of (1+r+ε), where ε is a random number drawn from a normal distribution with zero mean and variance σ. This means that the project performance will be higher (if ε>0) or lower (if ε<0) than expected.

In this case, banks will be able to re-optimize their lending decisions based on the new information acquired about project returns. For very bad states of nature where $r+\varepsilon \leq r_{min}$, i.e. when project returns fall below the safe outside option of investing in Treasury bills, then banks will decide not to roll over the loan for the 2nd period. They will liquidate the 1st period investment cashing out (1+r+ε), and then they will simply invest in T-bills for the 2nd period.

In case instead $r+\varepsilon > r_{min}$, banks will continue to lend to Type B firms for the second period, but will revise their lending charges. In fact, as the market reacts to the news released about project returns, the interest rate for the 2nd period will adjust to[14]:

$$\left(r + 2\varepsilon + \frac{\varepsilon^2}{1+r}\right).$$

Therefore, banks' total payoff at the end of period 2 will be:

$$(1+r)\left(1 + r + 2\varepsilon + \frac{\varepsilon^2}{1+r}\right) = 1 + 2r + 2\varepsilon + r^2 + 2\varepsilon r + \varepsilon^2 = (1 + r + \varepsilon)^2$$

This assumes that $r+\varepsilon > r_{min}$ and that therefore banks lend both principal and interest to Type B firms again for the second period.

In other words, by adjusting their lending charges at the new rate prevailing in the market after ε is known, banks will be able to never leave any positive profits to the firm. We

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[14] The requirement that the second period interest rate be non-negative translates into the following restriction on r_{min}: $r_{min} \geq r + \left[(1+r)\left(\sqrt{\frac{1}{1+r}} - 1\right)\right]$

assume however that renegotiating the lending contract carries a fixed transaction cost equal to c. In conclusion, banks' total payoff at the end of period 2 can be written as:

$$\pi^{ST} = \begin{cases} \left[(1+r+\varepsilon)^2 - c\right] & \text{if } r+\varepsilon > r_{min} \\ \left[(1+r+\varepsilon)(1+r_{min}) - c\right] & \text{if } r+\varepsilon \leq r_{min} \end{cases} \qquad (2)$$

TIMELINE OF SHORT-TERM PROJECTS – TYPE B FIRMS

Period 1		Period 2
Banks lends \$1 at interest rate r Type B firms invest \$1 in short-term project	ε is known If $r+\varepsilon > r_{min}$, Banks will roll over the loan for 2nd period at interest rate equal to: $\left(r + 2\varepsilon + \frac{\varepsilon^2}{1+r}\right)$. Otherwise, Banks will cash out $(1+r+\varepsilon)$ and invest in T-bills for 2nd period.	In case $r+\varepsilon > r_{min}$, Firms pay back $(1 + r+\varepsilon)^2$ to the Banks.

A simple numerical example will help compare advantages and disadvantages for banks of financing Type A firms or Type B firms, i.e. of lending long-term vs. short-term[15].

Figure 6a and 6b plot the total payoffs to banks from investing long-term vs. investing short-term (equations (1) and (2) above) as a function of ε, based on the following simple parameter assumptions:

$R = 8\%$
$r = 5\%$
$c = 1\%$
$r_{min} = 2.5\%$ [16]

[15] The comparison is not between the single period returns to the bank of a short-term vs. a long-term investment but rather between the total pay-off obtained in either case at the end of 2 periods.

Figure 6a - Total payoff to the banks from lending short-term vs. long-term (small range of ε)

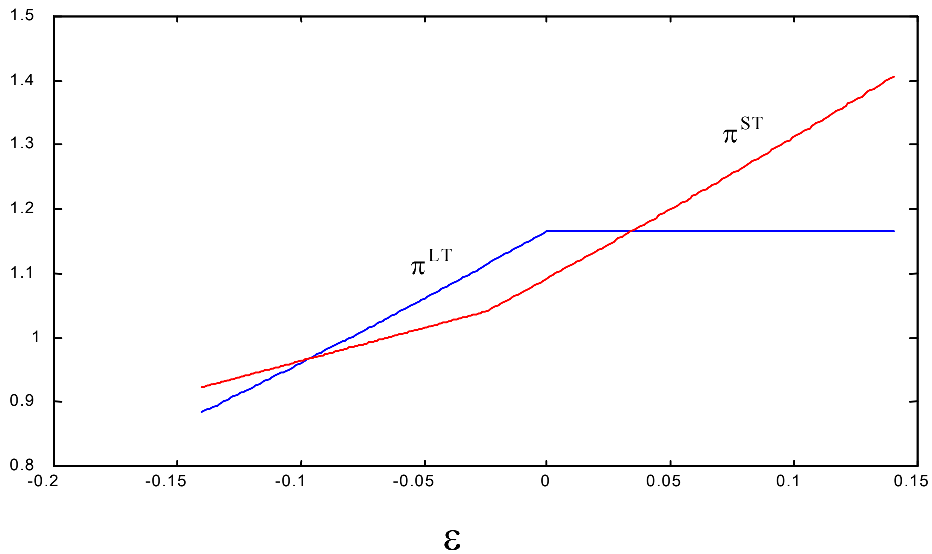
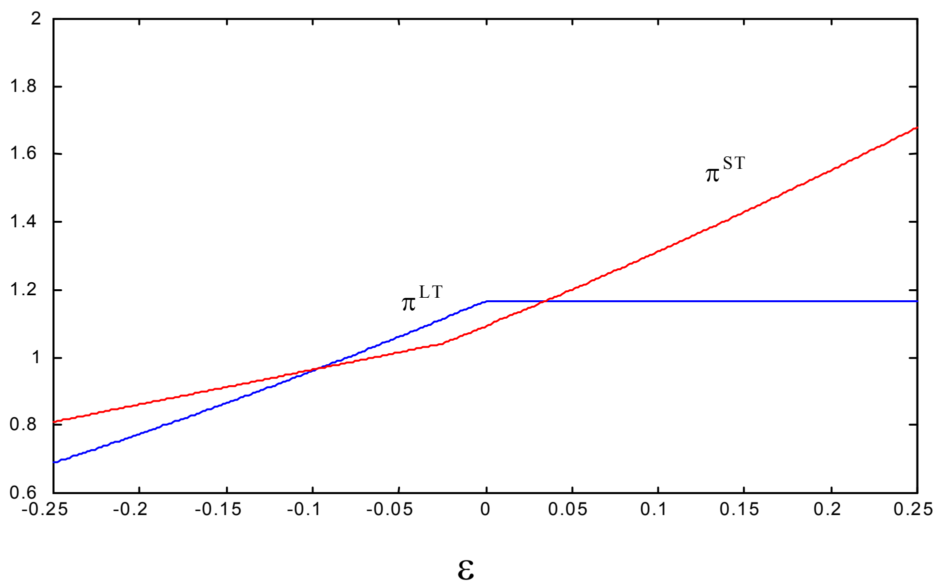


Figure 6b - Total payoff to the banks from lending short-term vs. long-term (large range of ε)



What appears clear from the graphs is that as long as ε remains close to its expected value 0, then long-term lending will provide banks with a higher return and save in transaction costs. In this case, comparing (1) and (2) we have:

[16] This is the lowest value that satisfies the restriction in footnote 15, given our choice of r.

For $\varepsilon \cong 0$, $\pi^{ST} = (1+r)^2 - c < (1+R)^2 = \pi^{LT}$ (2')

On the other hand, though, for very high values of ε, i.e. in case project revenues are unexpectedly high, banks would be better off having retained the option of renegotiating lending charges for the second period as opposed to having locked in the interest rate in a long-term contract. In this case in fact profits from short-term lending $(1+r+\varepsilon)^2$ will increase more than linearly with ε as opposed to profits from long-term investments remaining fixed at $(1+R)^2$.
Similarly, for very low values of ε, i.e. in case of unexpectedly low revenues from the projects, short-term loans appear preferable as they allow banks to exit the investment early thus limiting the losses.
It becomes clear therefore that a conclusion about the relative advantages or disadvantages (from the perspective of the lenders) of long-term vs. short-term loans crucially depends on the extent of volatility in project returns (σ).
A quick comparison of figure 6a with figure 6b suggests that as the volatility of ε increases, i.e. as the probability that ε takes values far from the mean increases, then the relative advantages to banks of short-term lending are magnified.

Figure 7a - Preference for Long-Term vs. Short-Term Lending as a function of the volatility of project returns.

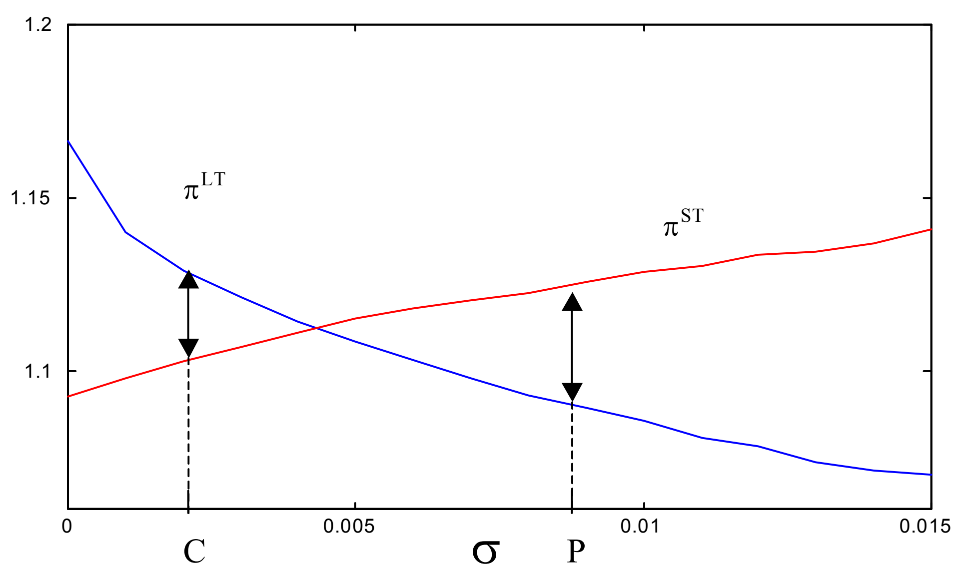


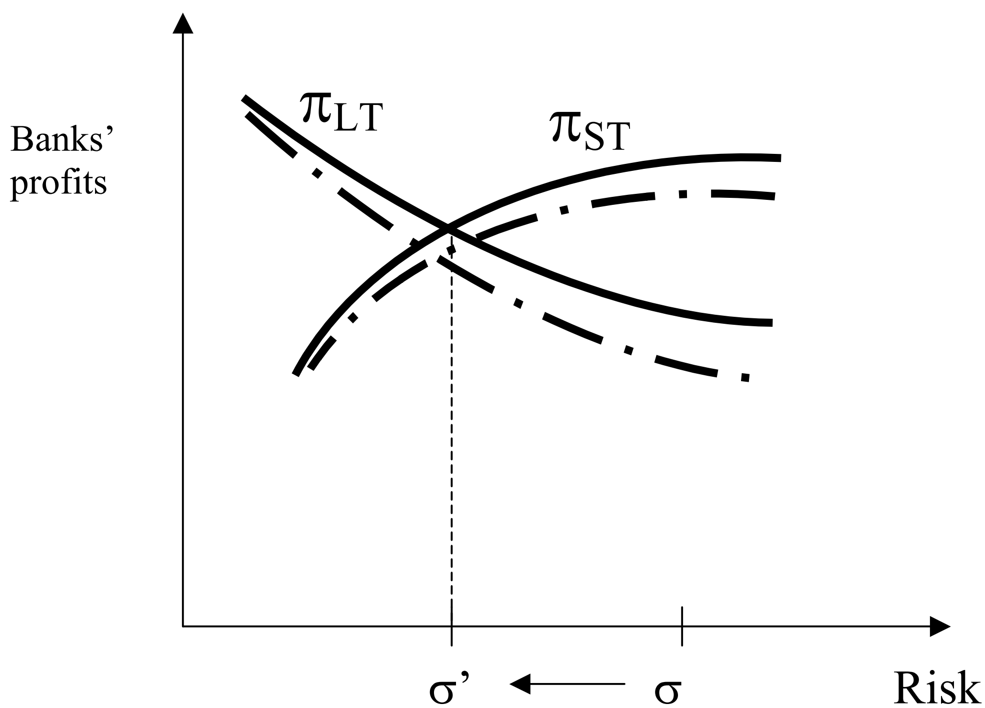
Figure 7a plots the same payoff schedules as in figures 6a and 6b (i.e. equations (1) and (2) above) only this time as a function of σ. Each point on the curves is an average based on 50,000 independent drawings for ε from a normal distribution[17] with mean zero and variance σ. When the volatility of project returns is relatively small, i.e. when ε remains almost always close to zero, then as we have seen in (2') long-term lending is preferable to banks. As σ increases, instead, there is a higher probability of either very good or very bad states of

[17] In order to maintain finite boundaries and to satisfy non-negativity constraints as discussed in footnote 13, any outliers exceeding (1+R) in absolute value are replaced with the mean of the distribution, i.e. 0.

nature[18]. In both cases, short-term lending becomes the superior choice as it allows banks to either revise the lending charges upward in order to extract any unexpected extra-revenues accruing from the project or exit the investment early in case it proves less profitable than the outside option of T-bills. With long-term lending, instead, banks could find themselves committed to lending at a sub-optimally cheap rate in very good states of nature or forced to continue lending to an unprofitable project with a high likelihood of default in very bad states of nature.

