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SEGMENTATION AND THE USE OF INFORMATION IN BRAZILIAN CREDIT MARKETS*

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Abstract

This paper shows how interbank asymmetry of information on borrower creditworthiness influences the roles played by lenders, credit information registries (CIRs) and regulators in credit markets. We stress the importance of relationship banking as a source of information in an environment of poor accounting and widespread tax evasion and discuss how this causes the segmentation of the credit market, making CIRs concentrate on providing black information and limiting the scope of prudential regulation. Furthermore, we show that the main traits of market segmentation are relatively robust to changes in interest rates and the cost to outsiders of assessing borrower quality.

Resumo

Este artigo mostra como a distribuição assimétrica de informação sobre a qualidade dos devedores influencia o papel de credores, bureaus de informação de crédito (CIRs) e reguladores no mercado de crédito. Nós realçamos a importância do relacionamento bancário como fonte de informação em um ambiente marcado por práticas contábeis pouco transparentes e ampla evasão fiscal e discutimos como isso leva à segmentação do mercado de crédito, fazendo com que os CIRs se concentrem em prover informação negativa e limitando o escopo da regulação prudencial. Além disso, nós mostramos que as principais características da segmentação do mercado são relativamente robustas a mudanças na taxa de juros e no custo, para outros participantes, de avaliar a qualidade do devedor.

1. Introduction

Until 1994, when inflation was brought down from the sky-high levels that had prevailed since the mid-seventies, the financial system in Brazil was almost entirely geared towards maximizing float income, which answered for close to half of the overall earnings of commercial banks. In that environment, being efficient in processing transactions, such as the payment of bills and checks, was paramount to banks, whereas credit granting activities received much less attention, since very little credit flowed to the private sector anyway.[1] Incentives for investing in proper credit analysis were further weakened by the fact that most medium- and long-term credit to firms and households was provided by state banks, funded by specific taxes and government transfers. And political interference, soft budgets and other distortions common to state-owned enterprises made the quality of credit analysis in those institutions particularly low [McKinsey (1998)]. Private banks, in turn, not only lent very little, but also concentrated their loan activities on short-term operations, such as overdraft facilities and working capital finance, for which borrowers' cash flows, managed by the same institution, worked as collateral. Entry deregulation in the late eighties, although expanding the number of banks, did little to change this scenario.

The dramatic reduction in inflation rates after the Real Plan produced many changes in the financial system. In particular, it reduced banks' float income, causing some of them to run into serious solvency problems. This was the case of most commercial state banks, and also of many small and some large private ones. Some of the small banks were liquidated, while most of the medium and large banks were resolved through purchase-and-assumption transactions, with the government assuming a large share of their bad loans.[2] In the case of Banco do Brasil, the country's second largest bank, the government had to make a capital infusion of close to US$ 8 billion to avoid bankruptcy. Other state banks were re-capitalized and then privatized. Several of the banks resolved in this period were acquired by foreign institutions.

One could expect that the loss of float income, a more stable macroeconomic environment and the entry of foreign institutions, which command modern credit analysis technology, would lead to a substantial expansion in credit activities. Surprisingly, though, this did not occur, with the overall amount of credit

1 In 1980-91, the volume credit to the private sector in Brazil averaged 27 percent of GDP, against ratios several times larger in industrialized and Asian developing countries [Demirguç-Kunt and Makismovic (1996)].

2 Since the Real Plan, 104 banks were resolved by different means: 42 were liquidated, 7 were incorporated in other institutions, 10 were transformed into non-financial institutions, 11 changed from universal banks to specialized financial institutions, and 34 went through purchase and assumption transactions.

extended to the private sector actually decreasing as a ratio of GDP [Pinheiro and Cabral (1998)]. The only segment of the credit market that showed a significant expansion was that of consumer and personal loans, which almost trebled as a proportion of GDP from 1993 to 1997. Banks were not prepared for this, with the boom in credit supply occurring with essentially no change in credit-granting practices, which continued to rely on old-fashioned methods for selecting borrowers. Other creditors, such as department stores and small retailers, were in even worse situation, since they lacked even this limited experience.

Not surprisingly, then, default rates increased dramatically in this market segment, causing the bankruptcy of creditors that just a few months before were posting record sales and interest income. This was the case of two of the country's largest department stores, Arapuã and Mesbla. Banks were not immune either. Public, national private and foreign banks all experienced a surge in default rates in their loans to households. Boavista, one of Brazil's most traditional banks, went bankrupt a year after posting the industry's highest profit rate, which was almost entirely based on interest income due on loans to consumers.

Lenders were unprepared to use the available information to select good borrowers, but the quality and nature of that information may also be blamed for those poor results. Credit Information Registries (CIRs) have existed in Brazil for several decades, but have traditionally maintained mostly black information, obtained from judicial and security registries, chambers of commerce and the Central Bank's registry on returned checks. Since after the Real Plan many borrowers were accessing credit markets for the first time, the information available in those CIRs provided little guidance about the likelihood of borrowers' default. In addition, to some extent the function of CIRs was less to inform creditors than to encourage borrowers to pay, since a bad debtor's name is erased from those registries once payment is done. That is, the emphasis was on enforcement, rather than on building data banks on borrower's payment history.

It is possible then to summarize the situation in Brazil's credit market in the immediate aftermath of the Real Plan as one in which bank supervision and prudential regulation had not been able to prevent the failure of a large number of financial institutions, banks had little expertise in providing credit and CIRs were ill equipped to provide the information necessary for adequate credit risk analysis. In sum, not an environment conducive to the sort of expansion in private sector credit that could help to accelerate economic growth.[3]

3 For evidence on the positive impact of financial deepening on economic growth, see King and Levine (1993) and Beck, Levine and Loayza (1999).

Brazil's credit market has changed since then, with banks investing in improving their credit analysis, a renewed dynamism in the CIR industry and a substantial upgrade in the quality of bank regulation. The decline in real interest rates and in reserve requirements since the 1999 devaluation of the real have also contributed to stimulate credit activities. But, as we argue in this paper, one feature of Brazil's credit market should not change in the foreseeable future: its segmentation into different submarkets, with borrowers who pose equal risk to banks facing different loan conditions, depending on their size and the nature of their banking relationships. Segmentation, in turn, will limit the scope of CIR activities, which should continue to concentrate on collecting and disseminating black information, largely with enforcement purposes. Further improvements in bank regulation should then take into account that a large share of the information necessary to assess credit risk will remain private to individual banks.

Taking the Brazilian case as an example, this paper analyzes the consequences of interbank asymmetry of information for the way credit markets operate and, in particular, for the role played by CIRs in disseminating information. We argue that poor accounting and widespread tax evasion cause relationship banking to be a key source of information about a wide spectrum of borrowers, making much of the relevant information about creditworthiness private to individual banks. In this environment, credit markets tend to fragment into segments with different characteristics regarding interest rates and average loan size. The more pervasive is tax evasion and the more opaque is publicly available information, the larger the share of credit channeled through non-competitive market segments, where banks exploit their information monopoly to extract rents from borrowers, charging interest rates above those which would prevail in the presence of symmetric information. We show that in such a segmented credit market the role of private CIRs is limited essentially to supplying black information about borrowers, the main objective of which is to foster debt repayment. Although the analysis is centered on the Brazilian case, we believe that our results are also relevant for other developing countries.

We proceed in three steps. In Section 2 we focus on the use of credit information by banks in their loan operations, showing how interbank asymmetry of information resulting from relationship banking causes market segmentation. In Section 3 we argue that market segmentation helps to explain why CIRs in Brazil tend to collect and supply mostly black information, and explain why this situation is unlikely to change even if better mechanisms to screen borrower type become available. In Section 4 we look at how market segmentation affects supervision and prudential regulation of the banking sector. A final section sums up our main conclusions and the policy implications of our analysis.

2. Bank Lending to Private Parties in Brazil

2.1. The Credit Decision Process

Up to 1994, private Brazilian banks were not very active in lending and therefore were not careful in implementing credit decision policies and processes. In the high inflation period, from 1974 to June 1994, with full indexation of wages, rents, contracts, foreign exchange and financial assets, monetary policy was generally aimed at controlling the nominal interest rate, therefore providing liquidity to sustain increasing levels of aggregate demand. Default ratios by both firms and individuals were low, changes in loan-loss reserves were a small share of banks' total expenditures, and credit income answered for an equally small fraction of their overall revenue. Under those circumstances, credit policies were almost non-existent, being limited to maintaining internal customers' files (*cadastros*) to store particularly negative information. Banks exchanged information about their customers with other lenders (both banks and non-banks) through a completely informal network of informers (the so-called *informantes*) whose sole function was to crosscheck restrictive data about the bank's borrowers.

It was only after price stability in 1994 that financial institutions became keen on expanding their lending operations, particularly in financing the sale of durable consumer goods. In fact, there was an incipient credit bubble beginning with the stabilization plan in July 1994 and lasting up to March 1995. Expenses and income associated with credit activities began to account for a significant proportion of total bank expenditures and revenues. However, both banks and borrowers were not prepared to operate in the new environment of easy access to credit. The default ratio on bank loans increased faster than total performing loans during this period, which is, among other factors, an indication of the generally poor quality of credit management then prevailing in the country. In January 1995, on average, for each *real* of performing loans banks posted R$ 0.08 of non-performing loans; in January 1997, the corresponding figure was R$ 0.18, that is, a 125% increase. This unsuccessful experience prompted many banks to restructure their credit areas, trying to introduce new policies and procedures to cope with credit risk.

Six years after the burst of this credit bubble, there are still substantial cross-bank differences with respect to the stage of their organizational development, as far as the formulation, implementation, monitoring, controlling and evaluation of credit policies, procedures and practices. On the one hand, there are some banks with a relatively strong credit culture, which tend to make intensive use of internally generated information as well as

external data (that is to say, mainly data provided by the various CIRs) as inputs to their credit decision process. On the other hand, banks with a loose or ill-formulated credit policy in most cases do not make use of formal criteria to allocate credit (other than the traditional method of establishing fixed credit limits to customers) and therefore use information less intensively, including CIR data, to decide on lending operations. In between these two types, and this might be the case of most banks, there are many institutions trying to introduce formal policies, procedures and practices of credit management, including purchase of foreign methods and models of credit analysis and scoring.

Procedures adopted in the credit decision process differ according to the type of bank and the characteristics of the loan/borrower. For loans to consumers and to small business, the general trend is towards the introduction of a highly decentralized process of credit management. According to this, all loan requests are treated automatically by statistical methods (credit scoring, for instance), based on information supplied by the client and/or available from public records, with a decision being rapidly reached at the branch level. Taking into consideration the borrower's characteristics, the statistical model assigns him/her a quantity of points and the corresponding automatic credit limit. Exceptions are dealt with at higher levels of the credit bureaucracy, generally by credit committees. This asset allocation process is mostly used in lending operations such as overdraft facilities, consumer installment credit, leasing, credit-card loans and secured or unsecured personal loans. That seems to be the most efficient way to guarantee speedy decisions in large retail banks, which can receive as much as 2000 loan applications per day.[4] For loans to small business, typically for working capital needs (based on discounting of predated checks and *duplicatas*), the decision process is very similar, with branches having their own credit limits for secured operations.[5] This means that a large share of all loans, as much as 80% in some banks, is decided at the branch level, based on automatic credit evaluation methods relying on statistical analysis.

For loans other than to the so-called retail market – i.e., consumers and small businesses – the traditional method of credit management is to establish credit limits per customer in order to restrain the lender's exposure to a particular obligor. A recent trend in the banking industry has been to transform the credit decision into a group decision, that is to say, a decision made by formal credit committees which are generally organized according to criteria such as the value of the loan, the existence

4 In fact, in this type of retail operation banks compete with each other with respect to the speed at which they can decide on loan applications, with speed in this case being measured in number of seconds.

5 Given the precarious quality of accounting and other financial information on small businesses, where the firms' and the owners' banking accounts often mix together, lenders tend to consider them as a single entity for credit granting purposes.

and kind of collateral, and the type of operation. Each application is treated on a case-by-case basis by the corresponding credit committee, taking into consideration variables such as the client's file (*cadastro*), its economic and financial situation, its relationship with the bank, its business tradition and its industry's prospects. In some large banks, branches do not extend business loans (except to the small businesses mentioned earlier), with loan applications being decided by these committees or by the bank's credit department. Some small wholesale banks with relatively large loan values per business customer have rather formalized rules for the credit committees' organization, including variables such as its composition, size of exposure, maximum and minimum loan maturity, types of collateral, rules for functioning and also for voting on loan requests.

Our interviews with bank managers revealed substantial differences with respect to the intensity with which financial institutions resort to CIR data – both black and white (see Annex A). As a general rule, it can be said that all banks use negative information provided by CIRs as a first filter in the credit decision-making process, that is to say, in order to decide whether or not to continue with the analysis of the credit application. Therefore, that type of information is the relevant barrier to discriminate between potential borrowers and applicants with no access to credit markets.[6] In the retail market, where a large number of low-value loans to small businesses and individuals take place, the discriminating variable is the borrowers' credit records (*cadastro*), which is heavily biased towards weighing the importance of restrictive information. In this case, black information provided by CIRs is probably the most relevant and possibly the only data used in the credit decision process.[7]

Once a credit relationship has been established, information provided by CIRs becomes useful also for monitoring the borrower's financial situation, i.e., to learn about the occurrence of events that might lead to default. In this way, both upgrades and downgrades in the borrower's creditworthiness can be anticipated by monitoring changes in his/her economic fortunes as recorded in those registries. This is not a trivial consideration, given that in the eighties and nineties the Brazilian economy has been subjected to severe macroeconomic shocks, which deeply

6 Of course, the larger the geographical coverage of the CIR databases the better the quality of the information. But banks also value two other aspects of the information supplied by CIRs. First, the timeliness and accuracy of the information, that is to say, the time lag between any event affecting borrowers' behavior and its transmission to the creditors' files. The shorter this time interval the more rapidly the credit registry traces the changes in the borrower's economic and financial conditions. Second, the degree of completeness of the information in terms of its market coverage, meaning by that the CIR's capacity to provide information on the borrower's behavior in other segments of the credit market, such as trade finance, consumer credit, real-estate markets, capital markets, and so on.

7 Indeed, some of the large commercial banks have replaced their own business records by similar information gathered and processed by Serasa, Brazil's largest CIR.

affected borrowers' ability to pay. High volatility in interest and exchange rates, varying restrictions on terms and conditions for lending, and trade liberalization are examples of macroeconomic outcomes that have made banks face large swings in market as well as credit risks.

