UNIVERSITÀ DEGLI STUDI DI VERONA

WORKING PAPER SERIES

Bad loans and efficiency in Italian Banks

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September 2005 - #28

Dipartimento di Scienze Economiche

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1. Introduction

Notwithstanding the development of markets and different financial intermediaries, banks maintain their central role in the economic systems and thus the problems related to their activities and performances are the focus of a large body of literature. The aim of this paper is to look at the the efficiency of the Italian banking system taking into account the role that the quality of banking credit may play at a microeconomic level.

The quality of credit is a known critical issue in the literature where it is recognized that three different aspects, relating to macroeconomic, competition and banking supervision issues, matter for its relevance. As for the first aspect, one needs to recognize that the financial structure of an economy plays a key role in the allocation of resources and bank credit is a main connection with the real sector. Furthermore, bank credit is still considered special in gathering information and monitoring borrowers, so that financing through financial markets cannot be seen as a perfect substitute for it. Moreover, the cost and the availability of bank credit affects heavily investment choices both with respect to firms financial structure and in relation to the structure of household financial portfolios and banking liabilities. This point is particularly important and relevant for bank-based economic systems, such as in many European continental countries and especially in Italy (Gambacorta, 1998; ECB, 2003).

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Related to these considerations, we can also highlight that the quality of credit is as important as its availability and cost for both resource allocation and growth, playing a specific role in these processes. The models of delegated monitoring and liquidity creation emphasize precisely the role of banks in the evaluation of credit worthiness and in the resource allocation; they also point out the beneficial effects of this type of banking activity in guaranteing stability and confidence in the payment system. As a consequence, poor credit quality, often a synonymous of excessive credit risk, may cause a greater volatility in the total credit with possible backward linkages to the same banking system. Indeed, the recent literature on finance and growth[1] highlights the importance of the access to financing for firms depending heavily from the external finance, even if the specific effects of the legal framework and of the structure of financial and banking systems are not unambiguously clear (Claessens and Leaven 2005).

At the macroeconomic level then, problem loans may be a signal of a wrong allocation of credit which may cause a decrease of the funds available for good and safer investments. Moreover, problem loans influence expected losses and so they may influence the state of the economic cycle causing a reduction in the supply of loans or changing the perception of depositors about the risks that banks take (Bernuer and Kubi, 2004). On the other hand, the same economic cycle or macroeconomic risks may influence the quality of credit indipendently from banks' behaviour, and it is likely that riskier borrowers, by type of agent or by sector of activity, may be affected more heavily even by general shocks thus inducing more pronounced effects for the involved banks.

The globalization of financial markets, the increasing competition and the new activities carried out by banks do not diminish the importance of credit risk for growth and stability among the different risks characterizing banking activities.[2] Even if macroeconomic instability has always been a major factor for banking crises (Basel Committee, 2004), the issue of borrowers selection, and therefore of credit quality is an important instrument or an intermediate target for regulators in order to dampen possible crisis. In fact, the quality of credit is the focus of

[1] See, e.g., Rajan and Zingales 1998, Levine, Loayazas and Beck 2000, Leahy *et al.* 2001, Levine 2003, Guiso and Iappelli 2004.

[2] For example, on the stability and the risks of the European banking systems, in 2002 the ECB pointed out the changes in the banks' risk profile in Europe with a relative more weight of market risk and non traditional risks, such as strategic, legal and reputation risks, following the shifts in banks' business activities (ECB, 2002). The report for 2004 highlights again the relevance of managing and monitoring credit risk in economic downturns and during periods of cyclical and structural changes (ECB, 2004).

the Basel reform in the banking supervision system on the relationship between credit and operative risk and capital requirements.

Following the first Basel agreement, banks used to get rid off assets with relatively high capital requirements from balance sheets even if they contributed very little to portfolio credit risk. Under the new approach to capital regulation, however the Basel Supervisors Committee aim to induce regulatory capital and economic capital as close as possible, and this requirement takes into account all the determinants of portfolio credit risk. So, inadequate assessment of loan loss provisions could be reflected in the amount of capital needed to absorb expected losses as well as the unexpected ones.

Last but not least, credit quality is a major instrument in banking competition to the extent that credit quality may lead to an efficient cost structure. A bad credit screening indeed makes the bank's lending subject to the winner's curse (Freixas and Rochet, 1997), particularly given that credit screening is poorly correlated among an increasing number of banks (Shiffer, 1997).

Quality of credit is then a specific signal of the soundness of the banking sector as excessive credit risk could impair the efficient allocation of capital but bad credit may also impair the performance of banking institutions. Indeed, some authors argue that a significant relationship is to be found between the efficiency of the banking system and economic growth, and at the same time the efficiency of the borrowing firms could influence the performance of the banking system (Lucchetti *et al.* 2001, Lozano-Vivas and Pastor 2003).