The stylized model presented above can provide us with useful insights to understand the observed predominance of short-term lending in developing countries (as discussed in section 2 and shown in fig.1). Take 2 points along the scale of σ in fig. 7a, for example points C and P. Developing countries are characterized by a higher level of volatility and default risk as in point P. Under such circumstances, figure 7a tells us that short-term lending is the most viable option for banks. Developed countries can instead be associated with relatively lower levels of risk (as in point C for example) and are in fact characterized by more liquid long-term debt markets[19].

Figure 7b - The offsetting effects of government guarantees and capital requirements.



[18] In other words, a higher probability mass gets shifted to the tails of the distribution of ε.

[19] There are of course many other reasons, as illustrated in table 3 at the end, for the shorter maturity structure of bank loans to developing countries vs. developed countries. We think however that the basic intuition laid out in this model is key to understand the offsetting effects on banks' incentives of government guarantees and capital requirements. This will be the main goal of the analysis in the rest of the paper.

Figure 7b generalizes the intuition in figures 7a and will be useful to introduce the empirical analysis conducted in the following section.

The predominance of short-term debt in developing countries has been identified by the literature as a major threat for their financial stability and growth. Governments and multilateral agencies have launched a variety of incentive schemes (including political risk insurance, guarantees, B-loans, etc..)[20] in order to attract long-term finance to developing countries. As the analysis of the following section will show, bilateral and multilateral guarantees for long-term lending (including B-loans) can be thought of mitigating the risk of the bank, say from σ to σ' as illustrated in figure 7b[21].

As the risk level borne by the bank decreases, the added value of lending short-term diminishes. When it reaches σ', the risk mitigation is such that the bank is indifferent between lending short-term and long-term.

Quantifying the distance between σ and σ' will be a major goal of the empirical analysis in section 5.

The following step in our analysis will be to evaluate the offsetting impact on banks' incentives of Basel II capital requirements.

The dotted lines in figure 7b represent the new profit schedules that would prevail after the introduction of risk-sensitive maturity-adjusted capital requirements, such as those proposed by Basle II.

In general, holding capital is costly to the bank and therefore reduces its profits. Basle II capital requirements are risk-sensitive in the sense that a higher level of capital is required to hedge against higher risk. Accordingly, the distance between the dotted lines and the relevant original profit curves increases for higher values of σ. Moreover, at each level of σ Basle II capital requirements are maturity-adjusted, in the sense that banks will ceteris paribus be required to hold more capital to hedge against the risk of longer maturity loans as opposed to short-term exposures. This is reflected in the graph by a higher vertical distance at each level of σ between dotted and bold line for the π^{LT} schedule compared to the π^{ST} schedule.

It is to verify in figure 7b that the new indifference point, where the dotted schedules intersect, lies to the left of σ'. In other words, what the analysis in the following section will attempt to show is that the introduction of maturity-adjusted capital requirements might penalize incentives for long-term lending to the point that risk mitigation schemes offered by governments and multilateral agencies may result increasingly inadequate to reverse the bias towards short-term lending in developing countries.

[20] See table 2 for more details.

[21] Incidentally, one of the stated objectives of the B-loan program is to help bring firms in the periphery closer to the center of capital markets.

5. Empirical Analysis

For the purposes of the analysis in this section, it will be useful to assume a slightly more general setup. Let us indicate the expected profits of a bank subject to capital requirements and facing the choice of either lending long-term (1 loan lasting T periods) or rolling T times a 1 period short-term loan as follows:

$$\pi^B = E_0^Q \left\{ \sum_{t=1}^{T} [\, p_t \, \Gamma_t - d_t \, \rho \, K_t \,] \right\} \qquad (3)$$

where:

- E_0^Q denotes the risk-neutral expectation at time 0;
- p_t is the interest and principal payment at time t;
- d_t is a risk-free discount factor equal to e^{-rt} where r is the per-period T-bill rate;
- $\Gamma_t \equiv [\, (1\text{-LGD})\, d_t + \text{LGD}\, \delta_t \,]$ is a weighted average between the risk-free (d_t) and the risky discount factors ($\delta_t = e^{-(r+q)\,t}$) where q denotes the risk-neutral probability of default and LGD stands for "Loss Given Default", i.e. the fraction of the value of the loan that will not be recovered in case of default;
- K_t represents the regulatory capital required at time t;
- ρ represents an estimate of the per-period opportunity cost of holding capital.

In this framework, the introduction of capital requirements, that are both risk-sensitive and maturity-adjusted, can be simply formalized as follows:

$$K^{q}_{LT,ST} > K^{q'}_{LT,ST} \qquad \text{for any } q > q'$$
$$K^{q}_{LT} > K^{q}_{ST} \qquad \text{for any } q \qquad (4)$$

As we will see in more detail in section 5.1, both assumptions lie at the core of the new capital adequacy regulation proposed by the Basel Committee on Banking Supervision.
The impact of assumption (4) on the bank's profits has already been shown graphically by the dotted lines in figure 7b. On the next page, figure 8a emphasizes in particular the additional cost imposed on long-term lending by the maturity adjustment.
Consider the Basel II regulatory capital requirement that a bank would face when lending to a given counterparty over a given horizon of say T years. If the bank decides to lend only for 1-year maturities, retaining the option at each point in time until time T whether to roll over the short-term loan or not, then ceteris paribus it will face a relatively low constant capital requirement K_{ST}, since in any moment in time the bank's exposure will have a remaining maturity not exceeding 1 year. On the other hand, the bank will face significantly higher capital requirements K^{LT}, if it decides instead to commit to a long-term T-year loan. Ceteris paribus, the capital required will however decrease linearly over time as the remaining maturity decreases.
As an attempt to quantify the area of the triangle depicted in figure 8a, section 5.1 will illustrate the nature of the maturity adjustment to capital requirements currently proposed by the Basel Committee for corporate exposures and will discuss in particular its limited

applicability to project finance loans where significant aging effects appear to justify the adoption of a non-linear maturity adjustment.

Figure 8a - The additional Cost for LT lending implied by the Basel II Maturity Adjustment

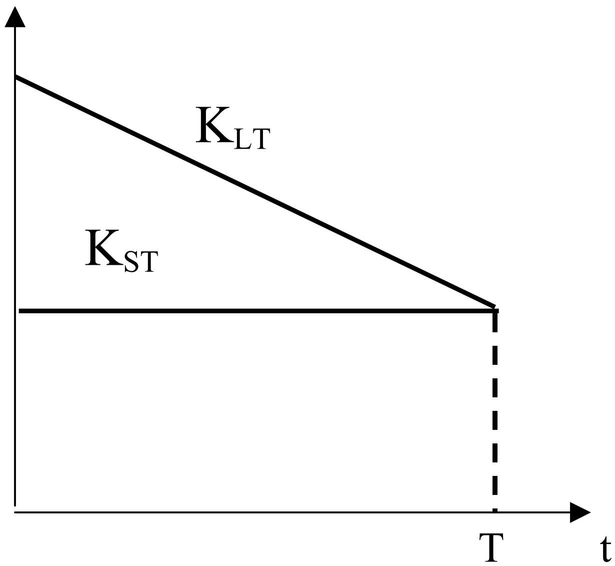
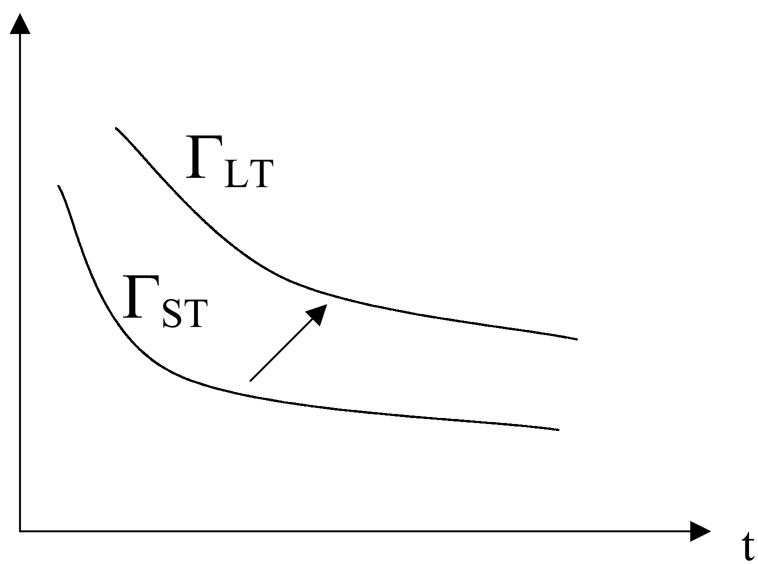


Figure 8b - The Risk-Mitigation Effect of Long-Term Credit Guarantees.



On the other hand, we are fully aware that it might not be appropriate to look at the calibration of the maturity adjustment in isolation. Section 5.2 attempts to analyze the joint impact of a broader set of incentives. In fact, if, on one hand, long term lending might be penalized by the new Basel maturity-adjusted capital requirements, on the other hand, a number of alternative incentive schemes exist around the world (including political risk insurance, guarantees from export credit agencies or multilateral institutions and in particular B-loans) with the purpose of facilitating long-term lending to emerging economies especially for infrastructure projects.

Based on a database of syndicated bank loans to Latin American companies[22], section 5.2 will attempt to extract the value of the risk-mitigation provided by the A/B Loan Structure first launched by the International Finance Corporation (or IFC, the private arm of the World Bank) and now widely used by all multilateral development banks[23].

In general, all the insurance/risk mitigation schemes mentioned above can be easily interpreted within the framework of equation (3). So far, we have assumed that the per-period discount factor for the bank be independent of maturity, i.e. :

$$\Gamma_{LT}^{q} = \Gamma_{ST}^{q} \equiv \left[(1 - \mathrm{LGD})\ e^{-r_t} + \ \mathrm{LGD}\ e^{-(r_t + q)} \ \right] \qquad (5)$$

As they are extended under the umbrella of multilateral organizations and usually directed to finance long-term developmental projects, B-loans are effectively regarded by most borrowers as preferred creditor debt, i.e. they have high seniority and are exempted from debt-rescheduling. A simple way to incorporate this in the model could be to assume that they have a lower LGD.

Alternatively[24], long-term loans benefiting from implicit or explicit guarantees from bilateral or multilateral governmental agencies could in general be modeled by simply replacing q in (5) with q' given by :

$$q' = \alpha\, q \qquad \text{with } \alpha \in (0,1) \qquad (6)$$

where α accounts for the fact that, in force of the guarantee, the bank is partially insured and will only be left with a fraction of the original risk posed by a given borrower.

It is easy to see that modeling long-term loans with either a lower LGD or a lower q will drive a wedge in the bank's per-period discount factor appearing in equation (3) when lending at different maturities:

$$\Gamma_{LT}^{q} > \Gamma_{ST}^{q} \qquad (7)$$

Inequality (7) translates into an outward shift in the bank's discount curve (see figure 8b), as the risk attached to cash flows accruing to the bank at each point in time is reduced by the guarantee.

[22] Data sources include: Loanware database (Capital Data Ltd.) and Bloomberg.

[23] To my knowledge, no previous attempt exists in the literature to conduct a similar exercise on a systematic basis.

[24] We will pursue this alternative approach empirically in section 4.2.

Summarizing, inequalities (7) and (4) will produce incentives for and against long-term lending, respectively. Both of them can be interpreted in the general framework of figure 7b. Long-term credit guarantees as in (7) attempt to mitigate the risk level from σ to σ' in order to make banks at least indifferent between the short-term and the long-term lending options. On the other hand, the introduction of maturity-adjusted capital requirements as in (4) produces asymmetric downward shifts in the profit curves, as seen in figure 7b, moving the indifference point out of reach further to the left.
The model laid out in this section provides a unified framework to analyze both inequalities (7) and (4) separately as well as to evaluate their joint impact on banks' debt maturity choices. Section 5.3 will pull both elements of the analysis together and simulate numerically equation (3) to visualize how different levels of risk mitigation, cost of capital and capital requirements might affect banks' optimal maturity choice. As we will see, paraphrasing the title of a recent article by Paul H. Kupiec[25], "the devil is in the calibration details".

5.1 The latest calibration of the maturity adjustment to capital requirements proposed by the Basel Committee and its applicability to project finance loans.

The Basel Accord on Capital Adequacy requires banks to maintain at all times sufficient capital[26] as a cushion against the risks they face. In particular, the latest calibration proposed in October 2002 [27] defines the minimum regulatory capital required on exposure i as follows:

$$K_i = LGD_i \; N\left((1-R)^{-0.5} N^{-1}(PD_i) + \left(\frac{R}{1-R}\right)^{0.5} N^{-1}(0.999) \right) (1-1.5b_i)^{-1} \left(1+(M_i-2.5)b_i\right) \quad (8)$$

where:

- M_i measures the "effective maturity" of the i-th exposure capped at 5yrs;
- LGD_i is the Loss Given Default, i.e. the fraction of the value of the loan that is lost in case of default;
- N (.) is the cumulative distribution function of a standard normal and N^{-1} its inverse;
- PD_i is an estimate of the actual 1-year probability of default[28] of the i-th obligor;
- R is a measure of asset correlation defined as follows:

[25] To paraphrase the title of the recent article by Paul H. Kupiec, "The New Basle Capital Accord: The Devil is in the (calibration) details", International Monetary Fund, April 2001
[26] According to the Basle Accord, two categories of "capital" are eligible as a cover for credit risk: tier 1 capital, consisting of equity and disclosed reserves and tier 2 capital, including undisclosed reserves, general provisions and hybrid debt-capital instruments. At least 50% of the capital requirement must be met with tier 1 capital.
[27] What follows is based on the latest revised formulae released by the Basel Committee in October 2002 with the results of the Quantitative Impact Survey n.3.
[28] PD is the actual 1-yr probability of default as opposed to q that denotes in our framework the instantaneous risk-neutral default probability. See Crouhy, M., D. Galai, and R. Mark (2000) for a simple explanation of how to derive actual 1-year default probabilities (PD) from instantaneous risk-neutral default probabilities (q).

$$R = 0.12\frac{1-e^{-50PD}}{1-e^{-50}} + 0.24\left(1-\frac{1-e^{-50PD}}{1-e^{-50}}\right) \quad (9)$$

- Finally, b is the parameter that determines the slope of the maturity adjustment, and is calibrated as:

$$b = \left(0.08451 - 0.05898\log(PD)\right)^2 \quad (10)$$

A comprehensive explanation of the analysis underlying the above calibration of capital requirements appearing in the latest Basel proposal is beyond the scope of this paper[29].