The importance of negative information in credit analysis decreases as the size and complexity of the loan operation increase. Its role is therefore less important in the so-called middle-market, which seems to be the most profitable business lending activity in Brazil. Banks use two types of information to make loan decisions in this credit segment: firstly, black and white information provided by CIRs and by other lenders and, secondly, data collected by the bank itself through balance-sheet analysis and on-site visits to firms. In most cases, lenders use the CIR information either to check or to complement their own private information and analysis. There are financial institutions that even maintain their own in-house credit rating facility. Some more aggressive banks in this market segment almost disregard the usual published balance-sheet data, on account of their misrepresentation of the actual economic and financial situation of companies. Instead, they replace the formal accounting information with an internally created managerial information system to trace the actual changes in the company's financial conditions. One important part of such a system is to monitor the liquidity of the borrowers' receivables (mainly *duplicatas*) since the latter are the most commonly accepted collateral for business loans in Brazil. The data and analysis of borrowers' creditworthiness gathered by internally developed management information systems remain private to the bank and are not shared with credit bureaus.

In the case of loans to large firms (private corporations, Brazilian and multinational, and some state-owned firms), information provided by CIRs has a very limited role in the credit analysis process, in comparison to the research and analysis conducted by the lender itself, coupled with whatever private information has been previously gathered by the financial intermediary. Audited balance sheets and other financial statements are also valuable in such cases because they are more reliable than for smaller firms. In particular, many of these borrowers, being public corporations (with shares quoted in domestic or US stock markets, or having raised funds abroad through issuance of eurobonds or through debt instruments in Brazilian markets, such as debentures and commercial papers) have to provide investors with a regular flow of information on their economic and financial conditions. The credit process takes longer and is obviously more costly, relatively to other lending operations. Lending to the so-called corporate sector accounts for a large proportion of the total credit portfolio of Brazilian retail banks,

though its client-base is very small. Spreads are also rather narrow in this type of credit operations.[8]

An important feature of the Brazilian credit market that comes through rather clearly from the above description is its division in three segments, which differ with respect to typical loan size and the nature and amount of information on borrowers used by creditors. In the retail market the number of loan applications is very large, loan size is small, interest rates are high and the credit-decision process is decentralized and automated, relying mostly on outsourced, black information. In the middle market, banks tend to base their decisions on internally collected information, which is often obtained from a continued banking relationship with borrowers. This information remains private to the bank. The very poor quality of the information contained in those borrowers' balance sheets, largely a result of pervasive tax evasion and poor accounting practices, makes information on the borrower's cash flows extremely valuable to assess her actual creditworthiness. A third market segment comprises foreign and large national corporations, which for various reasons keep much better accounting, which is largely public information. In this market segment there are fewer borrowers, but loans tend to be larger and interest rates lower than in the other segments.

Some of these features of the Brazilian credit market are evident in Table 2.1, which shows the distribution of borrowers with total debts of R$ 20,000 or more in any single financial institution, according to loan size and number of institutions with which they contracted those loans.[9] On the whole, there were 1.1 million individual borrowers in this group on June 30, 2000, with outstanding debts of R$ 65,0 billion, each of them owing on average R$ 58,878. For the 178.8 thousand firms in the same category, total debts added to R$ 162,3 billion, corresponding to an average loan of R$ 907,489 per firm.

Brazilian borrowers tend in general to prefer single-bank relationships. In the case of individual borrowers, only one in every twenty owes money to more than one institution. This pattern is heavily influenced by the behavior of small debtors, that is, those with total loans between R$ 20,000 and R$ 50,000, who account for 66% of all individuals with debts above 20 thousand *reais*, and who only exceptionally (0.5% likelihood) borrow from more than one institution. Among mid-sized individual borrowers (R$ 50,000 $< l \leq$ R$ 200,000) single banking is

8 They can vary from 0.5% to 5.0% p.a., with the lending rate following closely the changes in the basic domestic interest rate (*Gazeta Mercantil*, September 22nd, 1999). These contrast with much higher average spreads on commercial loans, which in September 1999 reached 36.9% (Central Bank).

9 Not shown in Table 2.1 are the loans to borrowers with debts of less than 20 thousand *reais* in any single financial institution. Overall, these account for 30 percent of the total credit extended to individuals and firms in Brazil (R$ 325.0 billion on June 30, 2000), with R$ 53.0 billion lent to individuals and R$ 44.8 billion to firms.

Table 2.1
Distribution of Borrowers According to Value of Total Loans (*l*) Extended by the Financial System and the Number of Institutions that Have Extended Those Loans (June 30, 2000)[a]

Sum of Loans Extended to Each Borrower (l) in 000 R$	*1 Institution*		*2 Institutions*		*3 Institutions*		*4 Institutions*		*5 or More Institutions*		*Total*	
	Individuals	*Firms*	*Individuals*	*Firms*	*Individuals*	*Firms*	*Individuals*	*Firms*	*Individuals*	*Firms*	*Individuals*	*Firms*
$20 \leq l \leq 35$	503.118	55.372	2.450	1.690	135	342	26	113	4	105	505.733	5.622
$35 < l \leq 50$	223.325	20.621	4.600	3.203	119	250	13	86	1	67	228.058	24.227
$50 < l \leq 100$	246.001	21.005	20.458	13.030	1.187	2.242	83	258	11	224	267.740	36.759
$100 < l \leq 200$	63.534	8.475	14.702	7.891	2.837	4.652	424	1.499	79	582	81.576	23.099
$200 < l \leq 1.000$	8.620	6.460	5.712	5.578	2.412	4.883	842	3.452	397	4.451	17.983	24.824
$1.000 < l \leq 10.000$	1.021	2.032	504	1.514	266	1.324	170	1.128	172	4.234	2.133	10.232
$10000 < l \leq 50000$	41	238	27	138	10	129	5	131	12	943	95	1.579
$50.000 < l \leq 100.000$	5	47	-	13	-	18	-	20	-	165	5	263
> 100.000	3	42	1	13	1	11	-	8	-	153	5	227
Total	**1.045.668**	**114.292**	**48.454**	**33.070**	**6.967**	**13.851**	**1.563**	**6.695**	**676**	**10.924**	**1.103.328**	**178.832**

Source: *Central Bank.*
[a] *Includes only borrowers with debts of R$ 20 thousand or more in any single financial institution. On June 30, 2000, 1 USD = R$ 1.769.*

also prevalent, with only 11.4% of them having debts with more than one institution. Even among large borrowers (l > R$ 200,000) single banking is common, although 52% of them have debts with two or more institutions.

Single-banking is also dominant among firms, which however tend to diversify their sources of loans more than individuals. Considering all firms with debts of R$ 20,000 or more, we have that just 36.1% of them borrow from more than one bank. In the case of small debtors single banking is more prevalent, with only one in every ten firms owing money to more than one institution. Mid-size commercial debtors tend to operate with more banks than small ones, but yet 49.3% of them have debts with only one institution and 35.0% with just two institutions. For large commercial debtors, however, multiple-bank relationships are the norm, with only 23.8% of them operating with a single institution.

Below we present a simple model with interbank asymmetry of information that produces the sort of market segmentation described above. Segmentation arises because good borrowers are "informationally captured" by the institution with which they bank, and as a consequence end up paying higher interest rates than they would in the standard symmetric information case. The assumption that in the context of interbank asymmetry of information inside banks are able to extract rents from safe borrowers is standard in models that feature relationship banking.[10] Differently from those models, however, we assume that, one, even for

10 See, for instance, Sharpe (1990), Besanko and Thakor (1993), and Padilla and Pagano (2000).

the inside bank, there is a cost to assess borrower type; and, two, that a borrower can evade this "information trap," by making its type known to outside banks, even if at a cost, what constrains the monopoly power of the inside bank.[11] We then use the model to conduct some comparative static exercises to see how this market structure changes with banks' borrowing rates and the cost of information.

2.2. The Model

The model has 2 types of borrowers, safe and risky, with probabilities of default $1-q_s$ and $1-q_r$ ($q_r < q_s$), respectively. When borrowers default, the bank receives nothing. Borrowers differ also with respect to how much the loan is worth to them (v), and to the size of the loan (l) they seek, which is assumed to be independent of v. For consumers v may be interpreted as the rate of time preference and for firms as the rate of return they expect to obtain from investing the money they borrowed. We assume that v is uniformly distributed in $[0,V]$, while l has an exponential distribution with mean λ.[12] For all intervals $[V_0,V_1]x[L_0,L_1]\subset[0,V]x(0,\infty)$ there is a proportion p of safe borrowers. Borrowers' rate of return or time preference and the size of the loan they seek are private information, but their distributions are common knowledge. All banks and borrowers are assumed to be risk neutral.

At the beginning of each period, each borrower has a banking relationship with a single bank.[13] It is easier for this incumbent bank than for all other banks to ascertain this borrower's type, but there is also a cost associated to this.[14] To make her type known to outside banks, entering what we call the corporate market, a borrower has to spend C_C. Alternatively, she may decide to reveal her type to the incumbent bank at a cost C_M ($< C_C$).[15] We assume C_C and C_M to be public information. Finally,

11 There is also a difference of degree: the information advantage that the inside bank has vis-à-vis outside banks from being able to infer a borrower's shadow accounts is likely to be much larger than the one it would be able to derive from a "normal" banking relationship. Moreover, this privileged access concerns not only the ability to better discern negative facts about the borrower, which could be hidden by accounting tricks, but especially positive factors, that while widely publicized in advanced economies, will be kept under wraps in countries in which tax evasion is widespread.

12 In Annex B we present the empirical distributions of loan size for individuals and firms on June 30, 2000. Because these reflect the distribution of loans actually extended, they do not necessarily have to be exponentially distributed, even if the ex-ante distribution is. Comparing the empirical distribution with the exponential, lognormal, uniform and Weibull distributions with the same mean we find that the exponential distribution provides the best fit in the case of individual borrowers, but not for firms, for which the lognormal gives a closer approximation.

13 It is not necessary to assume that borrowers do not bank with other institutions, but simply that only one of these has sufficient information on the borrower's financial data to securely ascertain at a low cost whether she is safe or risky.

14 In practice, because it is necessary to process the relevant information and due to high market volatility, which causes borrower type to change frequently.

15 One way to interpret C_C is as being the cost to hire a rating agency. But in the Brazilian context a more relevant factor tends to be the cost of conducting business in a formal way, with proper accounting. In particular, because this makes tax evasion more difficult, increasing borrower's tax expenditures. So we attribute most of the difference between C_C and C_M to the difficulty of borrowers who tap the corporate market to evade their taxes.

a borrower may opt not to reveal her type and borrow in the retail market. There is no fixed cost in accessing the retail market.[16]

The credit market is then divided in three segments: corporate, middle and retail. In the first, there is perfect symmetry of information and all banks know whether the potential borrower is safe or risky. In the retail market no bank knows a borrower's type, and complete asymmetry of information prevails between banks and borrowers. We assume that the number of banks is sufficiently large for loans in the corporate and retail markets to be priced competitively. The middle-market is characterized by a close banking relationship, so that only one bank knows whether the potential borrower is safe. This sort of interbank information asymmetry exists in all credit markets, but what is peculiar in Brazil and possibly in other developing countries is the magnifying effect of tax evasion and poor accounting practices, with only one bank being able to observe the actual cash flow, and indirectly the creditworthiness, of the borrower. We assume that each bank acts as a monopolist in its middle market segment.[17]

The game is played as follows. Initially, banks set a menu of interest rates for the three market segments. Borrowers then decide whether or not to tap the market, and, if they decide to borrow, in which market segment to do so. A Nash equilibrium may then be derived by fixing the menu of interest rates so that banks maximize their expected profits conditional on borrowers' optimal reactions.

A safe borrower i will choose the corporate market iff (if and only if)

$$q_s(v_i - R_C^s)\, l_i > C_C \text{ and } C_C - C_M < l_i(R_M^s - R_C^s)q_s, \text{ that is,}$$

$$v_i > R_C^s + \frac{C_C}{l_i q_s} \qquad (2.1) \text{ and}$$

$$l_i > \frac{(C_C - C_M)}{q_s(R_M^s - R_C^s)} = L_C \qquad (2.2),$$

16 The results do not change if we assume instead that it is the bank that initially incurs the cost C_C or C_M and later charges it to the borrower, as long as (i) the latter still incurs some upfront cost to apply for credit and (ii) the mechanism to screen borrower type always correctly identifies her type and she knows that. The model would not change either if we assumed that banks pay for screening borrowers and afterwards charge this cost to them by way of interest rate spread s so that $s(l) = C_j/l$, where $j = M$ or C for the middle and corporate markets, respectively.

17 The realization that a continuous financial contact between a bank and its clients generates valuable information dates back to Kane and Malkiel (1965) and Black (1975). Fama (1985) noted that this information is important for both screening and monitoring purposes. Lummer and McConnell (1989) present empirical evidence that the information generated by close bank relationships is well valued by market participants. Besanko and Thakor (1993) analyze the importance of relationship banking for both lenders and borrowers and argue that the rents earned by banks from that relationship may be an important incentive to avoid the moral hazard problems created by risk-insensitive deposit insurance. Boot (forthcoming) reviews the recent literature on relationship banking and the empirical evidence on its value for borrowers and lenders.

where R_C^S and R_M^S are the interest rates charged to safe borrowers in the corporate and middle markets, respectively. Competition in the corporate market ensures that $R_C^S = (1 + R)/q_S - 1$, where R is the banks' borrowing rate. Condition (2.1) states that a safe borrower will be interested in accessing the corporate market only if the expected net benefit of the loan exceeds the cost of informing the market about its type. Condition (2.2) says that a safe borrower will go to the corporate market if the savings from paying a lower rate of interest rate in this market segment more than compensate the additional cost of revealing her type to outside banks. These imply essentially that the corporate market is the best option for large safe borrowers.

Safe borrowers will choose the middle market iff

$$q_s(v_i - R_M^S)\, l_i > C_M,\ C_C - C_M > l_i(R_M^S - R_C^S)q_s, \qquad \text{and}$$

$$C_M < l_i(R_T - R_M^S)q_s, \qquad \text{that is}$$

$$v_i > R_M^S + \frac{C_M}{l_i q_s} \qquad (2.3), \text{ and}$$

$$\frac{C_M}{q_s(R_T - R_M^S)} = L_M < l_i < L_C \qquad (2.4), \text{ where}$$

$$R_T = \frac{1 + R}{p^T q_s + (1 - p^T)q_r} - 1$$

is the interest rate charged from borrowers in the retail market, with p^T being the proportion of credit extended to safe borrowers in that market segment.[18] L_M and L_C are, respectively, the lower and upper bounds of the middle market and, because they depend on the menu of interest rates, are determined endogenously.