These considerations lead to the main questions of this paper. Do high levels of problem loans usually seen as a signal of the financial distress of a bank necessarily imply bank's inefficiency? Can its quality be considered a specific characteristic of credit, and how can one capture its effects on bank's efficiency? To answer these and related questions, in this study we estimate banks' technical efficiency taking into account problem loans by using directional distance functions. These are a generalization of the radial distance functions which, since Shephard's contributions, have been used to give a single-valued representation of production relations in case of multiple inputs and multiple outputs (Chambers, Chung and Färe 1996 and 1998).

Using directional distance functions it is posisble to credit bannks for their efforts to increase outputs and decrease the problem loans. We indeed find that the technical efficiency of banks increase once we recognize their efforts to reduce problem loans. The next section reviews the literature that addresses the issue of how to take into account problem loans in the production process and efficiency evaluation of banks. Then we introduce the notation, the model and the empirical algorithms we use in the study. In section five we illustrate the data we use and discuss the results. Section six concludes the paper with the suggestions for further research work.

2. Review of the literature

Before reviewing the main findings of the rather scattered evidence on bad or non performing loans in the literature about banking efficiency, let us first notice two general problems with the empirical evaluation of credit risk using balance sheets data: the definition of non performing loans (Bloem and Gorter, 2001), and their characteristic of being an ex-post measure of credit risk.[3] As for the first problem the main drawback is that non performing loans are, usually, different type of loans which can be classified by quantitative criteria, e.g., number of days of overdue scheduled payments, or qualitative criteria (management judgement, information) or both. This makes more difficult the comparison between different countries but also the choice of the specific items from the balance sheets to be considered for the analysis. The second problem, on the other hand, may impair the results and the interpretation of the analysis as problem loans are a consequence of a preceding activity of selection of the creditworthiness, the rate of decay of loans but also of the bankruptcy laws that may influence the explicit impact of the credit risk on banks.

The paper of Berger and De Young (1997) is the central one for the discussion of the channels through which problem loans may influence banks' efficiency. They find a negative relationships between cost efficiency and risk in failed banks. Observing that failing institutions have larger proportions of non performing loans and that average institution incurs high costs and low profits relative to institutions of best practice, they test different hypothesis to describe the intertemporal relationship among problem loans, cost efficiency and financial capital. They call 'Bad luck' when loan quality problems may arise after events beyond the control of the bank's management, while 'Bad management' relates the quality of the assets to the performances of the management who may have poor skills in credit scoring or difficulties in monitoring and controlling borrowers. Their 'Skimping

[3] A further important problem about quality evaluation is that "..nonperforming loans is an ex post measure of quality rather than ex ante measure as not all low quality loans end up being nonperforming loans, and not all loans that are performing well today will continue to do so in th efuture..." (Hughes and Mester 1993:).

hypothesis' explains the relationships as a bank's trade-off between short term operating costs and future loan performance problems and their 'Moral hazard hypothesis' explains the incentives to take more risks by a bank with low level of capital. Their analysis suggest that cost efficiency may be an important indicator of future problel loans and problem banks.

Before their study few papers had explicitly taken into account the relationships between credit risk and efficiency. Given that bad loans, or non performing loans, are still the preferred variable for the quality of credit, loan losses provisions being the second one,[4] the main difference lays in the role they perform in the different models. So the consideration of managers' trade offs between risk and return allowing for the possibility of non-risk neutrality, leads to the inclusion of non performing loans as an indicator of underlying financial conditions of the bank in addition to financial capital, usually in a cost function context (Hughes *et al.* 1996).

Hughes and Mester (1993) are among the first to specify loans by different product lines, as a first step to take account of risk, adding non performing loans as a quality measure for total outputs. Charnes *et al.* (1990), instead considers loan loss provision as an additional input together with actual loan losses. A feature of some of these studies is the attempt to estimate efficiency controlling for the credit risk as an environmental variable which influence the performance of the banks.

Recently, Pastor (1999, 2002) adopts a different estimation procedure referring specifically to the bad management hypothesis. Provision for loan losses are again used as an indicator of the credit risk, but the aim of the paper is to decompose the component due to bad luck from the one due to the bad management hypothesis. The focus of credit risk is always on the input side but with more explicit relationship to the specific bank performance.

A different approach to the problem can be found in Berg *et al.* (1992) and Resti (1994). Even if they both do not consider non performing loans as a specific output, they include them as a factor by which to adjust total loans in order to get a more correct measure of the traditional output of banks. In Berg, in particular loan losses are introduced with negative sign in the output vector,[5]

[4] Hughes and Mester (1993) underline that loan loss provisions is an inferior measure of quality as it may be set strategically by the banks or by regulators.