For our purposes it is important to note that, based on (8), risk weights for long-term exposures will be adjusted upward in a linear fashion, i.e. they will be increased by a fixed coefficient b for each year of effective maturity exceeding the benchmark 2.5 years. (10) defines the b coefficient as an inverse function of PD, meaning that the magnitude of the adjustment will be higher, the lower the risk of default.

The rationale for this can be best understood by conceptually decomposing the total risk facing the bank on a given exposure into 2 parts: first the probability that the obligor defaults, second the risk that the latter probability might increase over time (credit quality migration). The first component is incorporated in the PD estimate. The second component, instead, is what the maturity adjustment is supposed to cover for. Now, clearly, credits that are already rated very low (=very high PD) have little room to be further downgraded short of default (little room for PD to increase and asset value to decrease). For low-risk assets, instead, most of the risk is made up by the second component since their PDs are very close to 0. This is taken as the rationale for requiring a higher maturity adjustment (higher b) for lower-risk exposures.

Figure 9 shows the linear increase in capital requirements with maturity applying the IRB Basel calibration in (8), (9) and (10). The top line represents the capital requirement for a unit exposure to an obligor with PD=1.37 % [30] and LGD of 50% at different maturities. I compare this scenario with the capital charge that would be required on the same exposure if the bank had partially mitigated its risk –for example obtaining a guarantee or buying insurance – such that the PD parameter would be reduced by say 10% (capital requirements for this lower risk scenario are represented by the lower parallel line).

As is obvious from the chart, by obtaining some form of insurance coverage that mitigates its risk, a bank could lend at a longer maturity and still face the same capital requirement that it would be charged on a shorter-term uncovered exposure. We will later return on the importance of this "maturity extension effect" for financing developmental projects in emerging countries.

Applying the Basel II maturity adjustment to project finance loans in LDCs raises a number of issues.

First of all, as shown by Moody's and Standard and Poor's cumulative default curves for corporate bonds reported in fig. 12, while the linear relationship assumed by the Basel

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[29] The reader is referred to the original QIS 3 documents appearing on the BIS website at www.bis.com

[30] According to Altman and Suggit(2000), that corresponds to the mortality rate of a B-rated syndicated loan.

Accord between maturity and credit risk may be a fairly good approximation for investment-grade securities, significant non-linearities start to prevail as we go down the the rating scale. For non-investment grade securities, there is little room left to migrate downward on the rating scale. Of the two components of credit risk discussed above, default risk represents by far the most significant concern compared to migration risk short of default. As a consequence, the contribution of maturity to credit risk and the need therefore for an explicit maturity adjustment result greatly reduced.

As mentioned before, the calibration of the maturity adjustment in (10) partially addresses this issue by establishing a negative relationship between the maturity adjustment coefficient b and the obligor's probability of default. What is less convincing in Basel II is the need to apply a linear maturity adjustment to non-investment grade exposures across all asset classes.[31]

In what follows, we will argue that for project finance loans in particular, loan aging might have a significant risk mitigation effect that might justify the adoption of a less than linear maturity adjustment. This particular asset class generally offers limited or no recourse to the corporate sponsors, as project cash flows represent the primary source of loan repayments. As a consequence, it is reasonable to assume that the probability of default may significantly decline as time goes by since the origination of the loan and project construction approaches its successful completion.

Altman and Suggit (2000) analyze default data for a sample of over 4,000 syndicated bank loans originating in the period 1991-1996. They find mortality rates for bank loans to be generally higher than comparable mortality rates for corporate bonds in the first 2-3 years after issuance, whereas the difference between them appears much less pronounced in later years[32]. In other words, in the case of bank loans, default risk picks up in the first couple of years after issuance but then tapers off over time.

I attempt to further investigate the risk-mitigating effects of loan aging for syndicated bank loans using 2 major VAR models that have wide application in the commercial banking business, namely KMV and CreditRisk+.[33]

KMV is a mark-to-market credit risk model based on the option pricing valuation approach originally proposed by Merton[34], whereas CreditRisk+ is a default-mode model which applies an actuarial science framework to the analysis of default risk.

Though very different in their assumptions, methodologies and mathematical structures, these models have been shown to produce reasonably consistent results if properly parametrized.

Unlike the Basel "risk-bucketing" approach, they are designed to estimate a probability distribution of losses over the whole portfolio or sub-portfolio of a financial institution. In this respect, they take into account correlation and diversification effects among the risks underlying individual exposures, so that in general the total capital charge for the portfolio does not coincide with the mere sum of the capital charges that would apply to each individual position.

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[31] Applying his asymptotic single factor version of KMV to zero-coupon and par-coupon bonds, Gordy finds that for EDFs above 2.5%, capital charges are lower on five year maturity than on four year maturity and for EDFs above 6%, capital charges decrease already after 2 year maturity.

[32] See table 6 in Altman and Suggit (2000).

[33] As new solutions are being investigated to replace the old 1988 Basel Capital Accord, "Value-at-Risk" models have been the object of intense study by bank regulators (especially Bank of International Settlements and Federal Reserve). An extensive comparative analysis of their structure, parametrization and performance is contained in the January 2000 issue of the *Journal of Banking and Finance*.

[34] See Merton, (1974).

As a first approximation and to make their results comparable with the Basel approach, I run both models under the simplifying assumptions of a homogeneous perfectly fine-grained portfolio (in other words, there is no undiversified idiosyncratic risk) with a single systematic risk factor[35].
Both models require as input not a single 1-year PD but the whole vector of cumulative default probabilities over 1, 2, 3, .., years up to maturity. I feed the models with the issuer-based mortality rates estimated by Altman (2000) for syndicated bank loans.[36]
In the absence of publicly available cumulative default rates for bank loans, using as proxies Altman and Suggit (2000)'s mortality rates requires the hypothesis of a homogenous portfolio of loans all with same origination date. In this case, in fact, the concepts of remaining maturity and years after issuance are no longer distinguishable for our purposes.
In each chart of figures 10 and 11, the top curve illustrates results at the 99.97 VAR percentile and the bottom curve instead at the 99.90 percentile. Finally, given the documented high sensitivity of CreditRisk+ to the calibration of the parameter σ (i.e. the volatility of the single systematic risk factor), I report in figure 11a and 11b alternative results under the 2 different assumptions of σ=1 and σ=1.25.
The general picture arising from figures 10 and 11 appears to confirm the risk-mitigating effect of loan aging.
Providing an alternative calibration of the maturity adjustment accounting for the effect of loan aging is beyond the scope of this paper. We will limit ourselves to provide the basic intuition with a simple example.
In the absence of any contrasting evidence, and consistent with Altman and Suggit's data, let us assume that marginal default rates increase over the first few years in the life of a project finance loan and then rapidly taper off once the most critical construction phase is successfully completed. In other words, let us draw a gamma distribution of marginal default probabilities over the life of the loan as shown in figure 17a. Then the corresponding cumulative default rates for loans of different ages would look like in figure 17b. Consistent with our expectations, the maturity adjustment flattens out for older loans, confirming the risk mitigating effect of loan aging.
To summarize, unless the Basel proposal is amended to incorporate differential treatment of maturity across different types of exposures, implementing the accord in its present form would require banks to maintain at each point in time a proportionally thicker capital cushion to hedge against long-term commitments as opposed to short-term exposures across the board for all asset classes. The analysis in this section suggests that a clear-cut linear relationship between maturity and risk is hard to establish across exposures of different types and credit qualities. Especially for syndicated bank loans, loan aging appears to have a significant risk-mitigating effect, which should not be neglected in the calibration of the maturity adjustment for this asset class.

[35] See Gordy, (2003)
[36] Altman and Suggit(2000)'s database of syndicated has the most observations falling in the two rating categories B and Ba. The latter though – as the authors admit – is biased by an abnormally large default amount in the fifth year (see Altman and Suggit (2000) p. 245). I rely therefore on the cumulative mortality rates for the B-rated class.

5.2 Quantifying the Risk Mitigation implicit in B-loan agreements.

In the previous section (see fig. 9), we have assumed an exogenous 10% reduction in the probability of default (i.e. α=90% in (6)) due for example to an explicit or implicit guarantee or partial insurance mitigating the risk of a given exposure.
The purpose of this section is to make α endogenous. More precisely, we will attempt to back out from actual data on long-term vs. short-term loans what is the magnitude of the risk-mitigation described in inequality (7).
There are many forms of credit enhancements nowadays available to banks for long-term lending. They include partial risk or partial credit loan guarantees as well as many "political risk" insurance products, providing coverage for specific non-business risks, such as transfer and convertibility, expropriation, war, and so on (see table 1 for a synopsis).
All of these risk-mitigation products have very different features and are generally customized for individual transactions. Most of the data is private property of individual insurers and a comprehensive cross-section of comparable pricing information to my knowledge is not available.
In many respects, instead, B-loans represent a much more standard product and they have been available since the 1960s channeling long-term bank loans to finance developmental projects in emerging countries.
Under the typical A/B-loan structure, a multilateral development bank (MDB) is the lender of record to a borrowing company for the entire amount of a loan. The MDB keeps a portion of the asset (usually 25 to 40 percent) for its own account (the A-loan) and syndicates the remainder (B-loan) through separate participation agreements with commercial banks. The borrower's legal contract is solely with the MDB, which enjoys a de facto preferred creditor status in most countries. As a result, although participant private lenders bear, to the extent of their participations, the full credit risk associated with the project being financed, on the other hand they benefit from the preferred creditor's "umbrella" in the sense that other "political" risks (such as convertibility and transfer risk, sovereign rescheduling risk and moratorium risk) are effectively mitigated.
Drawing from sources like Loanware database (Capital Data Ltd.) and Bloomberg, I have assembled data on firms in emerging markets that over the last decade have received long-term loans benefiting from "political-risk" insurance guarantees (especially B-loans) and at the same time (within the same 2-year period) have also managed on their own to tap into international financial markets by selling bonds or obtaining loans usually though for much shorter maturities.
I compiled 2 datasets of bank loans, which we will refer to in what follows as the "non-guaranteed" and "guaranteed" loans, respectively.
Data-fields for each loan in both datasets include:

1) date in which the loan was signed;
2) amount of the loan;
3) name of the borrower company or special purpose vehicle;
4) industry sector of borrower company;
5) country of borrower company;
6) interest rate charged (usually a fixed spread over 6-month Libor);
7) maturity of the loan;
8) repayment schedule and grace period;
9) name of lending bank or syndicate of banks.

The dataset of guaranteed loans includes loans by commercial banks (or often syndicates of commercial banks) to firms in emerging countries, which either benefit from explicit governmental guarantees or constitute integral part of A/B loan agreements of multilateral development banks.
The dataset of non-guaranteed loans, instead, includes all loans extended by banks or syndicates of banks worldwide (as recorded by the Loanware database) at purely market terms, i.e. without any form of either explicit or implicit credit guarantees by any third party. The sample size of this latter database runs in the thousands and is therefore not a constraint to the analysis.
What instead is a constraint for the analysis is that naturally not many of the firms that appear in the guaranteed-loans database also make it to obtain loans from commercial banks on their own (without bilateral or multilateral guarantees). Those that do make it to borrow on the market as well, usually only manage to receive very short-term credit. Moreover, there is also a timing issue: firms that in early years only manage to obtain credit under the umbrella of multilateral development banks, only in later years may make their appearance on the syndicated loan market on their own as well. The timing of loans is clearly also influenced by cyclical and in general macroeconomic conditions which crucially affect the general availability of credit to emerging economies as a whole.
In combining the 2 datasets, I therefore consider the sub-sample of loans only to those companies that within the same year have obtained both guaranteed and non-guaranteed loans.
As expected, when lending under the umbrella of a multilateral institution, the same syndicates of banks were able to offer better credit terms (longer maturities and/or lower spreads) to the same borrowers in the same years.
For example, B-loans in my sample have maturities ranging from 6 to 14 years whereas most private loans without any form of credit-enhancement seldom exceed a 3-year maturity.
From equation (3), we know that the expected pay-off to the bank at time t_0 from a loan extending to maturity T can be written as:

$$\pi^{B} = E_0^Q \left\{ \sum_{t=1}^{T} \left[p_t \Gamma_t - d_t \rho K \right] \right\} \qquad (11)$$

where both Γ_t and K are a function of q as explained in previous sections.
To implement the model numerically, we need further assumptions about LGD, ρ and r. Since the database we analyze includes not only syndicated loans but also regular loans and bonds with usually lower recovery rates , we assume an average LGD of 50%[37].
As a proxy for the opportunity cost of capital ρ, I take the average ROE in the US banking system throughout the 90's and set ρ=15%.
Finally, I assume a constant per-period risk-free interest rate r and set it equal to the yield on US Treasury bonds of maturity comparable to T, as inferred from the Treasury yield curve available to the parties signing the loan on the origination date.
For each loan, given information about key contractual features (including origination date, interest rate, maturity and repayment schedule), I construct the stream of cash flows p_t

[37] Averaging 30%-35% for syndicated loans (source: Altman, 2000) with 65%-70% for senior unsecured debt (source Moodys).

expected by the bank : initial disbursement at origination[38] and then the whole vector of interest + principal payments over time.

$$p_t = (LIBOR_t + s_t)\, OLB_t + PRINCIPAL_t \qquad (12)$$

In other words, given a loan of $1(million)[39], interest payments at each time t are computed applying the contractual interest rate to the outstanding loan balance at time t (OLB_t). Differing from loan to loan, the outstanding loan balance is computed over time following either a bullet or a straight- line repayment profile.