Finally, a safe borrower will operate in the retail market iff

$$v_i > R_T \qquad (2.5) \text{ and}$$

$$l_i < L_M \qquad (2.6),$$

In equilibrium, all risky borrowers, independently of loan size and expected return, will be in the retail market, since it is always the case that

$$R_T \le R_C^r = \frac{1 + R}{q_r} - 1 \le R_M^r$$

18 Note that because the average loan size granted to risky borrowers in the retail market will be larger than the average loan size extended to safe borrowers, p^T will be smaller than the proportion of safe borrowers in the retail market.

with R_T being strictly lower than R_C^r if $p^T > 0$.[19] Then, a risky firm or consumer will be willing to borrow if $v_i > R_T$. Therefore, the share of loans extended to safe borrowers in the retail market, p^T, is:

$$p^T = \frac{p(1 - (1 + L_M/\lambda)e^{-L_M/\lambda})}{1 - p(1 + L_M/\lambda)e^{-L_M/\lambda}} \tag{2.7}$$

Under these assumptions, and considering a universe of N potential borrowers, the volume of credit extended in each of the three market segments is given by:

Corporate market:

$$VC_C = Npe^{-L_C/\lambda}\left[(L_C + \lambda)\frac{(V - R_C)}{V} - \frac{C_C}{Vq_s}\right]$$

Middle market:

$$VC_M = Np\left\{\frac{(V - R_M)}{V}[(L_M + \lambda)e^{-L_M/\lambda} - (L_C + \lambda)e^{-L_C/\lambda}] - \frac{C_M}{Vq_s}\left[e^{-L_M/\lambda} - e^{-L_C/\lambda}\right]\right\}$$

Retail market:

$$VC_T = \frac{N(V - R_T)}{V}[\lambda - p(\lambda + L_M)e^{-L_M/\lambda}]$$

In equilibrium, banks make zero expected profit in the retail and corporate markets, which are actuarially balanced, and derive all their economic profits from the middle market, where they earn

$$(1 + R_M)q_s - 1 - R$$

for each dollar lent. Thus, total expected profit is given by

$$E(\Pi) = ((1 + R_M)q_s - (1 + R))VC_M \tag{2.8}$$

The only decision variable in this model is the interest rate charged by banks to their (safe) clients in the middle market. When fixing this rate, banks have to take two effects into account. On the one hand, the higher R_M, the more they earn from their middle-market clients. On the other hand, the more they raise this rate, the higher L^M and the lower L^C, so that less credit is extended through the middle market. Maximizing (2.8) with respect to R_M does not yield a closed form solution, but we can do some exercises on comparative statics using numerical maximization. In Tables 2.2 to 2.5 we conduct such an exercise, examining how the market behaves when we change the banks'

19 Because only safe borrowers access the corporate and middle markets, from now on we drop the superscript s from interest rates in these two market segments.

borrowing cost (R), the cost of accessing the corporate and middle markets (C_C and C_M) and borrower diversity (q_s-q_r). In all cases, unless otherwise stated, we fix R = 15%, λ = \$1, N = 1,000, V = 0.8, C_C = \$0.1, C_M = \$0.01, p = 0.6, q_s = 0.98 and q_r = 0.8.

To assess the impact of segmentation we compare the results of the model with two benchmarks in which interbank asymmetry of information is not present. The first is the case in which borrower type is public information, so that the volume of credit (VC^*) extended to safe and risky borrowers and the corresponding market interest rates (R^*) are, respectively,

$$VC_j^* = p_j N\lambda(V - R_j^*)/V \qquad (2.9), \text{ and}$$

$$R_j^* = (1 + R)/q_j - 1 \qquad (2.10),$$

where $j = s$ and r stand for safe and risky borrowers, respectively, $p_s = p$ and $p_r = 1 - p$. With perfect information the average loan size would be λ for both safe and risky borrowers.

The other benchmark is given by a situation in which there is no way to determine borrower type – i.e., there is interbank symmetry of information, but asymmetry between borrowers and banks. In this case the market interest rate and the volume of credit to safe and risky borrowers would be

$$R^{**} = (1 + R)/q^{**} - 1; \qquad (2.11), \text{ and}$$

$$VC_j^{**} = p_j N\lambda(V - R^{**})/V \qquad (2.12),$$

where $q^{**} = pq_s + (1 - p)q_r$.

It is immediate to verify that $q_s = q^C = q^M > q^{**} > q^T > q_r$, $R_s^* = R_c < R^{**} < R_T < R_r^*$, and that $R_C < R_M < R_T$. It follows that, if borrower type is not known by any bank, safe (risky) borrowers are worse (better) off than if borrower type was known to all banks. The intermediate situation of a segmented credit market, as modeled above, produces losers and winners. Large borrowers will tend to gain, particularly if C_C and C_M are small, but risky and small safe borrowers will lose. Yet, even though default and interest rates are higher in the retail market than in the rest of the credit market, risky borrowers will be better off with market segmentation than if complete symmetry of information prevailed. In this sense, interbank asymmetry of information creates a cross subsidy from safe to risky borrowers in the retail market. This subsidy will increase with borrower diversity ($q_s - q_r$) and decline with C_C and C_M.[20]

20 What is less intuitive is that safe borrowers in the retail segment also subsidize borrowers in the middle market, by reducing R_T and in this way constraining the ability of the incumbent bank to extract rents.

2.3. Comparative Statics

Compared to a situation of perfect symmetry of information, market segmentation penalizes safe borrowers in all three market segments (Table 2.2). Those in the corporate market pay the symmetric-information interest rate for safe borrowers, but have to spend C_C to reveal their type, which is equivalent to an additional 2.8% spread (considering the parameter values used in this exercise). Interest rates to borrowers in the middle market are 4.6 percentage points above the perfect information rate of interest, with borrowers incurring an information cost that is equivalent to a 1.4% spread. Safe borrowers in the retail market pay an interest rate mark-up that ranges between 24.6% and 28.6% depending on banks' borrowing rates. Risky borrowers pay an interest rate only marginally lower than they would if perfect information prevailed. These additional costs reduce the volume of credit extended to safe borrowers between 7% and 9%, compared to the amount that would have been extended in the case of perfect information symmetry. As a consequence, default rates are also higher than when borrower type is known to all banks.

Contrasted to a situation in which banks have equal ignorance about borrower type, market segmentation benefits borrowers in the corporate and middle markets, who are able to borrow at a lower cost, information costs included. Risky borrowers, in turn, are penalized with much higher rates of interest, as are small safe borrowers, for whom it is not worth to pay to let the market know its type. As a consequence, although with market segmentation more credit flows to safe borrowers and less to risky ones than when borrower type may not be inferred by banks, and as consequence the market default rate is lower, credit becomes concentrated on large borrowers.

A decline in the cost of capital to banks lowers interest rates to both types of borrowers in all situations, but to a larger degree in the case of risky borrowers, when either market segmentation or perfect information prevails. As a consequence, a lower proportion of total credit goes to safe borrowers, raising in the market's default rate, which however stays below the rate observed when banks are equally ignorant about borrower type.[21] With market segmentation, all players benefit from a reduction in R, with a rise in borrower surplus and bank profits.[22]

An important conclusion that follows from these results is that market segmentation does not substantially affect the overall volume and the quality of credit. By treating debtors who do not want to pay to credibly reveal their type essentially as risky

21 Note that this exercise abstracts from the likely increase in q_s and q_r as a result of lower interest rates, which would contribute to reduce default rates.

22 Note, though, that since credit volumes rise more than profits the rate of profit per dollar lent comes down.

Table 2.2
Credit Market Reaction to a Reduction in the Cost of Funds to Banks

Variables					
Banks cost of capital (R)	25.0%	20.0%	15.0%	10.0%	7.5%
With complete symmetry of information					
Interest rate					
Safe borrowers	27.6%	22.4%	17.3%	12.2%	9.7%
Risky borrowers	56.3%	50.0%	43.8%	37.5%	34.4%
Volume of credit ($)[a]	512.2	581.6	651.2	720.7	755.4
Safe borrowers	393.4	431.6	469.9	508.2	527.3
Risky borrowers	118.8	150.0	181.3	212.5	228.1
Market default rate	6.2%	6.6%	7.0%	7.3%	7.4%
Without interbank asymmetry of information					
Interest rate ($q^{**} = 9.2\%$ in all cases)	37.7%	32.2%	26.7%	21.1%	18.4%
Volume of credit ($)[a]	529.2	598.0	666.9	735.7	770.1
Safe borrowers	317.5	358.8	400.1	441.4	462.1
Risky borrowers	211.7	239.2	266.7	294.3	308.0
With interbank asymmetry of information					
Interest rate					
Corporate (R_C)	27.6%	22.4%	17.3%	12.2%	9.7%
Middle (R_M)	32.0%	27.0%	21.9%	16.8%	14.3%
Retail (R_T)	56.2%	50.0%	43.7%	37.4%	34.3%
Middle-market limits ($)					
Upper bound (L_C)	2.062	2.039	2.019	2.003	1.996
Lower bound (L_M)	0.042	0.044	0.047	0.049	0.051
Volume of credit ($)					
All borrowers	475.7	545.0	614.3	683.7	718.4
Safe borrowers	356.7	394.8	432.8	470.9	490.0
Corporate (VC_C)	143.5	160.8	178.2	195.6	204.3
Middle (VC_M)	213.1	233.7	254.4	275.0	285.3
Retail (VC_T)	0.2	0.2	0.3	0.4	0.4
Risky borrowers (in retail market)	119.0	150.2	181.5	212.8	228.4
Number of borrowers					
Safe borrowers	336	373	410	448	467
Corporate	39	45	51	57	60
Middle	289	319	348	377	391
Retail	7	9	11	14	15
Avg. loan size (safe borrowers, $)[b]					
Corporate	3.654	3.561	3.486	3.425	3.399
Middle	0.736	0.733	0.731	0.729	0.729
Retail	0.021	0.022	0.023	0.025	0.025
Market default rate[c]	6.50%	6.96%	7.32%	7.60%	7.72%
Banks overall profit ($)	9.30	10.32	11.34	12.36	12.87

[a] *Without interbank asymmetry of information, the average loan size to both safe and risky borrowers is equal to $1, so that the number of borrowers in each case is equal to the volume of credit extended.*
[b] *Average loan size for risky borrowers in retail market is $1 in all cases.*
[c] *The default rate in the retail market declines very slightly, from 19.98% when* R = *25.0% to 19.97% when* R = *7.5%.*

borrowers, banks limit the volume of bad credits and keep the market "relatively safe." The main negative consequence of market segmentation is then the high interest rates imposed on small safe borrowers.

With the parameter values used in Table 2.2, approximately 30% of all credit is granted to borrowers in the corporate market, who however represent less than 10% of the total number of borrowers (and between 4% and 6% of the universe of potential borrowers). Like corporate borrowers, all participants in the middle market are safe. But interest rates in this market segment are considerably higher, with $R_M - R_C$ giving the rent extracted by banks from middle-market borrowers. A remarkable result is that this rent actually rises when the cost of funds to banks declines, with spreads dropping less in the middle than in the corporate market. As a result, the range of loan values granted through the middle market (L_M, L_C) also contracts when R comes down, causing the expansion in the volume of credit to be particularly pronounced in the retail market. The increase in L_M leads to a rise in the average loan extended to safe borrowers in the retail market, but since most of the expansion in credit goes to risky borrowers, so does the cross subsidy provided by safe borrowers.

The average loan size extended to safe borrowers is very different in the three market segments. A remarkable result is that the average loan extended to risky borrowers (λ = \$1), all in the retail market, is actually higher than that given to safe borrowers in the middle market, while 40 to 50 times bigger than that granted to safe borrowers in the retail segment. To some extent, therefore, the difference between clients in the retail and middle-markets is more one of risk than of size. Also important is that, to disguise themselves, large risky borrowers will tend to spread their loan requests through various banks. This may help to explain why, as shown in Table 2.1, many mid-sized individual and commercial borrowers operate with more than one bank.[23]

An important parameter in our model is the cost of informing outside banks about one's type (C_C). The higher the value of C_C, the more banks are able to extract rents from middle-market borrowers, and as a consequence the higher R_M and banks' profits (Table 2.3). An increase in C_C and in R_M, in turn, moves both L_M and L_C upwards, reducing the volume of credit extended through the corporate market, but actually increasing lending in the middle and retail markets, even if the net effect is a decline in the total volume of lending. Because access to the corporate and middle markets become more expensive, proportionately more credit is extended to safe borrowers in the retail market, lowering

23 This may also explain why, as shown by Cole (1998), borrowers who concentrate their financial transactions on a single bank are more likely to obtain credit than firms with multiple sources of financial services.

Table 2.3
Reactions to Changes in Cost of Access to Corporate Market
(with interbank asymmetric information)

Variables					
Cost of access to corporate market (C_C, in $)	0.015	0.040	0.080	0.100	0.150
Interest rate in middle market (R_M)	17.6%	19.0%	21.0%	21.9%	24.1%
Middle-market limits ($)					
Upper bound (L^C)	1.841	1.893	1.977	2.019	2.125
Lower bound (L^M)	0.039	0.041	0.045	0.047	0.052
Volume of credit ($)					
All borrowers	642.1	633.5	620.6	614.3	599.6
Safe borrowers	460.6	452.1	439.1	432.8	418.0
Corporate (VC_C)	210.0	200.1	185.2	178.2	161.6
Middle (VC_M)	250.5	251.8	253.6	254.4	256.1
Retail (VC_T)	0.2	0.2	0.3	0.3	0.4
Risky borrowers in retail market	181.4	181.5	181.5	181.5	181.6
Number of safe borrowers					
Corporate	72	66	56	51	41
Middle	365	360	352	348	339
Retail	9	11	11	12	14
Avg. loan size (safe borrowers, $)[a]					
Corporate	2.896	3.051	3.329	3.486	3.943
Middle	0.686	0.699	0.720	0.731	0.756
Retail	0.019	0.020	0.022	0.023	0.026
Market default rate[b]	7.09%	7.16%	7.26%	7.32%	7.45%
Banks overall profit ($)	0.68	3.99	8.98	11.34	16.87

[a] *Average loan size for risky borrowers in retail market is $1 in all cases.*
[b] *The default rate in the retail market declines very slightly, from 19.98% when C_C = $0.015 to 19.96% when C_C = $0.15.*

R_T and attracting more risky borrowers, in the end raising the market default rate.

Therefore, although beneficial to banks, an increase in C_C harms almost all borrowers: (i) it moves borrowers in the lower end of the corporate market into the middle market, where they pay higher rates of interest; (ii) it allows banks to extract more rents from borrowers in the middle market; and (iii) it moves borrowers in the lower fringe of the middle market into the retail market, where interest rates are the highest. Still, safe borrowers already in the retail market and risky borrowers in general obtain a small gain from an increase in C_C, due to the marginal decline in R_T. It follows, conversely, that measures that contribute to reduce the cost for outside banks to infer borrower type, such as the adoption of better accounting practices, should help to reduce default rates, expand the volume of credit and benefit most borrowers. Still, inasmuch as this cost is due more to tax evasion than to poor accounting, the capacity of public policy to reduce the "information capture" of middle-market borrowers is in a sense rather limited.

A reduction in the value of C_M, the cost of informing the inside bank of one's type, attracts safe borrowers in the upper fringe of the retail market to the middle market, shifting upwards the demand for middle-market loans, and consequently allowing for a rise in R_M and in profits (Table 2.4). Despite facing higher interest rates, most borrowers in the middle market experience a net gain from this process, with the only losers being those in the upper end of this market segment, including those that as a consequence move to the corporate market. With fewer and only the very small safe borrowers remaining in the retail market, R_T goes up, lowering the demand for credit of risky borrowers, which in turn causes the market default rate to decline. With a low C_M, the retail market will essentially serve only risky borrowers.

In Table 2.5 we see that borrower diversity ($q_s - q_r$) is good for banks. If risky borrowers become less so, as in the second column of Table 2.5, banks have to bring spreads down in the

Table 2.4
Reactions to Changes in Cost of Access to Middle Market (asymmetric information)

Variables				
Cost of Access to Middle Market (C_M)	0.020	0.010	0.005	0.001
Interest rates				
Middle (R^M)	21.3%	21.9%	22.2%	22.4%
Retail (R^T)	43.6%	43.7%	43.7%	43.7%
Middle-market limits ($)				
Upper bound (L^C)	2.041	2.019	2.009	2.002
Lower bound (L^M)	0.092	0.047	0.024	0.005
Volume of credit ($)				
All borrowers	611.4	614.3	616.1	617.7
Safe borrowers	429.2	432.8	434.8	436.4
Corporate (VC_C)	175.7	178.2	179.4	180.2
Middle (VC_M)	252.4	254.4	255.4	256.2
Retail (VC_T)	1.1	0.3	0.1	0.0
Risky borrowers in retail market	182.2	181.5	181.3	181.3
Number of safe borrowers	583	423	424	429
Corporate	50	51	52	52
Middle	326	348	360	371
Retail	206	24	12	6
Avg. loan size (safe borrowers, $)[a]				
Corporate	3.512	3.486	3.475	3.466
Middle	0.774	0.731	0.709	0.691
Retail	0.045	0.023	0.012	0.002
Market default rate[b]	7.36%	7.32%	7.30%	7.28%
Overall credit market				
Banks overall profit ($)	9.89	11.34	12.07	12.67

[a] *Average loan size for risky borrowers in retail market is $1 in all cases.*
[b] *The default rate in the retail market rises very slightly, from 19.89% when C_M = $0.02 to 20.00% when C_M= $0.001.*

Table 2.5
Reactions to Changes in Borrower Diversity

Variables			
Default rates			
Safe borrowers ($1-q_s$)	0.020	0.020	0.150
Risky borrowers ($1-q_r$)	0.200	0.070	0.200
With complete information			
Interest rates			
Safe borrowers	17.3%	17.3%	35.3%
Risky borrowers	43.8%	23.7%	43.8%
Volume of credit ($)[a]			
Safe borrowers	469.9	469.9	335.3
Risky borrowers	181.3	281.7	181.3
Market default rate	7.0%	3.9%	16.8%
With asymmetric information			
Interest rates			
Corporate (R_C)	17.3%	17.3%	35.3%
Middle (R_M)	21.9%	20.6%	39.5%
Retail (R_T)	43.7%	23.1%	43.3%
Middle-market limits ($)			
Upper bound (L_C)	2.019	2.864	2.543
Lower bound (L_M)	0.047	0.402	0.310
Volume of credit ($)			
All borrowers	614.3	725.5	482.7
Safe borrowers	432.8	440.9	298.9
Corporate (VC_C)	178.2	99.2	86.5
Middle (VC_M)	254.4	315.2	201.7
Retail (VC_T)	0.3	26.5	10.8
Risky borrowers in retail market	181.5	284.5	183.7
Number of borrowers			
Safe borrowers	412	432	285
Corporate	51	22	19
Middle	348	269	193
Retail	12	141	73
Avg. loan size (safe borrowers, $)[b]			
Corporate	3.486	4.479	4.581
Middle	0.731	1.174	1.045
Retail	0.023	0.188	0.147
Default rate			
Retail	19.97%	6.57%	19.72%
Overall credit market	7.32%	3.96%	16.90%
Banks overall profit ($)	11.34	9.91	7.14

[a] *With perfect information, the average loan size to both safe and risky borrowers is equal to $1, so that the number of borrowers in each case is equal to the volume of credit extended.*
[b] *Average loan size for risky borrowers in retail market is $1 in all cases.*

middle market, and although this contributes to raise lending volumes, profits and especially profit rates come down. Interest rates drop very substantially in the retail market, causing the number of borrowers and volume of credit to boom. If the decline in borrower diversity arises from an increase in the default rate of safe borrowers (column 3), profits fall even more, as a result of lower spreads and volume of credit in the middle market. The retail market also becomes relatively more attractive in this case, with an increase in L_M and a decline in R_T.

More information on borrowers, due mainly to the decline in inflation, and lower interest rates, since 1999, were the most important changes that took place in Brazilian credit markets in the turn of the century. The above exercises suggest that although very relevant these changes should not eliminate or substantially alter market segmentation. In the next section we look at another important change in Brazilian credit markets, the strengthening of the CIR industry, and examine the extent to which this should significantly weaken credit market segmentation.

3. Credit Information

3.1. Implications of Market Segmentation to the CIR Industry

A credit market as featured in the model of Section 2.2 implicates a limited role for CIRs: essentially, maintaining black information and providing good ratings for safe borrowers in the corporate sector. In particular, there are no incentives for banks to share white information on borrowers, partly or completely, since by doing that they lose or at least reduce the rent they are able to extract from clients in the middle market (e.g., by lowering C_C), while gaining nothing in return, since banks make no profit in the retail and corporate markets.

Banks will be in general willing to share black information. If such a borrower is in the retail market, the bank will not loose anything from not lending to her, while by blocking her access to credit it will make her more likely to settle her debts. Black lists should be less effective in encouraging debt repayment in the middle market, since in this case the bank will have to weigh the expected gain from enforcement against the lost rent if it refuses to lend.[24] If the borrower is safe and sufficiently large to tap the

24 That is, the fact that the bank knows that the borrower is safe, despite having defaulted in the past, weakens the enforcement incentive of black lists. A comparable result is obtained by Padilla and Pagano (2000), who observe that a situation of complete information about borrower type may give borrowers weaker incentives to perform (i.e., strive to succeed with their projects) than one in which banks know only whether a borrower defaulted or not.

corporate market, enforcement incentives will again be weak, since the borrower may negotiate a loan with another bank allowing for a marginally positive profit to the lender. In these cases, how effective are black lists as an enforcement mechanism will depend on market structure and other incentives. Still, banks will have no incentive not to provide black information (or at least threaten to), and will have some to do so, even if access to credit is not entirely blocked. In the middle market, for instance, since outside banks cannot differentiate middle from retail market borrowers, inclusion of a safe borrower in default in a black list will increase the bank's bargaining power and consequently the rent it is able to extract.

In a segmented credit market, the use of black lists as an enforcement mechanism should extend to the willingness of lenders to drop borrowers from the list if they settle their debts, as this will increase their incentives to repay, while doing little harm to creditors, since information in these lists is scarcely useful, even if borrower type is persistent through time. For the middle and corporate segments, these lists have little use due to the point made above: whether a loan is granted or not depends on borrower type, and since in those market segments this is known for sure, there is little sense in trying to infer it from such lists. Black lists are more useful for credit decisions in the retail market. Since borrowers who defaulted are more likely to be risky than those that did not or that had not been in the market before, and since on average banks lose money when they lend to risky borrowers, it makes sense to deny credit to firms and individuals in black lists.[25] But considering that interest rates in the retail market are very close to those that would be charged to risky borrowers if perfect information prevailed, recovering defaulted loans will likely be more important than the additional risky of extending a loan to a borrower who defaulted in the past, particularly if lenders are shortsighted (as they should be in an environment of very high interest rates).

The role of credit bureaus in a segmented credit market may be more broadly assessed if we assume that not all information that is relevant to predict borrower type is private to banks (as illustrated by the existence of black lists). In this way, suppose that banks can improve their ability to infer borrower type by acquiring and processing information z ($0 \leq z \leq 1$), at a cost $C(z) = c_0 + c_1 z NA_T$ – where c_0 and $c_1 > 0$, and NA_T is the number of loan applicants in the retail sector – as presented in Table 3.1,

25 $P[risky|default] = \frac{(1-q_r)(1-p)}{[(1-q_r)(1-p)+p(1-q_s)]} > \frac{(1-q_r)(1-p)}{[(1-q_r)(1-p)+p(1-q_r)]} = (1-p) = P[risky] =$

$\frac{q_r(1-p)}{[q_r(1-p)+pq_r]} > \frac{q_r(1-p)}{[q_r(1-p)+pq_s]} = P[risky|no\ default]$, for $q_s > q_r$.

Table 3.1
Probability of Correctly Inferring Borrower Type

Actual Borrower Type (X)	*Inferred Borrower Type (Y)*		
	Safe (Y=1)	*Risky (Y=0)*	
Safe (X=1)	$P(X=1, Y=1) = p\,\alpha(z)$	$P(X=1, Y=0) = p\,(1-\alpha(z))$	$P(X=1) = p$
Risky (X=0)	$P(X=0, Y=1) = p\,(1-\alpha(z))$	$P(X=0, Y=0) = (1-p)-p\,(1-\alpha(z))$	$P(X=0) = 1-p$
	$P(Y=1) = p$	$P(Y=0) = 1-p$	

where $\alpha(z) = p + z(\bar{\alpha} - p)$.[26] The information cost $C(z)$ is charged on a pro rata basis to borrowers in the retail market, with each paying $C_T(z) = C(z)/NB_T(z)$, where NB_T is the number of borrowers in the retail market.[27] In addition, banks charge an interest rate R_T to applicants who they consider to be safe – for reasons similar to those noted in Section 2, loan applicants thought to be risky will not borrow in this market segment.

The use of the screening technology will further fragment the market, since it will allow for the creation of a new market segment, which we will call superretail (*ST*), that operates in the same way as the retail segment did in Section 2.2: no questions are asked, no initial fees charged, and all borrowers are charged the same (high) rate $R_{ST} \approx (1 + R)/q_r - 1$. In this sense, the technology should not change one main characteristic of the credit market: the negative correlation across market segments between average loan size on the one hand and spreads and default ratios on the other. Market segments will change, however, with their limits becoming as defined in Table 3.2. We see that:

(i) The corporate market continues to operate as described in Section 2.

(ii) The middle market now has borrowers of two types, both of them safe. The first are those discussed in Section 2 – not large enough to tap the corporate market, but sufficiently big to be willing to spend C_M to show that they are safe. The second are those who would prefer to borrow in the retail market, but because they were wrongly considered to be risky resort to the middle market.

(iii) The retail market continues to have safe and risky borrowers, but the latter in a lower proportion. All risky borrowers for whom $q_r l_i(v_i - R_T) > C_T$ and $l_i > L_T^R$ will apply for a loan in the retail market, and actually borrow if (mistakenly) considered to be safe. Similarly, all safe borrowers for whom $L_T^S < l_i < L_M$ and

26 Most of the following results would also apply if $\alpha(z) = p + F(z)(\bar{\alpha} - p)$, where $F(z)$ is any cumulative distribution function.

27 This is equivalent to assume that borrowers pay an interest rate spread to cover the cost banks incur when using the screening technology, which declines with loan size so that $s(l) = C_T/l$, where $s(l)$ is the spread charged for a loan of size l.

Table 3.2
Credit Market Segmentation with Screening Technology

Market Segment	*Loan Range (A)*	*Willingness to Contract Loan (B)*	*Number of Actual Borrowers as Proportion of Number of Borrowers Satisfying Conditions A and B*
Corporate (all safe)	$l_i > (C_C - C_M)/((R_M - R_C)q_s) = L_C$	$v_i > R_C + C_C/(q_s l_i)$	p
Middle – I (all safe)	$L_C > l_i > (C_M - C_T)/((R_T - R_M)q_s) = L_M$	$v_i > R_M + C_M/(q_s l_i)$	p
Middle – II (all safe)	$L_M^R = (C_M - C_T)/((R_{ST} - R_M)q_s) < l_i < L_M$	$v_i > R_M + C_M/(q_s l_i)$	$p\,(1-\alpha(z))$
Retail – I: Safe and classified as safe	$L_T^S = C_T/((R_{ST} - R_T)q_s) < l_i < L_M$	$v_i > R_T + C_T/(q_s l_i)$	$p\,\alpha(z)$
Retail – II: Risky and classified as safe	$l_i > L_T^R = C_T/((R_{ST} - R_T)q_r)$	$v_i > R_T + C_T/(q_r l_i)$	$p\,(1-\alpha(z))$
Superretail – I: Very small safe	$l_i < L_T^S$	$v_i > R_{ST}$	p
Superretail – II: Very small risky	$l_i < L_T^R$	$v_i > R_{ST}$	(1-p)
Superretail – III: Small safe	$L_T^S < l_i < L_M^R$	$v_i > R_{ST}$	p (1-α(z))
Superretail – IV: Other risky	$l_i > L_T^R$	$v_i > R_{ST}$	(1-p)-p(1-α(z))

$q_s l_i(v_i - R_T) > C_T$ will apply for a loan in the retail market. Those who are considered safe will go ahead and borrow in this market segment.

(iv) Small safe and risky borrowers (those who seek loans lower than L_T^S and L_T^R, respectively); safe borrowers who initially sought credit in the retail market but were wrongly considered to be risky, and for whom $l_i < L_M^R$; and all risky borrowers unable to access the retail market will go to the "superretail" market segment, as long as they have $v_i > R_{ST}$.

For the technology to co-exist with market segmentation it can be neither too efficient and cheap nor insufficiently so. On the one hand, it is necessary that $\bar{\alpha} < 1$ or $C_T > C_M$. To see that, suppose the contrary, that for $z \leq \bar{z}$ $\alpha(z) = 1$ and that $C_T(\bar{z}) < C_M$. Then, for a sufficiently large z it would be possible to perfectly identify borrower type with the use of information accessible to all banks. Competition would then drive R_T down to R_C. Because $C_T(\bar{z}) < C_M$, all safe borrowers would go to the retail market and only this and the super retail market segments would survive.[28] Therefore, segmentation of the credit market is not consistent with a technology that allows perfect screening at a low cost with the use of information that is publicly available.

28 If $C_T(\bar{z}) > C_M$, then (i) if $C_T(\bar{z}) > C_C$, the technology, although precise, would not be used, at least with $z \geq \bar{z}$, since it would be too expensive and for that reason outcompeted by the technology used to identify borrowers in the corporate market; (ii) if $C_T(\bar{z}) \leq C_C$, then the opposite would happen, and the technology would be the one used in the corporate market, with the situation returning otherwise to that described in Section 2.