In most of the loans in the database, as shown in (12), the interest rate consists of a contractually agreed spread s_t over LIBOR. An estimate of future LIBOR rates is therefore necessary to derive the full stream of expected interest payments till maturity of the loan.

As a first approximation[40] and consistent with the methodology employed in deriving risk-free discount factors, I use, as predictors of future LIBOR, the LIBOR forward rates which the parties signing the loan could have inferred from the swap yield curves available to them at the time of origination of the loan.

This gives me enough information to use equation (11) to back out the expected default risk implicit in the pricing of each loan. In other words, for each loan I numerically look for the value of q that sets (11) to zero (not very dissimilar from an IRR calculation).

I then compare results across the 2 sub-samples of loans: the loans benefiting from explicit or implicit "political risk" insurance (mostly B-loans) and the ordinary loans contracted at market terms without any sort of credit-enhancement attached.

As mentioned above, loans in the latter sub-sample generally exhibit much shorter maturities than those in the first sub-sample. Therefore, to make any comparison meaningful and consistent with my modeling approach in section 4, I replace –wherever needed – short-term loans in the second sub-sample with sequences of the same loans rolled over repeatedly so that the "composite maturity" roughly matches the maturity of corresponding loans in the first sub-sample (i.e. my T in (11)).

For each company, therefore, I can compare the default risk q, at a given moment in time, as implicit in the pricing of loans with and without credit enhancement. The comparison yields an indication of the risk-mitigation effect and therefore of the value of the explicit or implicit loan guarantee.

What I find is that the same company in the same year may obtain guaranteed loans at lower interest rates or longer maturities than non-guaranteed loans. Naturally, the very same lenders perceive a reduced risk (lower risk-neutral default probability or higher credit quality/rating in the above terminology) and offer better credit terms, if the loan is backed by implicit or explicit credit guarantees. The α ratios (based on equation (6)) between instantaneous risk neutral default probabilities (q) as implied by B-loans vs. ordinary loans provide me with an estimate of the value of the guarantees.

The median ratio in our sample suggests a value for α in (6) around 0.8874, meaning that the risk-mitigation effect provided by the multilateral umbrella in B-loan agreements drives the instantaneous risk-neutral default probability q down by about 11% on the median loan in our sample.

[38] I assume loans get fully disbursed in the same semester in which they are signed.

[39] I normalize loan amounts to 1 as in the theoretical part of the paper.

[40] I am also working on an alternative estimation of forward LIBOR rates based on CIR modeling of the interest rate swap yields, following Duffie and Singleton (1997).

This estimate of α should however be considered as an upper bound since by construction the sample is not representative of the average firm in developing countries. In fact, only the largest, and financially more solid firms have been able to access the syndicated bank loan market and we therefore only have data for them. This problem can be overcome by applying sample selection estimation techniques based on both macroeconomic and balance sheet data[41].

In an extension of this paper, I aim at correlating the size of α with firm's size, profitability and ownership structure within a generalized Tobit framework.

In other words, the median α in our sample might not correspond to the median firm in developing countries. A lower value for α than the median might be more representative. In what follows, we will therefore use 2 values from our empirical distribution of α: the median $\alpha = 0.8874$ and the lowest quartile $\alpha = 0.80$.

5.3 *Joint impact of capital requirements and risk-mitigation products on banks' optimal debt maturity choice.*

Pulling together the analysis in sections 5.1 and 5.2, we will here provide numerical examples based on the model in equation (3) to illustrate how different calibrations of the maturity adjustment to capital requirements along with the availability of credit-enhancement for long-term lending may jointly impact banks' optimal maturity choice.

Given our discussion of the Basle maturity adjustment in section 5.1, we can now attempt to quantify the area of the triangle in figure 8a. Consider the simple comparison between committing to a 5-year loan or rolling over a 1-year loan five times. With our assumptions of PD=1.37% and LGD=50%, our triangle would look like the one depicted in figure 13a.

Instead of trying to evaluate the magnitude of the additional capital required on long-term exposures in absolute terms, the approach I suggest in this paper is to gauge its significance with respect to the possibility that it might offset the incentives for long-term lending provided by B-loan and similar risk-mitigation products.

A first attempt to assess the risk-mitigation effect of B-loans in section 5.2 has provided us with a median estimate for α of 0.8874. If we use this factor to decrease the risk-neutral default probability corresponding to our PD of 1.37%, our new triangle will be like in figures 13b. In other words, a first conclusion that can be drawn is that if the Basle regulation recognized the risk mitigation, which the market appears to attach to B-loans, then the capital required at any point in time in our example should be reduced somewhat along the lines of the comparison between figures 13a and 13b.

Assume now that a bank faces 2 investment alternatives:

i) Committing to a long-term loan which yields a semiannual interest payment consisting of a spread s' over LIBOR with a maturity of T years and an instantaneous risk-neutral default probability q' ;
ii) Rolling over a sequence of short-term loans which yield a semiannual interest payment consisting of a spread s over LIBOR and have an instantaneous risk-neutral default probability q. Each individual short-term loan has a maturity of 1 year and is

[41] An application of sample selection estimation to the analysis of syndicated loan spreads is in Eichengreen and Mody (1998)

rolled over T times, so that the composite maturity matches the maturity of the long-term loan T.

From (11) and (5), we know that the t_0 net payoff from a loan extending to maturity T can be written as:

$$V = \sum_{t=1}^{T} p_t \left[(1\text{-LGD})\, e^{-rt} + \text{LGD}\, e^{-(r+q)\,t} \right] \qquad (13)$$

where p_t is computed as in (12) and the same assumptions about Treasury and Libor rates carry over from the previous section.

As both long-term and short-term loans have bullet amortization, principal balances will be identical between the two alternatives if, as we postulate, the rolling short-term loan will be always extended up to matching the total maturity of the long-term loan.

In order to single out the impact of the risk mitigation, i.e. of the assumption $q' = \alpha q$, we will further assume that $s = s'$. [42]

The effect of the risk mitigation offered to long-term loans is plotted as a function of maturity in figures 14a and 14b for $\alpha = 0.8874$ and $\alpha = 0.80$ respectively. Plugging in a lower risk-neutral probability of default $q' < q$ into (13), shifts out the discount curve as we had seen in figure 8b and increases therefore the net present value of cash flows accruing from the loan. The impact is naturally higher the longer the maturity of the loan, i.e. the longer the stream of cash flows to be discounted back to time t_0.

Let us now attempt to combine in a single graph the offsetting effects of maturity-adjusted capital requirements and of the risk mitigation for long-term lending.

If we add to (13) the additional term given by the opportunity cost arising to the bank from capital requirements, then the present value of net profits to the bank becomes:

$$\pi = V - \sum_{t=1}^{T} d_t\, \rho\, K_t \qquad (14)$$

where d_t is the risk-free discount factor and K_t is the time t capital requirement, computed based on the Basle IRB calibration described in section 5.1 for a unit exposure with instantaneous risk-neutral[43] default probability q.

Figures 15a and 15b plot the difference in net profits between the long-term (i) and the short-term (ii) option as a function of maturity T. Curves are reported for two possible assumptions on the value of ρ (or opportunity cost of holding capital): $\rho = 15\%$, $\rho = 30\%$. [44]

The exact point where the curve crosses zero will depend on the extent of the risk mitigation α and on the assumed opportunity cost ρ. What appears clear from the graphs, though, is that, as maturity increases, the additional cost implied by the maturity adjustment will quickly offset the benefit to long-term lending of risk-mitigation products like B-loans.

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[42] I assume a spread of 250 bp over Libor which is in the range observed in the market for leveraged loans (see Altman and Suggit(2000)). Furthermore, I choose q to be 1.1% so as to correspond to a 1-year PD of 1.37% to be consistent with the assumptions in previous sections.

[43] See Crouhy, M., D. Galai, and R. Mark (2000) for a simple explanation of how to derive actual 1-year default probabilities (PD) from instantaneous risk-neutral default probabilities (q) based on KMV methodology.

[44] In fact the total cost of raising capital for a bank can be significantly higher than our average baseline estimate of 15% due to time, country or bank-specific capital supply shortages as well as due to agency costs.

Finally, the offsetting effects of government guarantees and capital requirements on banks' optimal maturity choice is shown in figures 16a and 16b as a function of the magnitude of the maturity adjustment, i.e. the parameter b in (10). As before, a different line is plotted for different possible assumptions on ρ. Figure 16a assumes a low risk mitigation effect (α = 0.8874), figure 16b depicts instead the case of α = 0.80. In both cases we have fixed T=5. Both figures also report the magnitudes of the maturity adjustment assumed by Basle (2001) for an exposure with PD equal to 1.37% under the marked-to-market and default-mode approaches (indicated in the graph as b_{MTM} and b_{DM} respectively) as well as the latest QIS 3 calibration of the maturity adjustment as reported in (10) and indicated in the graph as b_{QIS3}.
A few recent articles in the credit risk literature, including Kalkbrener, M. and L. Overbeck (2001) and (2002), have attempted to use the latest credit risk modeling techniques to calibrate the effect of maturity on credit risk. Overall they find that the Basle II maturity adjustment should be revised downward.
The analysis in this section offers a new perspective in addressing the problem of calibrating the maturity adjustment to regulatory capital requirements. Our results appear in line with the literature. In particular, they suggest that the magnitude of the Basle II maturity adjustment even on lower-rated exposures might significantly offset the incentives provided by government guarantees to encourage the flow of long-term finance to developing countries.

6. Summary and Conclusion

The main focus of this paper has been on capital requirements and in particular on new proposals for bank capital regulation currently under study at the Bank for International Settlements in Basle, Switzerland and due to be internationally implemented by 2006. One important issue on which the Basle Committee expressly seeks feedback, but that has not been adequately explored yet by researchers, is the so-called maturity adjustment to credit risk capital. The latest proposal (Basel Committee on Banking Supervision, 2001-2002) is to require banks to maintain a capital cushion against each of their credit risk exposures that ceteris paribus increases linearly with the maturity of the underlying loan obligations. In the advanced approach, the maturity adjustment is required across the board on all classes of loans (commercial, sovereign, project finance, etc..).
Applying credit risk models like KMV™ and CreditRisk+™ to default data for syndicated loans, I find that the standard linear relationship between maturity and credit risk assumed by the Basle II framework might over-penalize in particular long-term project finance loans, as it neglects the significant risk mitigating effect of loan age on the term structure of cumulative default probabilities.
I therefore turn to analyze capital requirements from a theoretical perspective, based on the impact they might produce on the incentives of banks and in particular on their decision about the optimal maturity structure of their loan portfolio. I set up a simple model to investigate the problem of a bank choosing between short-term vs. long-term lending under incomplete information about the volatility of project returns. I find that when the volatility of project returns is high, short-term loans will be preferred as they provide the valuable option of adjusting lending decisions and charges over time based on any new information acquired.
My model lays out simple micro-foundations to explain the shortage of long-term bank finance in emerging countries. At the same time, it provides a useful framework to assess the impact of a large variety of bilateral and multilateral risk-sharing schemes (incl. sovereign

guarantees, political risk insurance, B-loans, etc..) designed to effectively subsidize long-term lending to LDCs especially for infrastructure projects.

I construct a unique database of B-loans and look for cases when the same borrowers have also managed to obtain credit in the same years on the syndicated loan or bond markets. Implementing my theoretical framework numerically, I device a method to compare spreads and maturities obtained on B-loans with spreads and maturities available to the same sample of companies at market terms (borrowing directly on the market). This allows me to extract an estimate of the value of the implicit "risk mitigation" provided by the multilateral umbrella in the case of B-loans. Basle II is likely to increase capital requirements on B-loans. My analysis instead shows that they should be granted lower capital requirements as part of the risk is effectively mitigated by the implicit political risk guarantee afforded by the « umbrella » of a multilateral development bank. I further simulate my theoretical construct numerically to evaluate how the additional cost for long-term lending implied instead by Basle II 's maturity adjustment might offset the « implicit subsidy » provided by bilateral and multilateral risk-sharing schemes to attract long-term finance especially for infrastructure projects in LDCs.

The maturity adjustment to capital requirements will naturally provide banks with stronger incentives to restructure their long-term loans into renewable short-term contracts. Along with making the flow of bank finance to developing countries inherently more unstable (sudden reversals of funds are easier in a short-term contract framework), this will also affect the allocation of bank capital flows to LDCs. In particular, given the scarce availability of long-term bond markets in developing countries and the major role played by banks, overall credit for infrastructure projects (and in general for developmental projects requiring long-term finance) might further be reduced.