On the other hand, the technology must be sufficiently cheap (low C_T) and accurate (low R_T) so as to make the retail market competitive vis-à-vis the middle and superretail markets for at least some loan values. That is, the interest rate in the retail market must be sufficiently lower than in the superretail market and not much higher than in the middle market so as to compensate, from the point of view of a sufficiently large number of safe borrowers, the fixed fee (C_T) they have to pay when contracting a loan in the retail market. That means that for at least some $z > 0$, $L_M > L_T^S$, which requires

$$\frac{C_M}{C_T} > \frac{R_{ST} - R_M}{R_{ST} - R_T} \qquad (3.1).$$

Therefore, while, on the one hand, the screening technology may be unlikely to be used, for it will have to be reasonably cheap and efficient to be adopted, on the other hand, if introduced, it may completely change the nature of the credit market. In fact, we may verify that with competition in the retail segment and banks seeking to maximize profits, only two extreme possibilities exist. One, banks do not use the technology and the retail and superretail segments become the same, as was the case in Section 2. Two, the polar situation ensues, with R_T arbitrarily close to R_M and L_M relatively large, so that almost all credit is channeled through the retail market. The following reasons explain why the no-technology equilibrium is the only feasible solution even for reasonably efficient and low cost screening technologies:

[1] Due to economies of scale in the use of the screening technology, and the fact that all but the very small risky borrowers want to borrow in the retail market, a separate retail market is feasible only if R_T is sufficiently low as to cause a substantial volume of safe credit to be extended through that market segment, in this way making the default rate and the borrowing fee (C_T) consistent with that demand. We can show that even for rather cheap and moderately accurate screening technologies it is not possible to generate such a solution unless R_M is relatively high.

[2] If the screening technology is sufficiently accurate and cheap as to satisfy (3.1), competition in the retail market will lead to a reduction in R_T such that the middle market will vanish, except for the provision of loans to safe borrowers who are mistakenly considered risky. This is possible because by lowering R_T down to R_M, banks are able to increase the volume of credit to safe borrowers in the retail segment by a larger extent than to risky borrowers, in this way lowering the default rate in a way consistent with the reduction in R_T.

[3] But banks will react by making the middle market more attractive – and in this way deriving some profit – by lowering R_M to a point where the technology is no longer able to generate a feasible solution to the retail market. Because banks can lower R_M down to slightly more than R_C, and still make a profit, only if the technology is very accurate and cheap, so as to outcompete banks in the middle market, will it be used, in this case eliminating in practice the middle market.

The above argument is illustrated numerically in Table 3.3, where we show how competition between the retail and middle markets works when the screening technology is available, in this case with $\bar{\alpha}$ = 0.97, c_0 = $1 and c_1 = $ 0.001 (variables presented in Table 3.3 are derived in Annex C). In columns A to E, banks' borrowing rate is fixed at 25%, and initially banks charge the profit maximizing rate R_M = 32% in the middle market. One of the possible ways the screening technology may be introduced is presented in column A, where R_T = 32.5%, substantially below the no-screening rate of 56.2% (see first column of Table 2.2). In this case, the retail market takes up the lower half of what used to be the middle market, reducing the amount of credit extended through this market segment to about half its previous size, with banks' profits falling in tandem.

Despite the high efficiency of the technology, correctly predicting borrower type in 92.4% of the cases, about a fifth of all lending in the retail market goes to risky borrowers, causing the default rate in this segment, 5.7%, to be almost the triple of that observed in the middle and corporate markets (2%). The technology is made competitive by the lower cost of screening borrowers ($0.0044 vs. $0.01 in the middle market) and the relatively high rates of interest charged by banks in the middle market.

There are many feasible ways to use the technology in the retail market, for a given rate of interest in the middle market, but only one that maximizes the number of borrowers in this segment. This is the one presented in column B, where we see that through a less intensive use of information (lower z) than in column A, banks are able to lower C_T, extend a larger volume of credit to safe borrowers and reduce R_T to an extent that makes borrowing in the middle market completely unattractive, except for those safe borrowers who are mistakenly classified as risky by the technology, what occurs with a probability of 18.4%. As a result, banks' profits fall even more, to less than a fifth of what they used to be before the introduction of the technology.

Obviously, one should expect banks to react, lowering R_M to make the middle market more attractive to borrowers, in the process stealing some of the clients who used to go to the corporate market (as reflected in the rise in L_C). This will also lead to a reduction in R_T, to keep the technology viable, as shown in column C, but yet succeed in increasing profits, even if to only a third of

Table 3.3
Model Solutions With Screening Technology*

Case	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
Parameters			*R = 0.25*					*R = 0.15*		
c_0	1	1	1	1	0	1	1	1	1	0
R_M	0.320000	0.320000	0.290000	0.290000	0.288000	0.219000	0.219000	0.186000	0.186000	0.185000
Variables										
R_T	0.324962	0.320004	0.294644	0.290003	0.562144	0.225677	0.219003	0.188407	0.186003	0.437114
C_T	0.0044	0.0038	0.0039	0.0042	0.0000	0.0042	0.0032	0.0025	0.0037	0.0000
q_T	0.943	0.947	0.966	0.969	0.800	0.938	0.943	0.968	0.970	0.800
z	0.877	0.584	0.992	0.915	0.000	0.914	0.531	0.926	0.925	0.000
$\alpha(z)$	0.924	0.816	0.967	0.939	0.600	0.938	0.796	0.943	0.942	0.600
L_T^S	0.019	0.016	0.015	0.016	0.000	0.020	0.015	0.010	0.015	0.000
L_M^R	0.024	0.026	0.023	0.022	0.037	0.027	0.032	0.031	0.025	0.040
L_M**	1.161	1.734.740	1.347	1.734.740	0.037	0.880	2.531.229	3.195	2.516.079	0.040
L_C	2.064	2.206	6.338	6.747	7.353	2.017	2.169	7.329	7.837	7.965
NA_T^S	231	354	268	377	7	236	429	432	454	11
NA_T^R	227	231	243	245	119	275	281	299	297	181
NB_T^S	213	289	260	353	4	221	342	407	427	6
NB_T^R	26	63	12	22	71	25	86	26	26	109
VC_T^S	104.3	291.5	140.7	356.1	0.1	87.2	345.1	356.4	431.3	0.1
VC_T^R	26.6	65.5	12.3	23.2	71.4	26.3	88.1	26.2	26.3	108.9
VC_M	110.6	41.6	231.2	22.8	374.3	168.4	55.2	97.8	26.0	452.1
Profit	4.82	1.81	3.28	0.32	4.58	7.51	2.46	1.20	0.32	5.11

* *In all cases, we fix* λ=$1, N=1,000, V=0.8, C_C=$0.1, C_M=$0.01, p=0.6, q_s=0.98 *and* q_r=0.8, c_1=$0.001 *and* $\bar{\alpha}$ = 0.97.
** *In columns B, D, G and I, the upper end of the retail market is given by* L_C.

the pre-technology level. Again, however, competition is not expected to leave things at that, and, as shown in column D, through a combination of lower interest rates and a less intensive use of information than in column C (although much higher than in column B), the retail market again wipes out the attractiveness of the middle market as a borrower's first option, with banks' profits coming down to almost nothing.

But again one should not expect banks to stand still against this loss of profitability. In this way, note in column E that by marginally reducing R_M, to 28.8%, banks are able to make the screening technology unfeasible – in the sense that it is not possible to attract to the retail market a sufficiently large volume of lending to safe borrowers to make R_T competitive (i.e., satisfy condition (3.1). In this final outcome, profits are reduced to half their value in Table 2.2, R_M is 3.2 percentage points below its profit-maximizing level (when the technology is not available), and the middle market covers a much wider range of the credit market, stealing the upper end of the retail market and a substantial part

of the corporate segment.[29] R_T, however, is back to its previous level, so that existence of the technology, when this is not used, benefits most of all borrowers in the middle market, even if there are some positive spillovers to borrowers that used to be in the upper (lower) end of the retail (corporate) market.

In columns F to J we repeat the previous exercise while fixing R at 15%. The results are very similar to the previous ones, with two important differences. First, maximization of the number of borrowers in columns G and I is carried out with less information per borrower (lower z) than in columns B and D, respectively, so that the probability of misclassification is higher than before. Second, the reduction in middle-market spreads and therefore in profits is also more significant. These two changes are the result of a higher number of safe borrowers seeking loans in the retail market when interest rates come down, making the screening technology more competitive.

Unless the screening technology generates feasible retail market configurations only for values of R_M above its profit maximizing level, and/or if setup costs are high and not recoverable, the mere existence of the technology should be sufficient to bring down interest rates in the middle market. That is, if the costs of introducing the screening technology are low, and banks are slow to react to its use by a competitor, existence of the technology will pressure R_M down, much in the same way that contestability operates to keep profits low. As a consequence, a change in conditions that facilitate introduction of the technology will reflect on a lower R_M and a wider middle market. But two features of a segmented credit market derived in Section 2 do not change. First, that the retail/super retail market is dominated by risky borrowers, which penalizes small safe borrowers. Second, that despite the more intense use of information to assess borrower type – now banks keep records on a wider range of borrowers – white information remains private to banks.

In practice, therefore, the actual use of the screening technology in the retail market presupposes limits to competition across the retail and middle market segments. These could take several forms. For instance, banks may introduce the technology while capping the size of the loans extended through the retail market, since large loans in this market segment are more likely to go to risky borrowers than do small ones. This would make the screening technology more attractive if fixed costs are not high, but it would only be effective if banks could identify the overall debt exposure of borrowers in the financial system. A consequence of this strategy would be to secure a forced clientele for

29 In this way, while price stability has made use of screening technologies more attractive, fostering demand for white information, which private CIRs are seeking to supply and banks learning how to use, it has also been the case that banks have started to expand their own information systems to absorb clients formerly in the retail segment into their middle-market clientele.

the middle market regardless of interest rates and costs in the retail segment. Alternatively, it may be the case that making sure that a borrower is safe becomes absurdly expensive for small loans and banks voluntarily limit the size of the middle market from below. Yet another possibility is that also in the retail market banks have privileged access to some of the information relevant to infer borrow type or have some transaction cost advantage vis-à-vis other banks, so that they are able to make a non-zero economic profit from lending in that market segment. In this case, they would weigh the gains made in the two market segments and possibly avoid corner solutions as those described above.

In none of these situations are banks likely to provide to other lenders the private white information they have on middle-market borrowers, for the reasons noted before.[30] This contrasts with the results of Pagano and Japelli (1993), who obtained that under some circumstances banks might be willing to exchange white information on borrowers, even if this reduces their ability to extract rents from them. The reason they reach a different result is that their model, distinctly from ours, assumes that banks earn positive profits even if they have no information advantage, because they have a location advantage vis-à-vis other banks. So they will trade white information if by doing that they can increase location rents in excess of the loss in information rents. The existence of location rents seems unrealistic for the corporate and middle-markets in Brazil, where all major banks operate nationwide, but it may be a reasonable assumption for the retail market, in this way helping to explain why banks could also extract rents in this market segment and would not want to make the screening technology unfeasible by lowering R_M "too much."

3.2. The CIR Industry in Brazil[31]

Traditionally, CIRs in Brazil have concentrated their activities on keeping black lists on borrowers in default, essentially with the purpose of enforcement, with borrowers who settle their debts having their names cleared from those lists – in fact, CIRs have explicit rules requiring participants to drop debtor names from those registries upon repayment. Even if creditors do not strictly abide to those rules, CIRs are keen to provide debtors with facilities for them to do so.[32] And borrowers have strong incentives

30 It is remarkable, for instance, that although it would make sense for banks to voluntarily share information so as to learn the total lending extended by the financial system to each borrower, an information that could be instrumental in identifying risky borrowers, nothing was done in that direction until mandated by the Central Bank (see next section).

31 This section partly draws on Pinheiro and Cabral (1998).

32 For instance, Serasa (see below) has an agency in each state to where borrowers can bring proof of debt settlement and get their names out of Serasa's listings. The Retailers Associations also keep a window in their offices where borrowers can "clear" their names from the SPC listings (see below).

to do so, since inclusion of one's name in any of those lists is in general sufficient to exclude him/her from the credit market.

Although CIRs have in common the emphasis on black information, and the fact that they share some of this information, they differ with respect to their data sources, their clientele, and to how updated and encompassing is their information. The most traditional CIR is the Returned Check Register (Cadastro de Cheque sem Fundos), which is managed by the Central Bank and lists all people who issued unfunded checks, an information compulsorily supplied by banks.[33] Regularly updated copies of this register are made available to participants and clients of all CIRs in Brazil.

This is the case of the SPC (Credit Protection Service), a network of CIRs established at municipal level and run by the local Associations of Retailers. The SPC not only facilitates the access of retailers to this data, but also collects and distributes among its members data on borrowers who are in default on their commercial or trading responsibilities with members of the association. These associations also keep a separate record for firms in default, but it is the SPC, which carries data on individuals only, that is the most used and best known of its black lists.

Serasa is Brazil's largest profit oriented CIR. Established in 1968 by three of Brazil's main national banks, currently all medium and large banks are shareholders in the company. As the other CIRs, Serasa was created essentially to keep black information, and although since the Real Plan it started to also offer white information, several of its main products still focus on restrictive data. This is the case of Achei and Recheque, two related products that provide information on unfunded, cancelled, stopped, stolen and lost checks. A third product, Concentre, supplies information on *protestos* (protests), checks with insufficient funds, bankruptcies, *concordatas* (reorganizations), legal actions (executive actions, search and seizure actions, Federal Justice fiscal execution actions), tax debts (with Secretaria da Receita Federal, the Brazilian tax authority), and participation in bankruptcy processes.

A fourth important CIR in Brazil is Cadin (Register of Defaulters), which was originally created to block access to credit from public institutions to firms and individuals who were in default either with a public financial institution or in their tax obligations. For this reason, originally only public financial institutions could access the Cadin. With time, access was open to all public institutions, in an attempt to enforce payment of all types of commercial obligations with public agencies, including

33 The value of this register for credit analysis stems from the widespread use of checks in commercial transactions, a practice inherited from the high inflation period, which was sustained after stabilization by the use of predated checks as a major source of retail credit. It is estimated that about 60 percent of all checks issued in Brazil are predated.

state enterprises in many different sectors (e.g., public utilities, gas stations, etc.). It stayed, however, out of reach to private creditors. Soon, the list of debtors in default increased so much, and the reliability of the information it kept deteriorated so tremendously, that the law forbidding public banks to lend to firms in Cadin was revoked, so that currently public banks use Cadin as one more source of black information on borrowers.

The growing demand for information on borrowers since the mid-nineties has attracted new players to the Brazilian CIR industry. Equifax, a large American company, bought SCI, a smaller competitor of Serasa, and credit rating agencies such as S&P's established local offices. It has also encouraged already established CIRs to diversify their services towards the supply of white information. This is the case of Serasa's Fica, Relato and Credit Bureau.

Fica is a data bank that provides information on key determinants of a firm's performance and an indicative evaluation of its credit risk. Its data comes mostly from banks: when a bank accepts a new business customer it is supposed to pass to Serasa the data collected on the loan application. Information can also be obtained with the firm itself – firms usually attend requests for information from Serasa. An offspring of Fica is Fica Avançada, which supplies the firm's: (a) legal identification, addresses, etc.; (b) balance sheets, income statements and internal cash generation, including both their current values and the position on December 31 of the two previous years; (c) working capital needs, its variation, cash balance and operational cash flow; (d) sources and uses of funds; (e) main economic and financial indicators; and (f) a brief analysis of the recent performance of the firm, with an indicative evaluation of the credit risk.