Unless the Basel proposal is amended to incorporate differential treatment of maturity across different types of exposures, implementing the accord in its present form would require banks to maintain at each point in time a proportionally thicker capital cushion to hedge against long-term commitments as opposed to short-term exposures across the board for all asset classes. In fact, a clear-cut linear relationship between maturity and risk is hard to establish across exposures of different types and credit qualities. My analysis in section 5.1 suggests that, especially for syndicated bank loans, loan aging appears to have a significant risk-mitigating effect, which should not be neglected in the calibration of the maturity adjustment for this asset class.

If the new Capital Adequacy framework is to further the interests of both the developed and the developing world, the maturity adjustment for credit risk in the banking book - as currently proposed - might need to be re-considered. The theoretical and empirical results in this paper will hopefully be useful in the ongoing process of revising the calibration of bank capital requirements.

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Table 1 - Types of sovereign or supranational support for private infrastructure projects

	Multilateral Banks and Export Credit Agency Debt	Government Guarantees	Informal Agreements[a]	Multilateral Banks and Export Credit Agency Guarantees	Government Equity Participation	Government Debt (Senior and Sub-ordinated)	Multilateral Equity Participation	Government Grants	Preferential Tax Treatment
Country and Project	**Honduras:** Electricidad de Cortes S. De R.L. de C.V (Elcosa I) 60-MW oil fired power plant; 15-yrs. PPA	**India:** Dabhol 695-MW power plant; combined cycle; imported liquefied natural gas (LPG)/oil distillate; 20 year PPA with Maharashtra State Electricity Board; tariff 2.4 ($.126) per rupees KWh	**Mexico:** Mexico City Toluca Toll Road	**Peru:** Aguaytia 145-MW gas-fired power plant	**Malaysia:** Kuala Lumpur Sepang Airport	**Pakistan:** Rousch 412-MW power plant CCPP residual fuel oil; 30-year PPA with Water and Power Development Authority	**Philippines:** Pagbilao 735-MW power plant, coal fired, 25-year PPA with National Power Corp.	**Brazil:** Linha Amerala (10-yr., 15 km, 6-lane road)	**Chile:** 450-MW Empresa Electrica Pangue
Project cost	$70 million	$922 million	$313 million	$235 million	$3,924 million	$507 million	$933 million	$174 million	$465 million
Date financial closure	1994	1995	February 1992	October 1996	1993	1996	1993	June 1996	1993
Example by mechanism	IFC: $10.5 m senior debt (LIBOR + 375 bps, 12-yr. maturity) FMO: (Dutch) $10 m senior debt (LIBOR + 375 bps, 12-yr. maturity) IFC B: $10m loan, 8-yr. maturity IFC: $3.5m subordinated debt FMO: (Dutch) $1.0 m subordinated debt	12-year counter-guarantee from the government of India for tariff-payments by the Maharashtra State Electricity Board; and termination guarantee (capped at $300 m)	Concession guarantees traffic volumes by vehicle category, if traffic volumes fell short of amounts specified in contract. Concessionaire entitled to request an extension of the concession term to permit recovery of its investments.	OPIC: $60 m political risk guarantee	$390 m in equity provided by the government of Malaysia	$40 m standby loan by National Development Finance Corp. (NDFC) $140 m sub-ordinated debt channeled to the Pakistan Fund from the World Bank ($70 m) and JEXIM ($70 m)	IFC: $60 m ADB: $40 m CDC: $35 m	$112 million grant from the Rio de Janeiro municipal government	$10 million in deferred tax duties

a. Informal agreements include comfort letters, side agreements, nonbinding tariff increases, and other similar agreements.

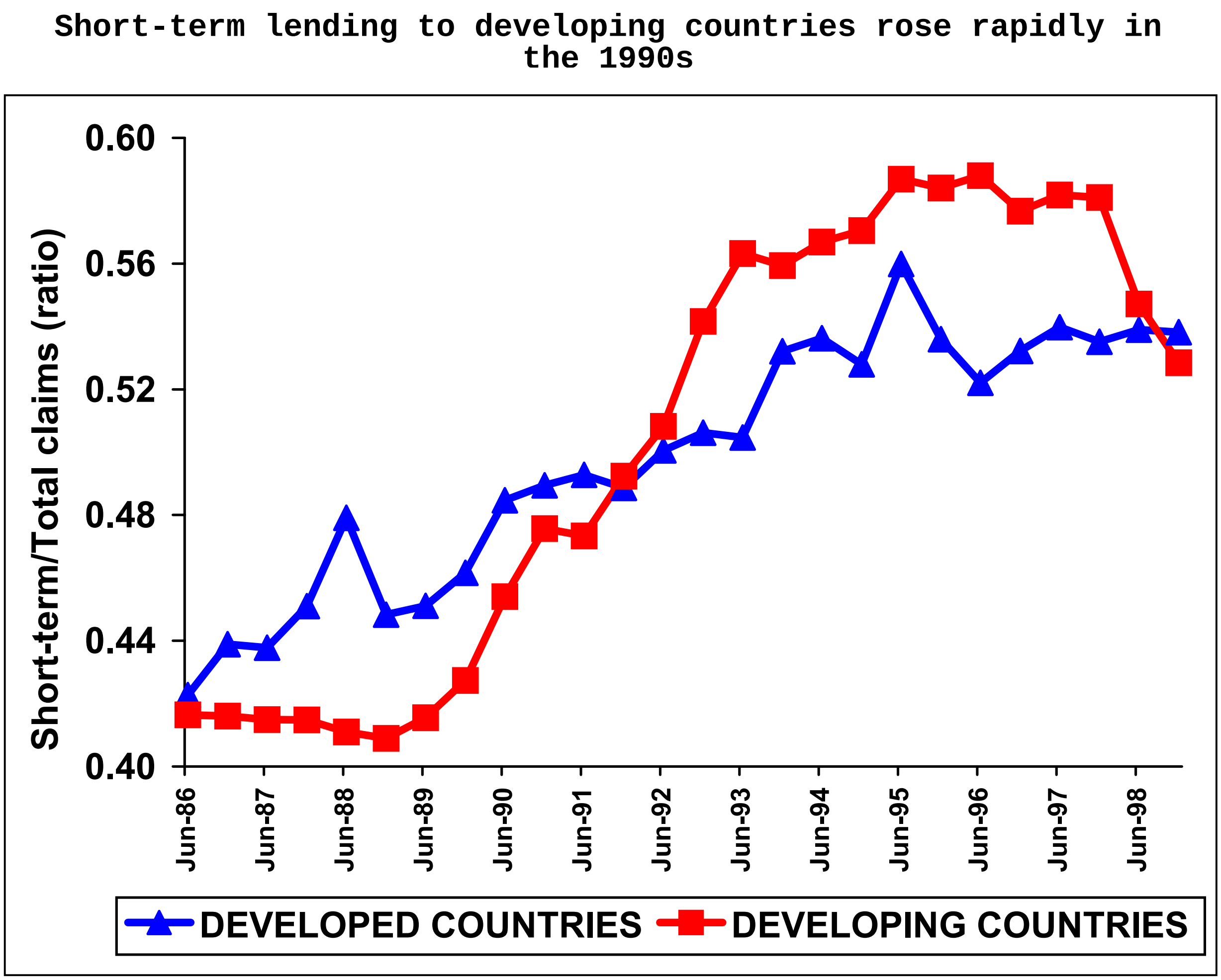
Table 2

Why maturities of bank loans to developing countries were shorter in the 1990s

Policy-induced distortions and cyclical influences versus structural factors

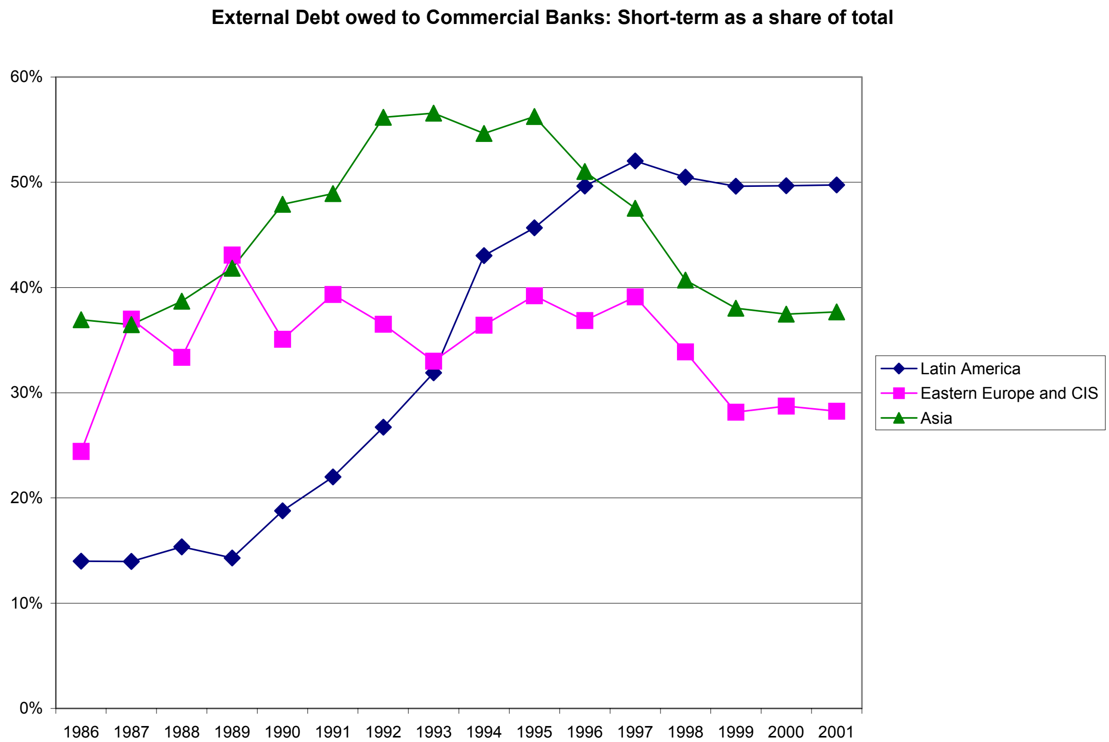
	Structural factors	Cyclical factors	Institutional and policy factors
Pull factors	Greater trade openness increased trade volumes and led to higher trade credits. Deregulation of domestic sectors permitting foreign investment created higher requirement for shorter-term working capital finance. Rising per capita incomes and declining indebtedness improved market access. Financial development led to deeper domestic debt market.	High interest rates and rapid growth in emerging markets, often accompanied by high returns from asset booms, attracted short-term capital inflows. Firms and financial institutions borrowed from abroad to take advantage of lower interest rates, substituting foreign for domestic loans.	Tax and other incentives favored short-term borrowing. Domestic banks were deregulated without adequate prudential regulations. Rapid capital account liberalization enabled domestic borrowers to access the international capital markets. Sterilization of capital inflows maintained a high interest rate differential while preventing nominal appreciation of the domestic currency. Bailouts of banks by central banks created moral hazard.
Push factors	New technology and telecommunications improved information sharing, reduced transaction costs, and facilitated frequent trading and short-term investments. Technical innovation and new financial instruments enabled risk monitoring and management of complex portfolios and also facilitated frequent trading.	Low interest rates and low growth in industrial countries encouraged investment in developing countries.	BIS regulation on capital adequacy encouraged short-term exposures. International rescue packages targeted short-term loans first, leading to a moral hazard problem.

Figure 1



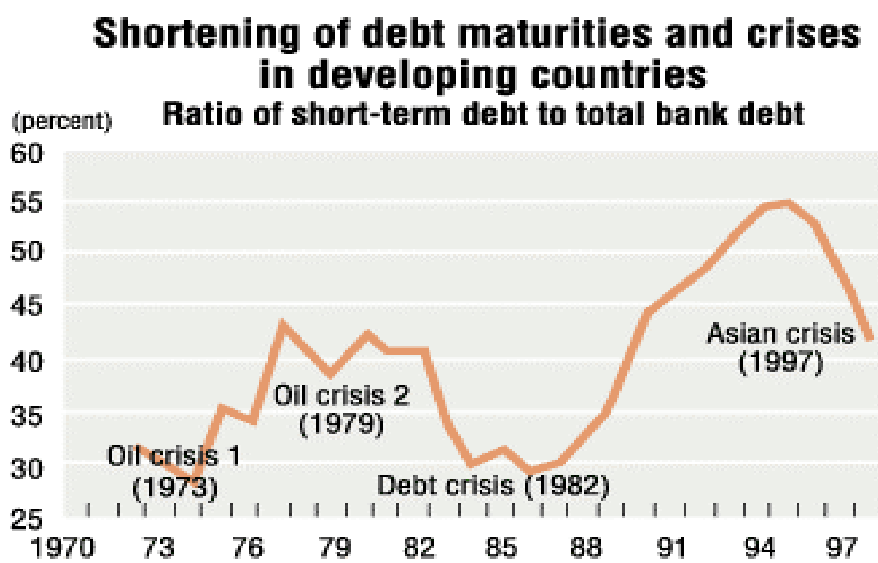
Source: Global Development Finance, The World Bank.