Relato gives, in addition to the data provided by Achei/Recheque and Concentre (see above), information on the payment history of the firm, obtained from suppliers and banks. It includes the name and legal identification of the firm's 5 main suppliers, the total number of suppliers along with the length of their relationship with the firm, and, for the 13 previous months: (a) the number of consultations about that firm, with information on the date and name of the firms responsible for the 4 last consultations; (b) information on due payment values classified as "on time" and by intervals of delay, together with the value of cash payments and total of payments for the month; (d) the evolution of the firm's debt to suppliers; (e) the date and value of the last purchase, of the largest invoice and of the largest cumulate value of purchases; and (f) due and not paid financial obligations. It also gives the consolidated position of bank and supplier credit.

Credit Bureau includes positive information on individuals obtained from and used by credit card, financial, leasing, factoring and insurance companies, as well as other organizations in

any way related to individual credit. To receive the information firms have to agree to provide feedback into the system (reciprocity regime). Credit Bureau includes: (a) name, date and place of birth, spouse's and parent's names, address, telephone, time at current address, if residence is owned or rented, main occupation, employer and time at current job; (b) negative information such as delays in paying credit obligations, legal actions, unfunded or irregular checks, etc.; (c) number and dates of recent credit consultations; (d) occupation, professional address, schooling, other addresses and professional activities, existing financial obligations and payment behavior; (e) outstanding credit obligations; and (f) credit scoring, calculated using risk predictive models.

Another important new development has been the creation of the CRC (Central Register of Credit Risk), a CIR managed by the Department of Bank Supervision (Departamento de Fiscalização) of the Central Bank. Every month financial institutions must inform to the CRC the value of their loan exposures with all clients to whom they have extended credit (including guarantees and credit allowances) totaling R$ 20,000 or more (see Table 2.1). For borrowers with total liabilities of more than R$ 50,000 they must also rate each loan operation according to a nine-tier rating system defined by the Central Bank. Each institution is free to use its own methods to assess the credit risk of each loan, but it must respect minimum standards established by the Central Bank.[34] To classify loans banks are expected to take into account the economic and financial health of the debtor and of the loan's guarantor, as well as characteristics of the loan itself. Financial institutions have up to the 20th of the month to inform balances at the end of the previous month.

Information in the CRC is made available at different levels to different "customers", but not to the public at large, which the law does not allow. Financial institutions access the CRC through a computer system (Sisbacen), where they learn the consolidated value of the debt of firms and individuals and the number of institutions that informed credit operations with each debtor.[35] This information may be shared with other companies in the

34 The system created by the Central Bank has 9 rating categories – AA, A, B, C, D, E, F, G, H. Loans with delays between 15 and 30 days can be rated at most a B, those between 31 and 60 days a C, and in this way successively until category H, which is mandatory for all loans with delays of more than 180 days. For loans with maturities of more than 3 years the permissible delays are twice as large.

35 Even though the CRC allows banks to learn little more than the total debt of a loan applicant, the importance of the CRC to overcome interbank information asymmetries should not be overlooked. The simple fact that a firm has managed to secure credit is in itself revealing about its actual probability of default. As time passes by, financial institutions will also be able to learn about the actual payment history of these firms, further reducing information asymmetries. Moreover, the Central Bank is planning to increase the access of banks to information about borrowers. Yet, it is remarkable, and telling about Brazil's CIRs, that according to Brazil's Central Bank "today the Central de Risco de Crédito is mainly seen as a source of negative information" (Banco Central, Nova Central de Risco de Crédito, presentation made at the Brazilian Federation of Banks, November, 9, 2000).

financial institution's conglomerate. To consult a client's record, the financial institution needs to obtain written authorization from the client, which is usually done when he applies for credit. The Central Bank charges a fee for the access to the Sisbacen, but not for the information in the CRC. Anyone can ask the Central Bank for information on all individual debts reported by financial institutions in his or her name, including the identification of the institutions and the value of the debts. However, if the debtor disagrees with the information in the CRC, it is up to him or her to go to the financial institution and ask for a correction.

4. Use of Credit Information in Bank Regulation and Supervision

The very high inflation prevailing in Brazil until June 1994 reduced the actual information contained in banks' balance sheets and in this way complicated bank supervision and regulation. But, at the same time, it made them less necessary, by allowing even poorly run banks to be profitable. Moreover, it discouraged credit activity, particularly by private banks, so there was little credit risk to speak of. This encouraged a policy of regulatory forbearance, which was especially pronounced in the case of state-owned banks. When inflation came down, the inadequacy of those practices was evidenced by the insolvency of a number of banks. It was not by chance, therefore, that the reduction in inflation rates coincided with an effort to improve supervision and regulation.

Prudential bank regulation in Brazil relies on standard instruments. Entry is regulated through rules concerning minimum capital requirements and good reputation of owners and managers, and is determined case by case by the Central Bank (and the President of the Republic in the case of foreign banks). In recent years, decisions about entry have been tuned to facilitate the privatization of state banks and the purchase and assumption of banks with solvency problems. In this process, foreign banks were given greater access to the market.

Banks are also required to keep both minimum absolute levels of capital (that vary according to type, size and region) and capital-asset ratios that follow the rules established by the Basle Agreement (Cooke ratios), adopted in Brazil in August 1994 (Central Bank Resolution 2099). According to these, banks' own capital (net worth) has to be equal to or larger than 11% of their risk-weighted assets, plus 20% of the credit risk in swap operations. These values have been in place since November 27, 1997, when in the aftermath of the Asian Crisis the Central Bank raised capital requirements.

Solvency regulations also include the requirement of minimum loan loss provisions. These reflect the credit risk of each loan, as classified in the nine categories (AA to H) used in the CRC (see Section 3.2). These provisions, in the case of loans of R$ 50,000 and above, are of 0.5%, 1%, 3%, 10%, 30%, 50%, 70% and 100% for each category from A to H, respectively. For loans below R$ 50,000 similar provisions apply, but risk classification may reflect only the extent of payment delay, although banks are free to adopt more rigorous criteria at their discretion. These rules, introduced in 2000, are more stringent and detailed than the ones in place before.

The Central Bank also restricts the composition of banks' loan portfolios. These restrictions are intended both to guarantee a minimum level of diversification and to prevent connected lending. A cap equivalent to 25% of the bank's net worth applies to all lending to individual borrowers. Lending to owners, managers and their relatives is forbidden.

Deposit insurance, established after the post-Real Plan bank crisis, is managed by the FGC (Deposit Guarantee Fund), a private nonprofit organization that guarantees deposits and certain financial investments up to R$ 20,000 per depositor in case of bankruptcy or closure by the Central Bank.[36] This insurance covers demand and term deposits, savings accounts, letters of exchange, real estate and mortgage letters (*letras imobiliárias* and *letras hipotecárias*) issued or guaranteed by the financial institution. All financial institutions, except for credit cooperatives, participate in the FGC, paying a monthly flat premium of 0,025% on the value of its outstanding balances on the accounts insured.

Although the rules are well spelled out and relatively standard, their enforcement has not always been as strict as one might have wished, especially in the case of state banks, although that too began to change in recent years. For instance, the closure of two state banks with a negative net worth – Banespa and Caixa Econômica Federal – was avoided through the expediency of delaying the publication of their balance sheets until they could be "restructured." The two largest federal commercial banks were given special grace periods to adjust their capital requirements to minimum regulatory standards. Another earlier example is provided by the lax application of the limits on connected lending.[37] The resolution of some insolvent banks, prior to the creation of the FGC, also revealed a "too big to fail" policy, and a

36 The value of R$ 20,000 was applied in all cases of banks liquidated before the FGC was established.

37 A Central Bank document describing the Program for the Restructuring of the Public State Financial System (Proes) observes that "like the private banks, official banks have also been forced to adjust to the new reality of a stable economy. However, in this case, their problems are more complex, not the least due to the excess of loans extended to controlling shareholders (in this case, the government of the respective state) and related firms, in disagreement with a basic prudential rule of the financial system."

practice of *de facto* complete insurance by the government of all creditors of large banks.[38]

Moreover, although prudential regulation was changed in recent years to raise capital requirements and make them more sensitive to borrower and loan risk, these changes did not alter its almost exclusive reliance on backward-looking information, mostly obtained from banks' balance sheets and debtor performance. Therefore, even though provisions for loan losses are based on a rating system that in principle reflects lenders' forward expectations regarding the risk of each loan, it is not clear why banks should in practice be more conservative than required by the minimum standards imposed by the Central Bank, which depend only on the duration of defaults (Section 3.2). On the contrary, banks will be subject to strategic biases and will tend to underestimate the probability of default, to lower their capital requirements and increase the goodwill of their clients, a behavior that probably explains why the CRC continues to be "mainly seen as a source of negative information."

Little information outside that collected from balance sheets, supervision visits or the CRC is used in bank regulation and supervision. In particular little use is made of credit information collected or generated by CIRs. The only noteworthy exception seems to be the use of black information gathered by private CIRs (i.e., the borrowers' *cadastro*), which the Central Bank takes into consideration when analyzing a bank's credit portfolio in its on-site supervision.

This situation, although on a par with the way prudential regulation works in most other countries, contrasts with what the literature recommends, in particular with the need to make it more forward looking and risk sensitive.[39] Credit information can be used to adapt four of the above regulatory instruments in that way: reserves for loan losses, capital adequacy requirements, insurance premiums and closure rules. Two of these instruments have received most of the attention in the literature: risk-adjusted deposit insurance premiums and capital adequacy ratios.

The idea to use risk-sensitive deposit insurance premiums goes back to the view that the main purpose of bank regulation is to protect small, largely unsophisticated depositors.[40] In the presence of limited liability, a bank's capital structure gives an incentive for owner-managers to follow an investment policy that

38 State banks, in particular, are perceived as *de facto* fully insured by the public sector. This explains why, despite showing default rates much above the industry's average, state banks experience an increase in their shares of total deposits when depositors fear for the health of the financial system.

39 See, for instance, Dewatripont and Tirole (1994), Freixas and Rochet (1997) and BIS (1999 and 2001). A possible reason for this contrast is the tendency noted by Rochet (1999) for "prudential authorities themselves (to) insist more on the prevention of systemic risk, a topic that has received so far less attention from theoreticians."

40 Dewatripont and Tirole (1994) call this justification for bank regulation the "representation hypothesis."

carries more risk than its depositors would like to. This is explained by the fact that equity holders typically benefit more in favorable states (the project succeeds) than depositors, whereas the two groups share losses proportionately in very bad states (the bank closes down). A flat rate deposit insurance premium, even if actuarially balanced, does not correct these perverse incentives. But this could be done, under certain conditions, through risk-adjusted deposit insurance premiums. In fact, Rochet (1992) shows that if the objective of bank owners is to maximize the market value of their future profits, risk-based deposit insurance is the only way to prevent them to choose very risky portfolios. However, there are both conceptual and practical problems to implementing fairly priced deposit insurance.[41] One of them is how to measure risk and determine risk premiums in an efficient and timely way.[42]

This perhaps explains the general preference of regulators to discourage excessive risk-taking by banks through the use of minimum capital requirements. These not only provide a cushion for bank losses, but also increase owners' stake when taking risk, encouraging more conservative decisions. For this regulation to be efficient, though, it is necessary that capital requirements be risk sensitive, that is, that the average cost of capital goes up when risk increases.[43] The best known effort to adapt capital adequacy rules to reflect credit risk is the Cooke ratio included in the Basle Accords of 1988. The Cooke ratio has been criticized, however, not only for disregarding other types of risk, but also for not adequately weighting different types of credit risk [Dewatripont and Tirole (1994)]. A 1999 report of the Basle Committee on Banking Supervision, while reinforcing the view that minimum regulatory capital requirements, adjusted for credit risk, should remain the main approach to promote safety and soundness in the financial system, acknowledges that "[t]he current risk weighting of assets results, at best, in a crude measure of economic risk, primarily because degrees of credit risk exposure are not sufficiently calibrated as to adequately differentiate between borrowers' differing default risks" [BIS (1999, p. 9)].[44] Freixas and Rochet (1997) suggest that a better way to make banks' capital-asset ratios dependent on their asset risk is to use borrowers' ratings, produced by independent agencies, to weight their assets. This idea is incorporated in the standardized ap-

41 For a summary of the main issues, see Freixas and Rochet (1997).

42 Commenting on proposals to reform the American deposit insurance system, Benston and Kaufman (1997, pp. 143-4) go a step further to argue that: "In theory, it is clear that risk-based insurance premiums would, at least partially, discourage institutions from following a high-risk loan strategy. But as a practical matter, how the risks and premiums would be determined was unclear, and, by themselves, risk-based premiums did not address the problem of regulators who were often slow, whether because of personal inclination or institutional pressure, to take steps that would address financially troubled institutions."

43 Rochet (1992) shows, in addition, that because of limited liability solvency regulations should also require a minimum absolute level of own capital.

44 Moreover, risk weights also favor lending to the public sector.

proach included in the New Basel Capital Accord put forward by the Basle Committee on Banking Supervision [BIS (2001)].

Some countries – e.g. New Zealand, Chile and Argentina – also rely on credit ratings produced by government auditors and/or by private agencies to directly increase banks' sensitiveness to risk exposure, requiring the publication of their own credit ratings. The expectation is that this increases market discipline by making depositors and other creditors more aware of the risk carried out by their banks (see Goldstein and Turner, 1996).[45]

Although the idea that prudential regulation can be improved by increasing the costs to banks of taking risk is well accepted, very little in that direction has been done in practice.[46] The main reason for that is the difficulty of finding the adequate information to use for that purpose. Rochet (1992) argues that for capital-asset ratios to be effective in controlling excessive risk the weights used in their computation have to be proportional to the systemic risk of the assets (their betas). But remarks, in a latter article (Rochet, 1999), that "an important peculiarity of bank loans, which constitute the bulk of the assets of most banks, is that their true value is a private information of the bank that has granted the loan." A second-best solution is then to weight loans using each borrower's credit rating. But that leaves unanswered the question of how to deal with unrated borrowers. Moreover, the value of credit ratings as leading indicators of default are still a matter of controversy (see Goldstein and Turner, 1996).

The Brazilian credit market illustrates well the practical difficulties and limitations of these recommendations. As pointed out in Section 2, for most borrowers, and a large share of the credit market, there is no public information to assess loan risk. The only exception is corporate borrowers, for which independent ratings are in general available. In fact, large firms are the prototype borrower addressed in the new BIS framework: they are rated by different institutions, including the most important credit-rating agencies and possibly the large banks with which they operate, and these ratings can be used directly to weigh their loans when computing capital requirements. The problem in this case would be how to choose among different ratings, but the empirical evidence suggests that for large non-financial firms the divergence in independent ratings tend to be relatively small [Morgan (1997)].

45 In principle, credit information could also be used to inform the decision to close or intervene in a bank, allowing the Central Bank to resolve the bank while it is still moderately capitalized. In practice, however, it could be legally difficult to intervene in a bank that is economically insolvent but still has a positive net worth. Adopting such procedure would likely demand changes in the law, possibly making intervention less discretionary, along the lines of the rules-based intervention procedures of the SEIR (Structured Early Intervention and Resolution) proposal (see Benston and Kaufman, 1997).

46 For instance, the risk-sensitive deposit insurance premiums adopted in the US in 1991, when the Federal Deposit Insurance Improvement Act (FDICIA) was enacted, uses a bank's capital-asset ratio to measure its risk [Benston and Kaufman (1997)].

A more complicated issue is how to incorporate into prudential regulation the risk of loans to mid-size companies for which there is no rating available. The problem is not only one of the quantity of firms, but that much of the relevant information for analyzing the credit risk of these borrowers arises from bilateral, long-term relationships that they keep with their banks, which is not disclosed either to the Central Bank or to private CIRs. In developing countries, balance sheets of many of these firms are utterly unreliable – even in some of the few cases in which they are audited by independent firms – and often do not to reflect the actual financial health of the firm.[47]

Thus, one the most important features of the New Basel Capital Accord proposal is the relevance attributed to information private to banks to assess credit risk: "a key element of the proposed revisions to the 1988 Accord is a greater emphasis on banks' own assessment of the risks to which they are exposed in the calculation of regulatory capital charges" [BIS (2001, p. 1)]. In this way, the proposal advocates the adoption in bank regulation of an "evolutionary approach" in which more sophisticated banks would be given more responsibility in determining their own capital requirements. The main element of this approach would be the use of banks' internal ratings to assess the risk of their credit portfolios. This approach would be complemented by a strengthening of the supervisory authority and greater disclosure requirements "to ensure that market participants can better understand banks' risk profiles and the adequacy of their capital positions."

These recommendations are in line with the results of this paper, in particular with the fact that in developing countries like Brazil banks have a monopoly over much of the information necessary to assess credit risk. Two other results of our analysis help to shed light on the issue of prudential regulation. First, as the cost of capital to banks (R) continues to decline (in December 2000 it was still 12%), market size will expand, but so will default ratios, signaling a deterioration in the quality of credit. Moreover, lower interest rates will not diminish the importance of market segmentation or the share of total credit channeled through the middle market. Bank profits will go up, with a higher volume of lending, but profit rates will come down,[48] likely reducing the ratio of charter values to own capital. Second, more access to credit information, through the CRC and the strengthening of the CIR industry, a continued upgrading of banks' credit decision process,

47 The Argentine Central Bank tries to mitigate this problem using the interest rate charged by banks in individual operations as a proxy of credit risk, using these to generate an Indicator of Credit Risk, used in computing minimum capital requirements. Escudé (1999) shows that under certain conditions interest rates are a good proxy to the systemic risk of loans. The shortcoming of this procedure is that it encourages banks to lower reported interest rates, using other means to remunerate their loans (e.g. minimum interest-free deposit balances).

48 This projection is consistent with Demirgüç-Kunt and Huizinga's (1999) empirical finding that a larger ratio of bank assets to GDP lead to lower bank profits and interest margins.

and a more intense lending activity by foreign banks,[49] will make credit markets more competitive, or at least more constestable, significantly reducing bank profits, as shown in Section 3. Furthermore, more competition and the introduction of better screening mechanisms may actually lead to an expansion of the middle-market, with banks reacting to competition by expanding the spectrum of borrowers on whom they keep their own information registers. That means that although more information on borrowers should be generated, the proportion of white information that is private to banks should rise.

These results lead, in turn, to two conclusions. One, that making prudential regulation more risk sensitive will depend on the regulator' s ability to extract unbiased ratings from banks. The challenge, then, is for the Central Bank to introduce incentives that lead banks to improve the quality of their credit analysis process, so as to be able to correctly identify safe borrowers; and to correctly inform the Central Bank about their ratings for each loan. These could be done, for instance, by increasing capital requirements of banks that consistently underestimate the risk of their credit portfolios, as revealed by ex-post debtor performance.[50]

Two, that stiffer competition and lower profits will encourage banks to take higher risks, making the need for adequate prudential regulation even more necessary. As noted by Riordan (1993), the effort dedicated to select good projects depends on the probability of being chosen to finance the project and on the expected return from doing this. Both are reduced when competition increases, "so more competition might harm market performance, even as prices draw closer to marginal cost." Keeley (1990) argues that an increase in competition resulting from changes in the institutional environment explains the reduction in capital-asset ratios and the increase in asset risk that eventually led to the S&Ls and bank crises of the eighties in the USA. Lower profits, in turn, cause charter values to decline, mitigating an endogenous deterrent to excessive risk taking. In this way, Weisbrod et al. (1992) show that a reduction in charter values has contributed to increase risk-taking by banks in the USA and Japan. Besanko and Thakor (1993) use a similar argument to reason that changes in the competition environment, by reducing the importance of relationship banking, and of the valuable private information it generates, lowers bank charter values and encourages risky lending.[51]

49 It is noteworthy that while the participation of foreign banks in total bank assets rose from 12.8% in 1997 to 27.5% in 2000, their share in total lending went from 11.7% to 17.8% (*Valor*, February 13, 2001, p. C1).

50 It is less straightforward how to factor into prudential regulation the available information about retail risks, for which not even the banks keep private information. The difficulty in this case is composed by the fact that only banks can truly differentiate between a middle- and a retail market borrower: for outsiders the lack of information is the same in both cases, and only the value of their debts is an indicative of which is which.

51 In fact, some authors go as far as advocating that prudential regulation should limit bank competition to discourage banks from investing in excessively risky assets (see, for instance, Matutes and Vives, 2000, and Hellman, Murdock and Stiglitz, 2000).

5. Final Remarks

That the information generated by close banking relationships is valuable to creditors in assessing borrower risk has long been acknowledged in the literature. This paper departed from this conclusion to argue that, in an institutional environment marked by poor accounting practices and pervasive tax evasion, the value of such information will be even higher, possibly to the point of segmenting the credit market. Segmentation causes banks to charge different interest rates and use different amounts of information when deciding whether or not to extend a loan to borrowers who pose the same risk. Segmentation is a reality in Brazil, where the loan market is divided into the retail (consumer credit and small business), middle and corporate markets.

Our comparative static exercises, based on a simple model with interbank asymmetry of information, showed that segmentation is robust to the sort of change that has characterized Brazilian credit markets in recent years, in particular to the lowering of interest rates, and therefore is unlikely to go away in the near future. These exercises also showed, however, that market segmentation does not substantially affect the overall volume or the quality of credit. By treating debtors whose type is unknown to all banks essentially as risky borrowers, banks limit the volume of bad credits and keep the market "relatively safe." Thus, the main negative consequences of market segmentation are the high interest rates imposed on small safe borrowers and the distorting effects of banks' monopoly power in the middle market, where borrowers are "informationally captured." In this way, although participants in the middle and corporate markets tend to pose similar risks, the former pay higher interest rates, with the difference reflecting the rents extracted by banks for their information advantage.

Segmentation causes the credit decision process to differ considerably according to borrower type. For loans to consumers and to small business, the general trend since price stabilization has been towards the introduction of a highly decentralized process of credit management. According to this, all loan requests are treated automatically by statistical methods, based on information supplied by the client and/or available from public records, with a decision being rapidly reached at the branch level. The discriminating variable in these cases is the borrowers' credit records, which are heavily biased towards weighing the importance of restrictive information. Thus, black information, provided mainly by credit information bureaus (CIRs), is probably the most relevant and often the only data used in the credit decision process in the retail market, which comprises as much as 80% of all loans in some banks.

The importance of negative information in credit analysis decreases as the size and complexity of the loan operation increase. Its role is therefore less important in the so-called middle-market, which seems to be the most profitable lending activity in Brazil. In this segment banks rely more on their own data, collected through balance-sheet analysis and on-site visits to firms. Some financial institutions maintain their own in-house credit rating facility, with the more aggressive banks almost disregarding the usual published balance-sheet data, on account of their misrepresentation of the actual economic and financial situation of companies. Instead, they replace the formal accounting information with an internal information system, used to trace changes in companies' financial conditions. One important element of such system is the monitoring of the liquidity of the borrowers' receivables, since the latter are the most commonly accepted collateral for business loans in Brazil.

In the case of loans to large firms, information provided by CIRs has a limited role in the credit decision process, which relies mainly on the research and analysis conducted by the lender itself. Audited balance sheets and other financial statements are more valuable in such cases, because they are more reliable than for smaller firms. In particular, many of these borrowers, being public corporations, with shares or bonds negotiated in domestic or international financial markets, provide investors with a regular flow of information on their economic and financial situation. Lending in the corporate market accounts for a large proportion of the total credit portfolio of Brazilian banks, though its client-base is very small and spreads rather narrow.

Because on average banks profit more from operations in the middle market than in the corporate and retail segments, and since these profits depend on their privileged access to information on borrower creditworthiness, they have no incentives to exchange white information with other banks. That is the case, for instance, of the data and analysis of borrowers' creditworthiness gathered by internal information systems, which remain private to the bank and are not shared with credit bureaus. Therefore, segmentation implicates a limited role for CIRs: essentially, maintaining black information and providing good ratings for safe borrowers in the corporate sector.

Banks will be in general willing to share black information, to a large extent with the purpose of enforcement – i.e., to increase the likelihood that defaulters settle their debts. The enforcement incentives of black lists will be the strongest in the retail market, which is also the segment in which their information content will be the most valuable for the credit decision process. In a segmented credit market, the use of black lists as an enforcement mechanism should extend to the willingness of lenders to exclude borrowers from these lists if they settle their debts, since this will increase their incentives to repay, while doing little harm to

creditors, since the marginal gain from information in these lists is small, even if borrower type is persistent through time.

These results from our model are largely consistent with the way the CIR industry operates in Brazil. In this way, through its relatively long history, Brazilian CIRs have been characterized essentially by the maintenance of black lists on defaulters, playing the dual role of informing creditors and encouraging defaulters to settle their debts, so as to have their names erased from them. Once a credit relationship has been established, information provided by CIRs becomes useful also for monitoring the borrower's financial situation, i.e., to learn about the occurrence of events that might lead to default. In this way, both upgrades and downgrades in the borrower's creditworthiness can be anticipated by monitoring changes in his/her economic fortunes as recorded in those registries.

We showed that introduction of better screening technologies or a greater availability of white information in the retail market may change the credit market in one of two possible ways. If accurate and cheap, this technology will make the retail market more competitive, possibly to the extent that segmentation will be greatly reduced. But banks are expected to react to stiffer competition from the retail market by reducing interest rates in the middle market, in this way securing some profits. Because they have access to privileged information, arising from their banking relationship with borrowers, they will likely outcompete the screening technology. Still, by making credit markets more contestable, an environment that facilitates introduction of those technologies will pressure interest rates downwards and contribute to expand market size. Because segmentation will tend to damp down the expansion of private CIRs, public intervention may be necessary if possibilities in this area are to be fully explored. Strengthening of the Central Register of Credit Risk (CRC) is likely to be an important step in that direction.

The end of the high inflation in mid-1994 exposed the deficiencies of bank supervision in Brazil, and triggered a process of reform that has produced better and more stringent regulation, particularly regarding minimum capital requirements. But these changes did not alter the almost exclusive reliance of regulation on backward-looking information, mostly obtained from banks' balance sheets and debtor performance. This situation, although on a par with the way prudential regulation works in most other countries, contrasts with what the literature recommends, in particular with the need to make regulation more forward looking and risk sensitive. Credit information can be used to adapt four of the above regulatory instruments in that way: reserves for loan losses, capital adequacy requirements, insurance premiums and closure rules. Two of these instruments have received most of the attention in the literature: risk-adjusted deposit insurance premiums and capital adequacy ratios.

Although there are both conceptual and practical problems to implementing such policies, one of them being the difficulty of regulators to properly and timely measure risk, this seems an alternative the Central Bank may wish to consider as a way to improve bank regulation. In particular, there is room to expand the amount of white information available to banks and regulators to analyze credit risk. An effort to improve accounting practices seems especially worthwhile, for its implications regarding market competition and greater access of regulators to information. CIRs may provide a useful way to organize this information, and regulators should consider the possibility of using CIRs more intensely. CIR ratings for corporate borrowers are a possible means to improve the quality of risk assessment in the CRC.

The reason why risk measurement poses such a difficulty to regulators stems from the fact that the true value of most of a bank's credits is private information for the bank itself. It makes sense, therefore, that the BIS proposal for reforming the 1988 Basel Capital Accord stresses the relevance of information private to banks to assess credit risk, advocating that more sophisticated banks should assume greater responsibility in determining their own capital requirements. The main element of this approach would be the use of banks' internal ratings to assess the risk of their credit portfolios.

These recommendations are in line with the results of this paper, in particular with the fact that in developing countries like Brazil banks have a monopoly over much of the information necessary to assess credit risk. Two other results of our analysis help to shed light on the issue of prudential regulation. First, as the cost of capital to banks continues to decline, market size will expand, but so will default ratios, signaling a deterioration in the quality of credit. Bank profits will go up, due to a higher volume of lending, but profit rates will come down, likely reducing the ratio of charter values to own capital. Second, more access to credit information, a continued upgrading of banks' credit decision process, and a rising participation of foreign banks in lending will make credit markets more competitive, or at least more constestable, reducing bank profits. Stiffer competition and lower profits will encourage banks to take higher risks, making the need for adequate prudential regulation even more necessary.

Second, we showed that if screening in the retail market is not sufficiently efficient to allow the retail segment to overtake the middle market, the result of competition may be less, rather than more publicly available information. That is, financial institutions operating in the middle market may react to stiffer competition from the retail market by lowering spreads and in this way enlarging the coverage of the middle market. This would cause a large volume of the information generated by banks on borrowers' creditworthiness private to them individually, making

it more difficult for others, including the Central Bank, to assess credit risk. As a major part of the overall credit in the economy is and will continue to be extended through the middle market, the Central Bank should devise mechanisms to encourage banks to improve their credit analysis and provide unbiased estimators of the credit risk associated with their loans. A possible means to do that would be through higher capital requirements or deposit insurance premiums for banks that consistently underestimate the risk of their loan portfolios.

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Annexes

Annex A

Banking Expenditures with External Credit Information

This annex presents empirical evidence on how much banks in Brazil spend to acquire external credit information on borrowers. Although we were not able to get data separated according to borrower type (corporate, middle and retail), the figures presented below give an indication of the magnitudes involved.

Our data covers a selected sample of 46 banks, out of a total of 220 banks operating in Brazil in December 1999. The sample is not random, in the sense that it was chosen to represent best the banks most heavily engaged in credit granting activities. 43 out of those 46 banks are private-owned, so the focus is on credit decisions by private institutions, but the two largest federal banks and one local state-owned bank are also in the sample. This comprises large, medium and small retail banks, selected according to factors such as value of loans and number of branches; investment banks, for which credit is not the main operating activity; and financial institutions owned by automobile manufacturers, which basically finance the sale of vehicles assembled by their parent company. The sample includes domestic and foreign institutions.