Figure 2



Source: The Institute of International Finance

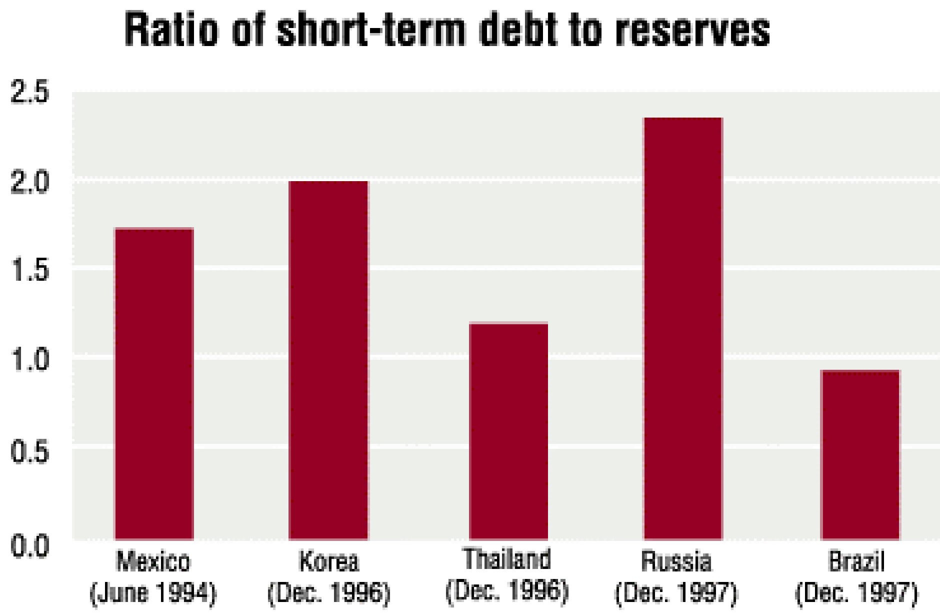
Figure 3



Source: World Bank Debtor Reporting System.

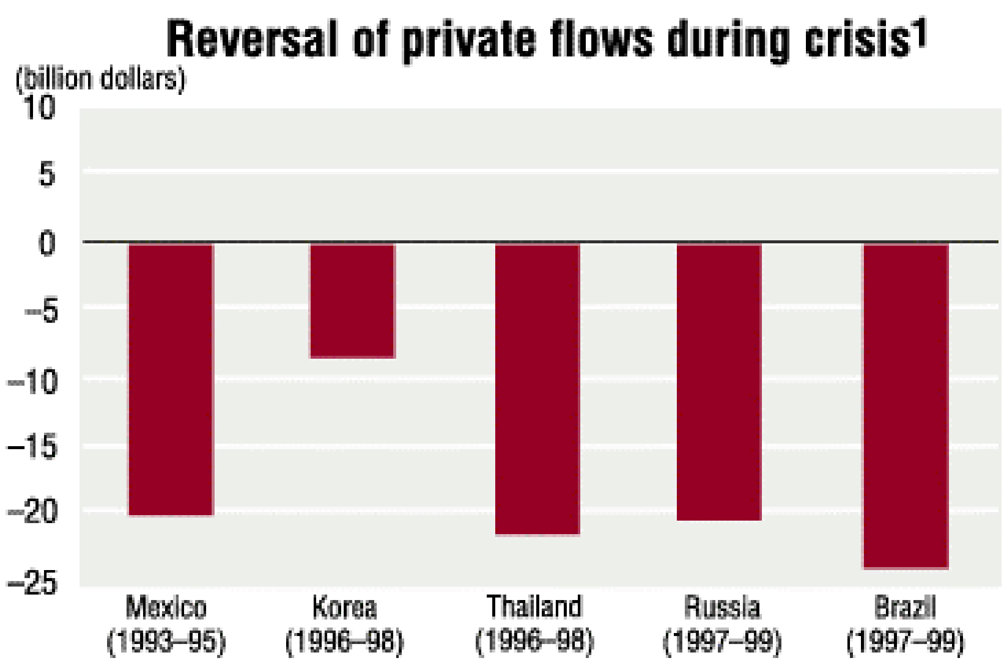
Note: Oil crisis 1 and oil crisis 2 refer to the crises that followed the raising of oil prices by the Organization of Petroleum Exporting Countries in 1973 and 1979.

Figure 4



Sources: Bank for International Settlements; and IMF, *International Financial Statistics*, various issues.

Figure 5



Source: IMF, *International Financial Statistics*, various issues.
[1] Excluding foreign direct investment.

Figure 9

CAPITAL REQUIREMENTS UNDER THE BASEL IRB APPROACH FOR CORPORATE EXPOSURES (QIS 3)

(assumes LGD=50% and PD=1.37%. PD is reduced by 10% in the low-risk scenario)

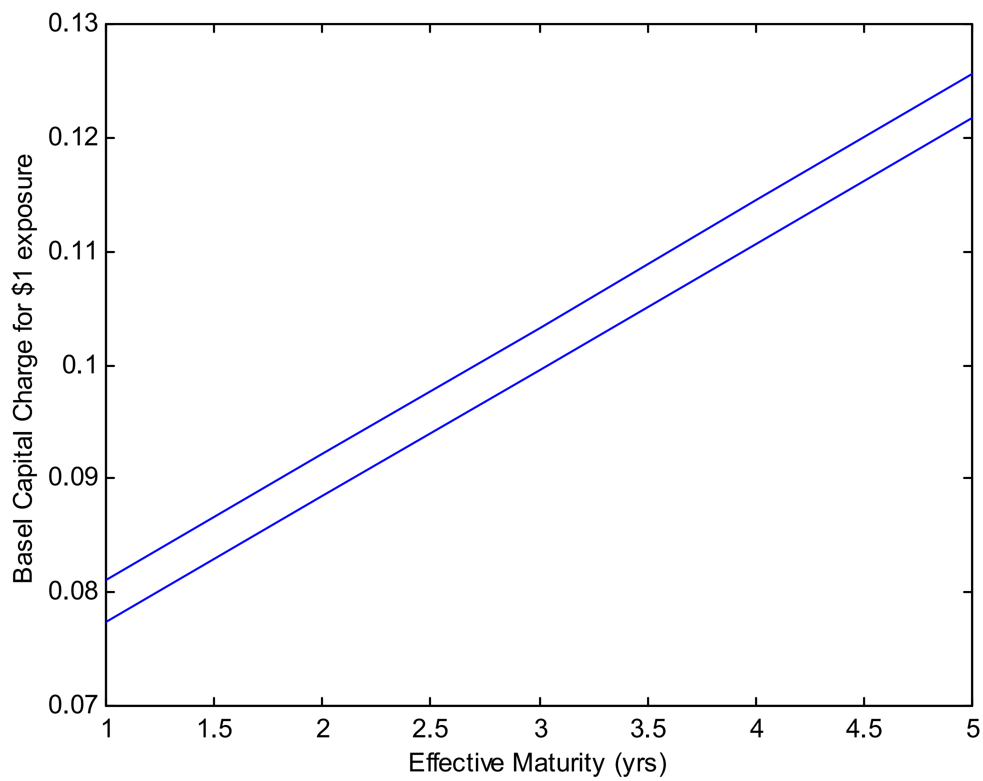


Figure 10

ASSESSING LOAN AGING EFFECTS WITH ASYMPTHOTIC KMV MODEL

(assumes LGD=50% and Altman's B-rated syndicated loans mortality rates; risk free rate is 4.9%)

Max # Yrs since origination	VaR 99.90%	VaR 99.97%
1	0.0833	0.1075
2	0.1318	0.1588
3	0.1506	0.1765
4	0.1457	0.1705
5	0.1447	0.1684

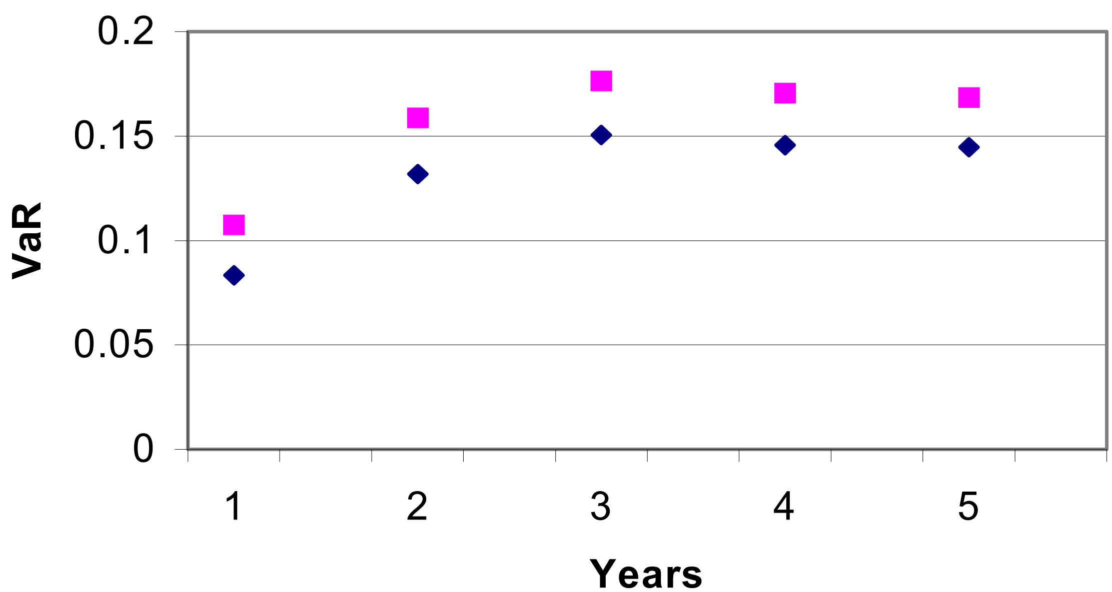


Figure 11a

ASSESSING LOAN AGING EFFECTS USING CREDITRISK+ with SIGMA=1

(assumes LGD=50% and Altman (2000)'s B-rated syndicated loans mortality rates. Homogeneous portfolio of 10,000 exposures with only 1 systematic risk factor of variance SIGMA=1 and no undiversified idiosyncratic risk.)

Max # Yrs since origination	VaR 99.90%	VaR 99.97%
1	0.04745	0.0558
2	0.08935	0.1050
3	0.1284	0.1508
4	0.1144	0.1344
5	0.1216	0.1428

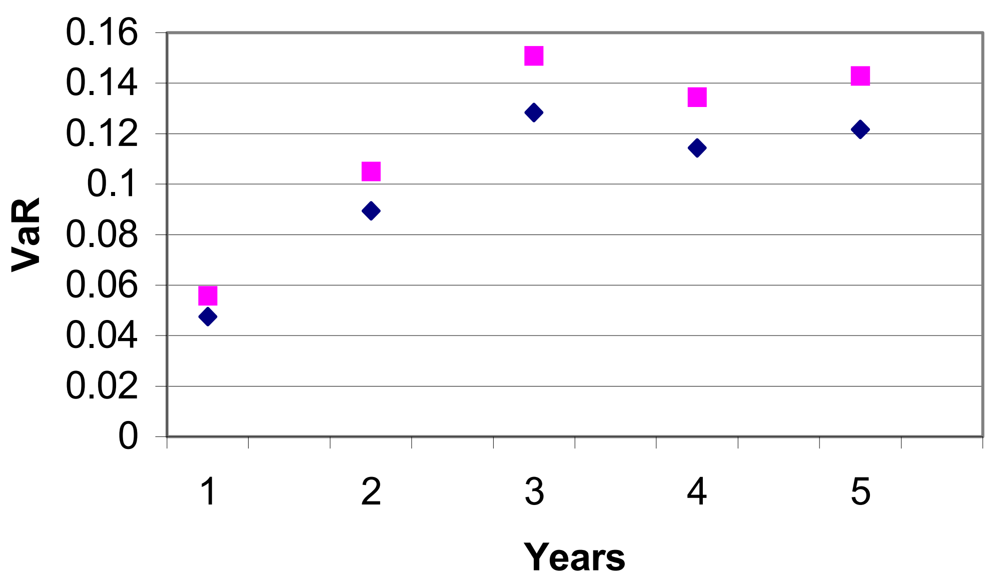


Figure 11b

ASSESSING LOAN AGING EFFECTS USING CREDITRISK+ with SIGMA=1.25

(assumes LGD=50% and Altman (2000)'s B-rated syndicated loans mortality rates. Homogeneous portfolio of 10,000 exposures with only 1 systematic risk factor of variance SIGMA=1.25 and no undiversified idiosyncratic risk.)