For each of those banks, we collected data on monthly expenditures (in *reais*) with credit information provided by Serasa, which as noted before is the most important CIR in Brazil. The time frame comprised the 18-month interval between January 1998 and June 1999. Table A.1 provides basic descriptive statistics on expenditures for each semester, showing that this variable presents a significant sample variance, as indicated

Table A.1
Total Expenditures on Serasa Credit Information
(monthly averages, in R$ thousand)

	1998-I	*1998-II*	*1999-I*
Monthly average	979.6	1,074.0	987.4
Standard-deviation	1,207.7	1,280.9	1,261.7
Coeff. of variation (%)	123.3	112.5	127.8
Minimum value	12.7	41.5	17.8
Maximum value	4,087.8	4,194.1	4,507.3
Share of the 5 largest (%)	38	35	38

Source: *Based on data provided by Serasa.*

among others by the difference between the maximum and the minimum expenditures per bank in each semester. The Table also indicates that expenditures are relatively concentrated, with the 5 banks with largest expenditures (roughly 11% of the sample) answering for between 35% and 38% of the total.

Obviously, size is likely to be an important reason why some banks spend more on CIR services than others. To examine this possibility, monthly average expenditures with Serasa's services were divided by the credit stock outstanding at the end of those three semesters. This ratio indicates the amount of money spent on buying external information for each *real* of the stock of loans prevailing at the end of the semester.[52] Table A.2 shows the data above normalized by the stock of credit outstanding at the end of each semester, except for the first period, in which the denominator is the total credit outstanding at the beginning of the period, that is to say, December 1997. In general, banks spent less than R$ 1.00 in buying credit information for each R$ 1,000.00 of credit registered in their balance sheets. As in Table C.1, there are large cross-bank differences in expenditures with CIR information, ranging from less than one cent of *real* to around R$ 5.00 for each R$ 1,000.00 of total credit.[53]

Is there a relationship between the amount of loans granted by each bank and its expenditure/credit ratio? That is to say, do banks with large stocks of loans spend more or less than small banks per unit of credit to buy information on their borrowers? A simple correlation test yields a negative – -0.170 and -0.179, respectively, for the first and second periods – but not statistically significant coefficient. Therefore, for our sample there

52 Obviously, this indicator has all the shortcomings associated with a ratio between a flow and a stock variable. However, as data on bank lending flows is not available in Brazil, we had to stick to the stock variable as a proxy for credit flows.

53 The number of observations drops from 46 in the first two periods to 40 in the last due to mergers/acquisitions in the private banking market, and to lack of information on credit figures for 3 institutions. The descriptive statistics for the last semester, rather similar to those for the two previous periods, suggest that this change in the sample did not compromise comparisons across semesters.

Table A.2
Monthly Expenditures on External Information for each R$ 1,000 of Credit Balances (in R$)

	1998-I	*1998-II*	*1999-I*
Monthly average	0.82	0.82	0.76
Standard-deviation	1.07	1.21	1.12
Coeff. of variation (%)	130.5	147.8	147.4
Minimum value	0.002	0.002	0.001
Maximum value	4.10	5.40	6.00
No. of observations	46	46	40

Source: *Based on data provided by Serasa.*

is no direct relationship between bank size and the ratio of expenditures with outside (Serasa) credit information to the stock of credit.

In addition to size, bank type may be another cause for the large dispersion in values shown in Table A.2. To examine this possibility, we calculated the average and standard deviation of the ratio of expenditures with Serasa credit information to the stock of credit separately for 5 groups of banks. The first two are specialized banks associated with the car-assembly industry, the main activity of which is financing the sale of motor vehicles, trucks and motorcycles, either to dealers or to the final consumer; and "multiple" banks centered mostly on wholesale businesses typical of investment banks, which do not require large branch network and personnel, such as capital market operations, securities trading and corporate finance. The last three groups are composed of retail banks, which in general are not specialized financial institutions, dealing with individuals and firms of all economic sizes. The latter differ according to their size, number and location of branches, and core business, and are hence classified into three categories: large, medium and small.

Table A.3 shows the ratio of expenditures with credit information to the stock of loans aggregated according to bank type. On average, retail banks spend more on collecting information on their borrowers, relatively to the size of their credit balances, than either investment banks or specialized banks linked to the car-assembly industry. Considering only the retail banks, there seems to be a negative correlation between expenditures and bank size, with large retail banks spending less than either the medium or the small sized banks. Although within group standard deviations are high and sample sizes small, so that group averages are not statistically different, the data suggests that the latter is the group of banks with the largest expenditures per total credit outstanding in the sample: on average, they spend three to four times more than the large retail banks for external information to screen borrowers. Moreover, note that within group coefficients of variation are lower than for

Table A.3
Monthly expenditures per R$ 1,000.00 of credit by groups of banks (in *reais*)

Groups of banks	*1998(1)*	*1998(2)*	*1999(1)*
Car-industry banks			
Average	0.136	0.106	0.080
Standard-deviation	0.105	0.034	0.032
Number	5	5	4
Investment banks			
Average	0.101	0.054	0.240
Standard-deviation	0.265	0.090	0.666
Number	12	12	9
Large retail			
Average	0.475	0.447	0.418
Standard-deviation	0.491	0.424	0.412
Number	7	7	7
Medium retail			
Average	1.38	1.30	1.154
Standard-deviation	1.23	0.87	0.826
Number	13	13	11
Small retail			
Average	1.47	1.97	1.37
Standard-deviation	1.34	1.94	1.85
Number	9	9	9
Total			
Average	0.82	0.82	0.76
Standard-deviation	1.07	1.21	1.12
Number	46	46	40

Source: *Based on data provided by Serasa.*

the complete sample, with the exception of investment banks, suggesting that bank type is in fact a relevant explanation for cross-bank differences in expenditures with outside credit information.

The fact that small retail banks spend more, relatively to credit balances, on buying CIR information than other types of retail banks may be due to three factors: firstly, this type of externally-generated data may be the only informational input used by small banks to decide whether to grant credit, since their size might not justify incurring the costs of having a "proprietary" system of collecting and analyzing data on their customers, unlike the medium and large retail banks which maintain such facilities, as mentioned earlier. Secondly, no matter how small, there is always a fixed cost component of assessing CIR information, which leads to a negative relation between loan size and costs of paying for external data. Therefore, there seems to be economies of scale not only in the information gathering process, but also in its utilization by banks. Finally, in pricing its products and services to banks, Serasa gives quantity discounts. Hence, the price of each additional unit of external data bought by any bank decreases as it buys more information from Serasa.

Annex B

Empirical Distribution of Loan Values

In Sections 2 and 3 we assumed that loan values (l) were distributed exponentially, essentially out of easy of mathematical manipulation. Data from the CRC, which became available to us afterwards, show that at least for loans above R$ 20,000, the exponential distribution is indeed a good approximation for loans to individuals, but that it does not provide a good fit for the empirical distribution of loans to firms. The main problem in this case resides in the low probability ascribed by the exponential distribution for small loans, comparatively to what is observed empirically. Or, looking from the other side, the empirical distribution of loans to firms is much more positively skewed than the exponential distribution with the same mean. Although we do not have the necessary data to test this hypothesis, we believe that the exponential distribution may provide a good fit for loans to firms if we truncate the empirical distribution from above.

In Figures 1 and 2 we present for individuals and firms the empirical, exponential, uniform, Weibull and lognormal cumulative distribution functions of loan values – in the last four cases imposing the value of the distribution mean to be R$ 58,878 and R$ 907,489, for individuals and firms respectively. In both cases the horizontal axis is in logarithmic scale (ln(l)). The best fit, as measured by a MSE statistic calculated for the 13 values for which we had information on the empirical distribution, is the exponential distribution in the case of individuals and the lognormal in the case of firms.

Figure 1
Empirical, Exponential and Other Distributions of Loan Values for Individuals

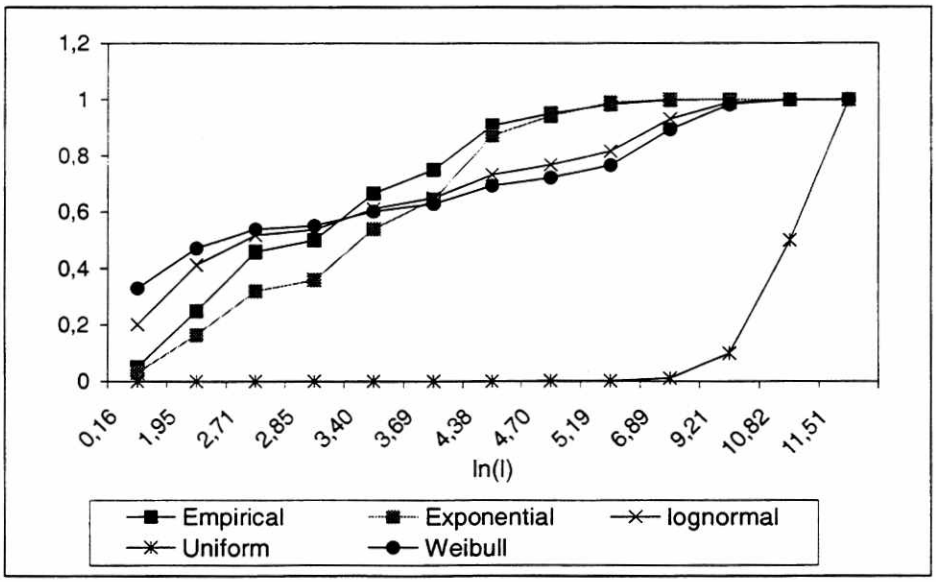
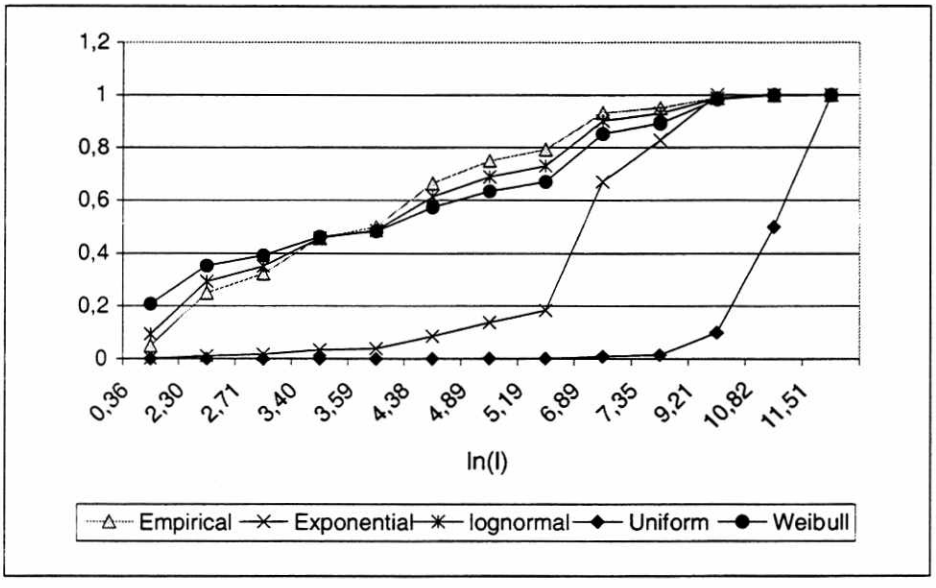


Figure 2
Empirical, Exponential and Other Distributions for Loan Values Extended to Firms



Annex C

The Retail and Middle Markets with the Use of the Screening Technology

With the use of the screening technology, the volume of credit, number of loan applicants and of borrowers, safe and risky, respectively, in the retail market are given by:

Volume of credit

$$VC_T^S = Np\alpha(z)\int_{L_T^S}^{L_M}\left[\int_{R_T+C_T/(q_s l)}^{V} dv/V\right]\frac{l}{\lambda}e^{-l/\lambda}dl =$$

$$= Np\alpha(z)\left\{\frac{(V-R_T)}{V}d\exp\left(L_T^S, L_M\right) - \frac{C_T}{Vq_s}\Delta\exp\left(L_T^S, L_M\right)\right\}$$

with

$d\exp(x,y) = (x+\lambda)\exp(-x/\lambda) - (y+\lambda)\exp(-y/\lambda)$
$\Delta\exp(x,y) = \exp(-x/\lambda) - \exp(-y/\lambda)$

and

$$VC_T^R = Np(1-\alpha(z))\int_{L_T^R}^{\infty}\left[\int_{R_T+C_T/(qrl)}^{V} dv/V\right]\frac{l}{\lambda}e^{-l/\lambda}dl = Np(1-\alpha(z))e^{-L_T^R/\lambda}\left[\left(L_T^R+\lambda\right)\frac{(V-R_T)}{V} - \frac{C_T}{Vq_s}\right]$$

Number of loan applicants

$$NA_T^S = Np\int_{L_T^S}^{L_M}\left[\int_{R_T+C_T/(q_s l)}^{V} dv/V\right]\frac{e^{-l/\lambda}}{\lambda}\,dl =$$

$$= Np\left\{\frac{(V-R_T)}{V}\Delta\exp\left(L_T^S, L_M\right) - \frac{C_T}{Vq_s}\int_{L_T^S}^{L_M}\frac{e^{-l/\lambda}}{l\lambda}\,dl\right\}$$

$$NA_T^R = N(1-p)\int_{L_T^R}^{\infty}\left[\int_{R_T+C_T/(q_r l)}^{V} dv/V\right]\frac{e^{-l/\lambda}}{\lambda}\,dl =$$

$$= N(1-p)\left\{\frac{(V-R_T))}{V}e^{-L_T^R} - \frac{C_T}{Vq_r}\int_{L_T^R}^{\infty}\frac{e^{-l/\lambda}}{l\lambda}\,dl\right\}$$

with $NA_T = NA_T^S + NA_T^R$

Number of borrowers

$NB_T^S = \alpha(z)NA_T^S$

$NB_T^R = p(1 - \alpha(z))NA_T^R/(1 - p)$

with $NB_T = NB_T^S + NB_T^R$

In the middle market, in turn, the volume of credit is given by

$$VC_M = Np\left\{\int_{L_M}^{L_C}\left[\int_{R_M+C_M/q_s l}^{V} dv/V\right]\frac{l}{\lambda}e^{-l/\lambda}dl\right\} + Np(1-\alpha(z))\left\{\int_{L_M^R}^{L_C}\left[\int_{R_M+C_M/q_s l}^{V} dv/V\right]\frac{l}{\lambda}e^{-l/\lambda}dl\right\} =$$

$$= Np\left[\left(\frac{V-R_M}{V}\right)d\exp(\lambda, L_M, L_C) - \frac{C_M}{Vq_s}\Delta(L_M, L_C)\right] +$$

$$+ Np(1-\alpha(z))\left[\left(\frac{V-R_M}{V}\right)d\exp\left(\lambda, L_M^R, L_C\right) - \frac{C_M}{Vq_s}\Delta\left(L_M^R, L_C\right)\right]$$

where the first term in the expression above accounts for borrowers who originally looked for loans in this market segment and the second for safe borrowers wrongly classified as risky in the retail market. Competition in the retail market ensures that banks make no profit in this market segment, so that:

$R_T = (1 + R)/q_T - 1$, where

$q_T = (q_s VC_T^S + q_r VC_T^R)/(VC_T^S + VC_T^R)$.

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