Max # Yrs since origination	VaR 99.90%	VaR 99.97%
1	0.06305	0.0754
2	0.1188	0.142
3	0.1707	0.2039
4	0.1521	0.1818
5	0.1616	0.1932

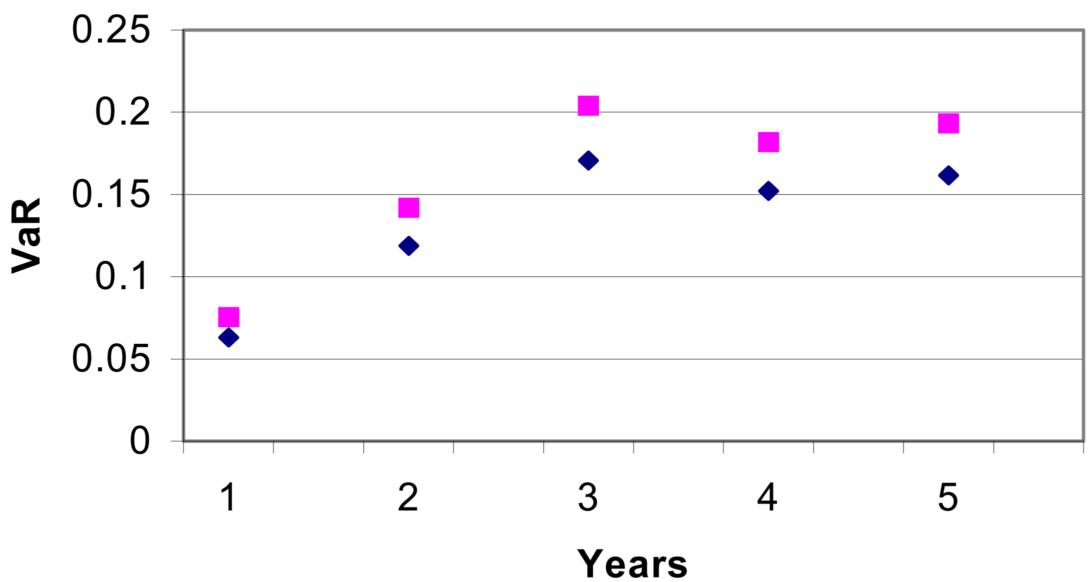
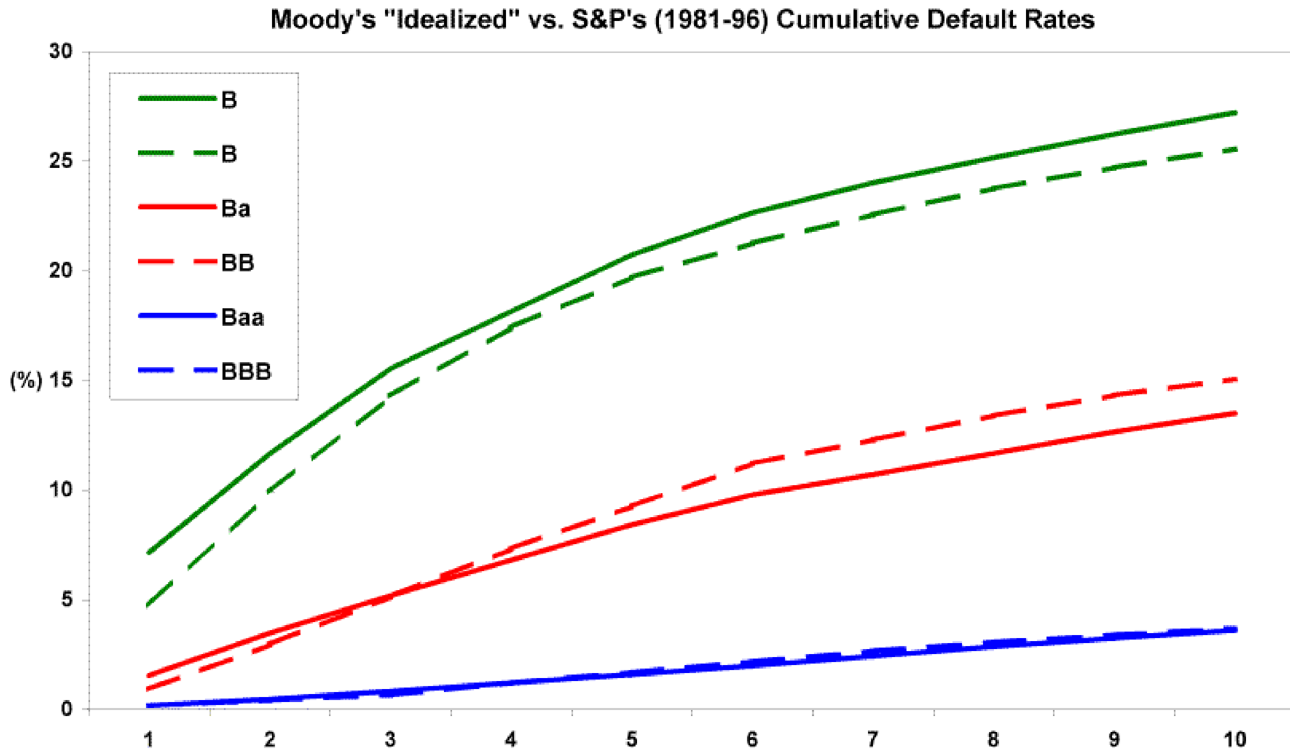


Figure 12



Source: Standard & Poor's CreditWeek, January 28, 1998, "Global Defaults Remain Low". Moody's Investor Service, Keenan, Sean C., and Carty, Lea V., and Shtogrin, Igor, February, 1998, "Historical Default Rates of Corporate bond Issuers, 1920-1997".

Figure 13a – Basle II Maturity Adjustment

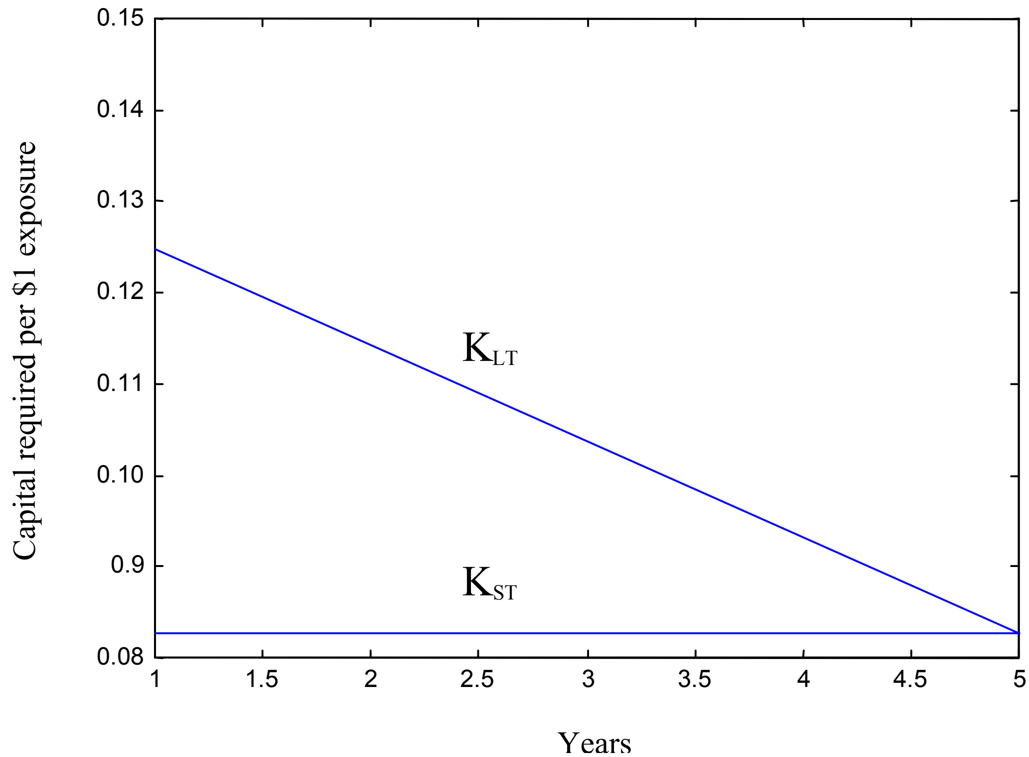


Figure 13b – Maturity Adjustment with Risk-Mitigation

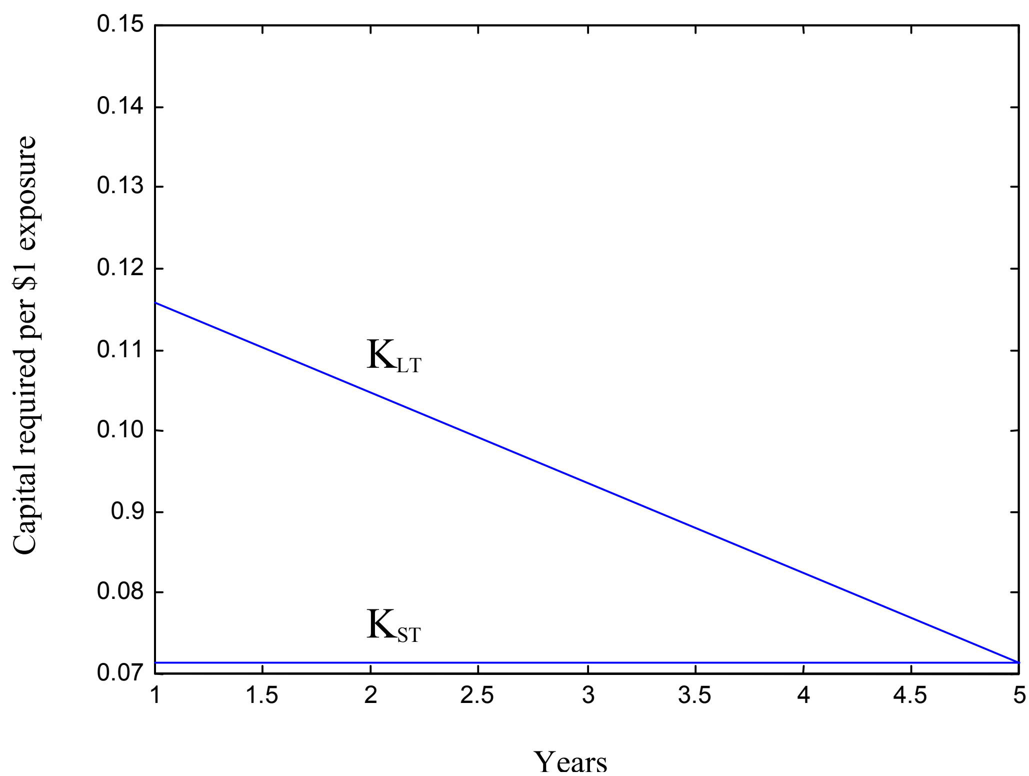


Figure 14a – Risk Mitigation Effect (α=0.8874)

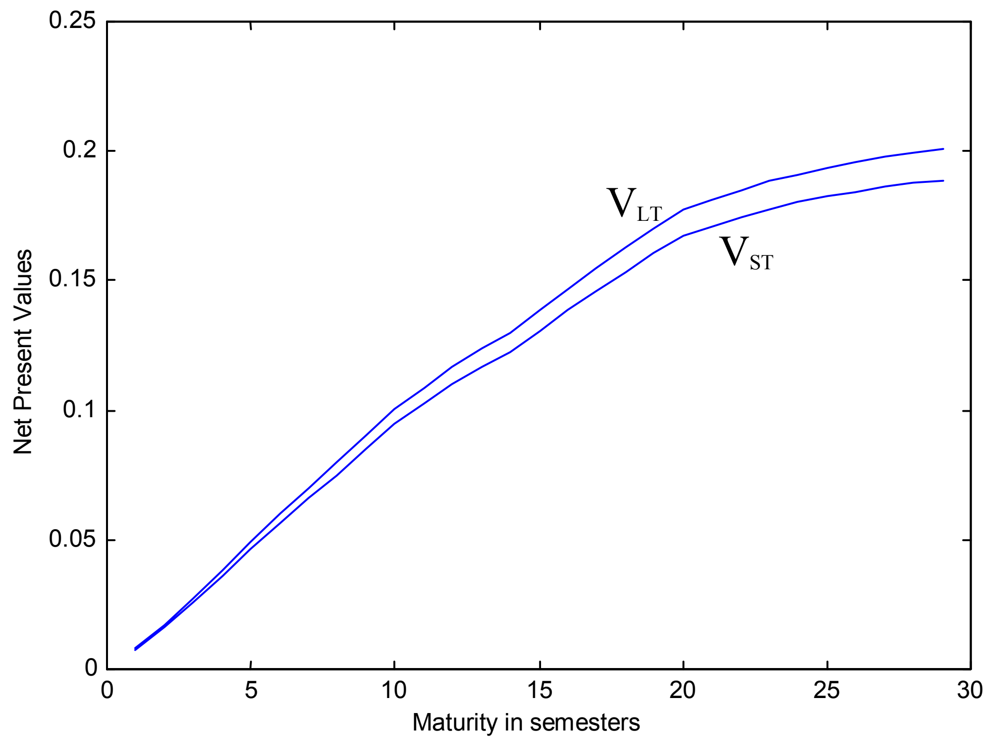


Figure 14b - Risk Mitigation Effect (α=0.80)

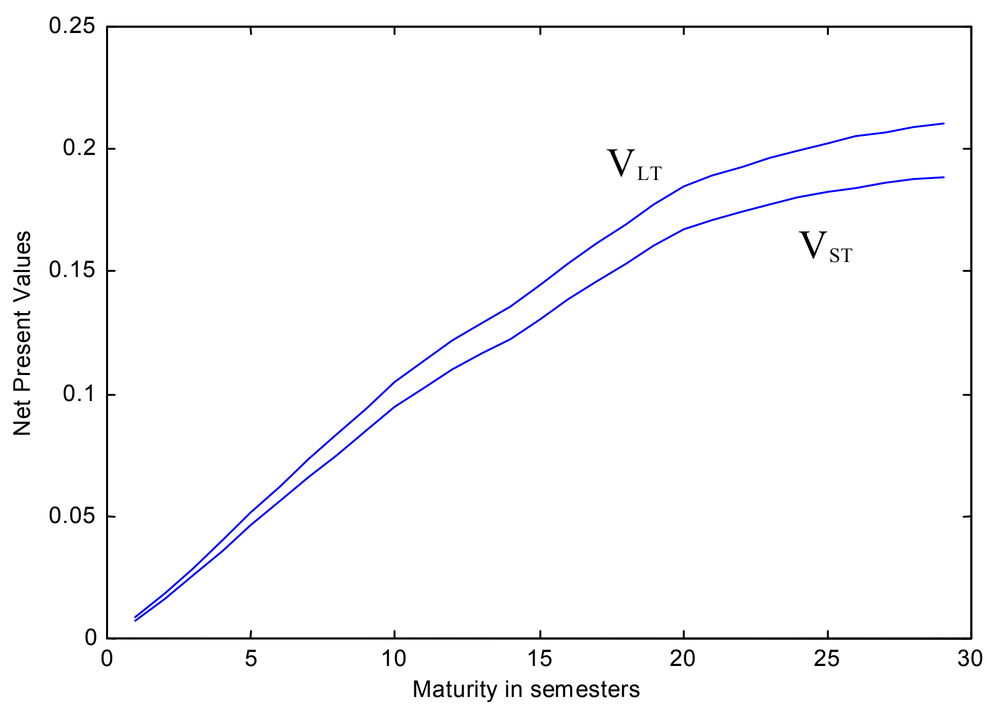


Figure 15a – Offsetting Effects on Banks' Maturity Choice (α = 0.8874)

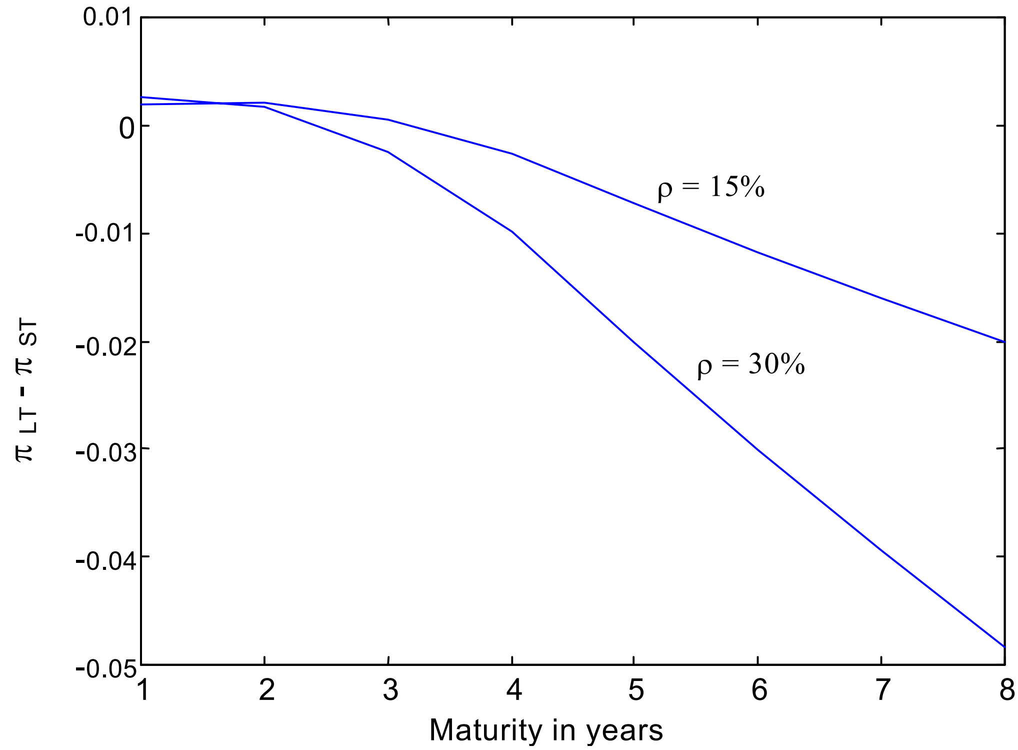


Figure 15b - Offsetting Effects on Banks' Maturity Choice (α = 0.80)

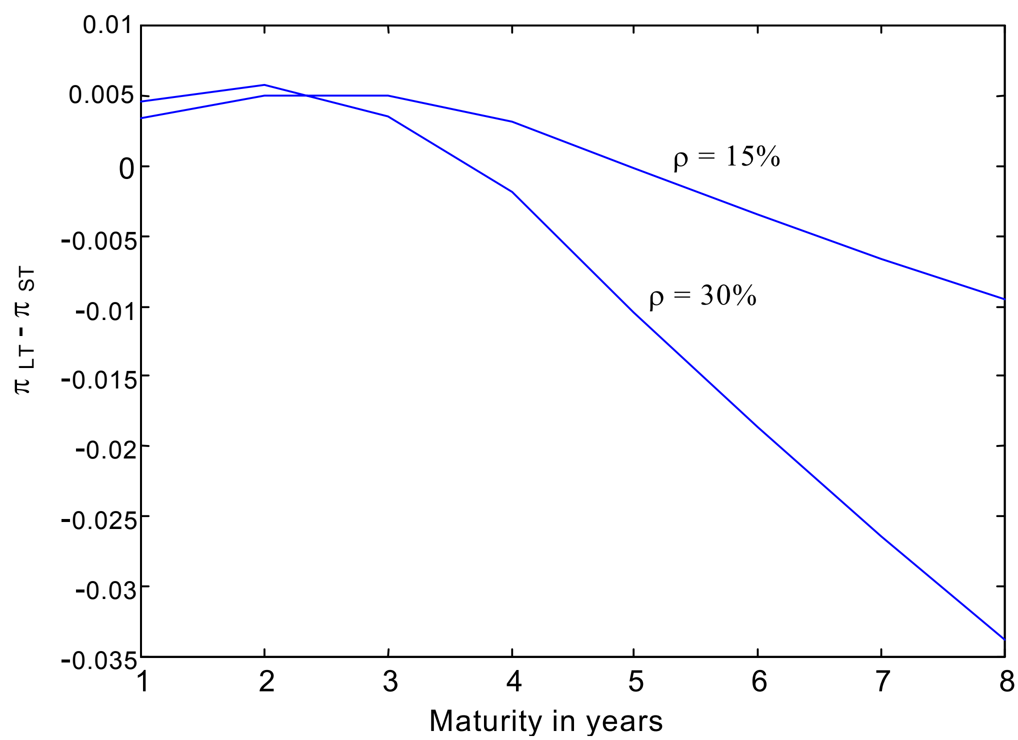


Figure 16a – Calibrating the Maturity Adjustment to Capital Requirements (α =0.8874)

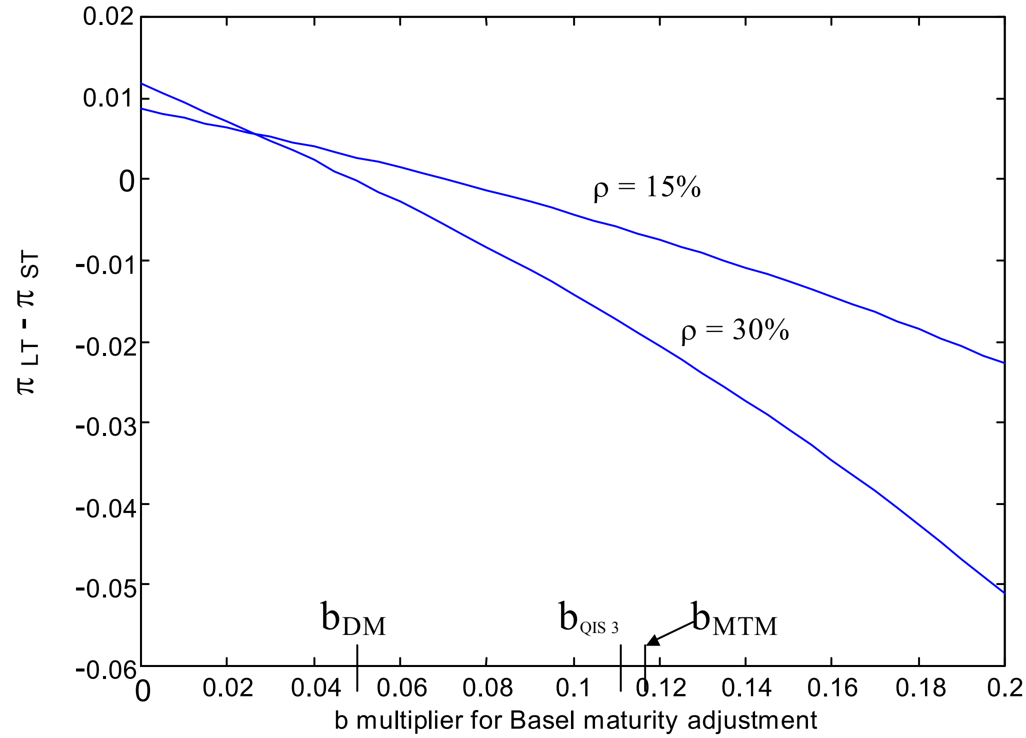


Figure 16b – Calibrating the Maturity Adjustment to Capital Requirements (α =0.80)

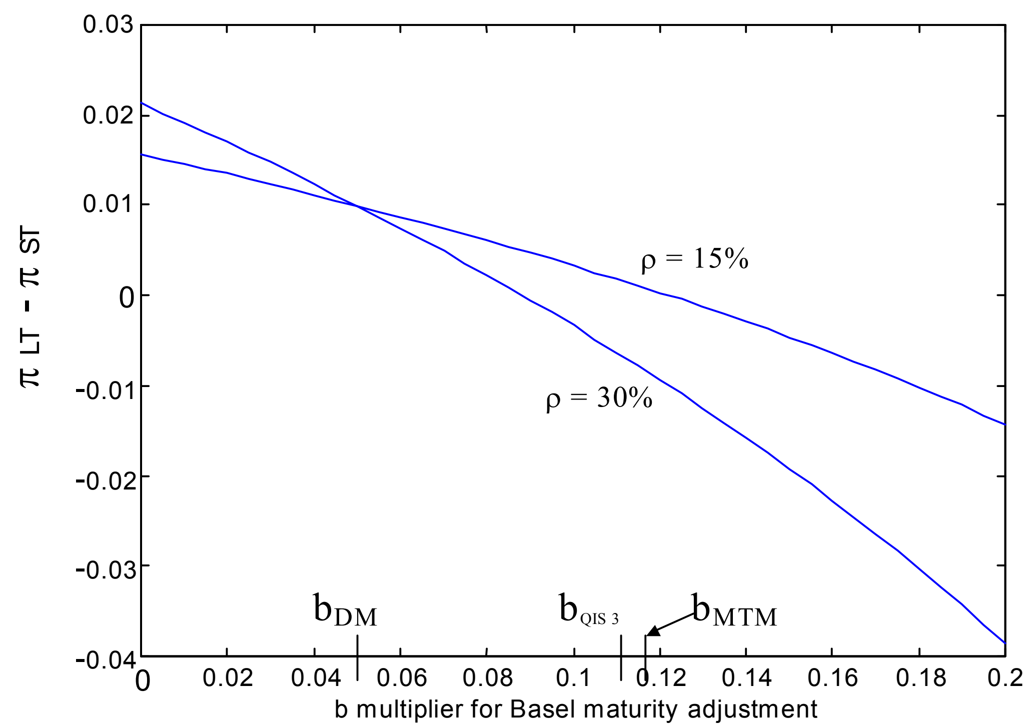


Figure 17a - Stylized relationship between marginal default probabilities and loan age for project finance loans.

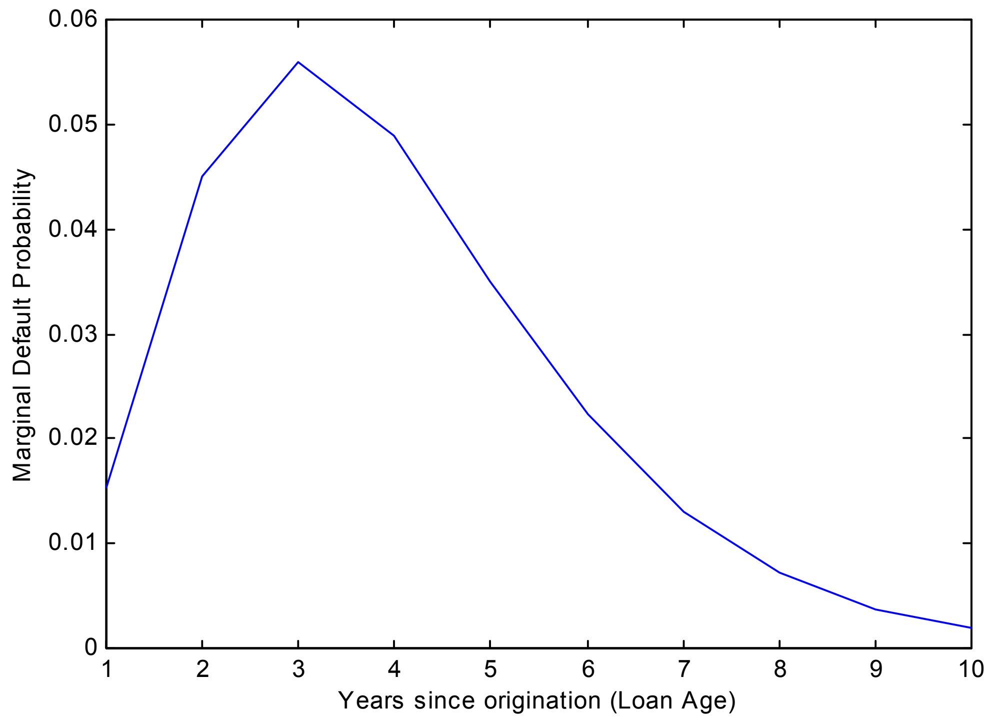


Figure 17b - Cumulative default curves for project finance loans of different age.