[5] Within the value added approach, the authors take into account three outputs: short term loans, long term loans, and non bank deposits, while the negative loan losses are interpreted as indicators of the quality of the loans.

whereas Resti considers directly only performing loans in his output vector, i.e., total loans net of problem loans. However, notice that this approach does not allow the consideration of non performing loans as a decision variable of the banks as other studies recommend, e.g., Pastor.

A different but somewhat related strand of literature deals with the environmental impacts in the measurement of efficiency and productivity growth. Färe *et al.* (1989) indeed started what has become now a relatively vast literature extending efficiency measurement when some outputs are undesirable. [6] The central notion of this paper, and of many that followed (for a recent application and partial survey see Ball *et al.*, 2001), is that of weak disposability of outputs. To credit firms or industries for their effort to cut off on pollutants, technology is modeled so that it can handle the case when the reduction of some (bad) outputs requires the reduction of some of the other outputs and/or the increase of inputs.

Besides the concept of output weak disposability, an interesting and useful idea for our setting is the directional distance function, a generalization of the radial distance function introduced to production economics by Chambers, Chung and Färe (1996) who extended and adapted the idea of the translation functions of Kolm (1976) and Blackorby and Donaldson (1980), and of the benefit function introduced in consumer theory by Luenberger (1992, 1994). The directional distance function allows to compare different firms and to measure their distance from the frontier of the technology moving along a preassigned direction. In this fashion it is possible to evaluate the performance of the firms that need to increase the production of the good outputs and decrease that of bad outputs (Chung, Färe and Grosskopf, 1999).

The first attempt to use the directional distance function to take into account the quality of outputs in a different context, i.e., health services, is a paper by Dismuke and Sena (2001). They consider the mortality rate as a (bad) quality attribute of the hospital production process and use directional distance functions to calculate a Luenberger-Malmquist productivity index. They are then able to decompose the productivity index into a quality index, plus a technical change and efficiency change components. In this paper we use the idea of the directional distance function to incorporate credit quality into the technology and thus we can estimate bank's efficiency taking into account credit risk.

[6] The first contribution that takes into account bad outputs is probably the work of Pittman (1983), who extends the approach of CCD, specifies a modified Tornqvist output index and uses dual data on pollutants' shadow prices to adjust the revenue shares.

3. Notation and model specification

In this study we treat the problem loans as a bad output. Indeed, the production of "good" outputs, such as loans and non interest income, is typically accompanied by the joint production of undesirable "bad" outputs, such as the bad or non performing loans. This implies that the reduction of the bad output can come only at a cost: either a reduction in the good outputs or the use of more resources. More formally, let $x \in \Re_+^N$ be a vector of inputs that can be used to obtain a set of desiderable outputs, denoted by $y \in \Re_+^M$, and a vector of undesirable outputs, $b \in \Re_+^H$. The technology can be defined in terms of a set $T \subset \Re_+^N \times \Re_+^M \times \Re_+^H$

$$T = \left\{ (x \in \Re_+^N, \quad y \in \Re_+^M \quad b \in \Re_+^H) : x \text{ can produce } (y, b) \right\}.$$

In words, the technology consists of all outputs - good and bad - that are feasible for some input vector. T satisfies the following properties (Chambers, 2002):

T.1: T is closed;

T.2: Inputs and outputs are freely disposable, i.e., if $(x', -y', -b') \geq (x, -y, -b)$ then $(x, y, b) \in T \Rightarrow (x', y', b') \in T$;

T.3: Doing nothing is feasible, i.e., $(0^N, 0^M, 0^H) \in T$.

Related to T are the input set, $V(y, b) = \{x : (x, y, b) \in T\}$, and the output set, $P(x) = \{(y, b) : (x, y, b) \in T\}$. For our purposes, i.e., to model the properties of joint production of desirable and undesirable outpus, we find more convenient to use the output set, which represents all feasible output vectors (y, b) for a given input vector x. We assume the standard properties of the output set, such as the axioms of possibility of inaction, no free lunch, the free disposal or strong disposability of the good outputs and the inputs. In addition, we assume that the output set is a convex and compact set.

We model the idea that reduction of bads is costly, i.e., the weak disposability of undesirable outputs, as:

$$(y, b) \in P(x) \quad \textit{and} \quad 0 \leq \theta \leq 1 \quad \textit{imply} \quad (\theta y, \theta b) \in P(x),$$

menaing that a reduction in bads is feasible only if goods are simultaneously reduced, given a fixed level of inputs. In addition, the notion that the good outputs are jointly produced with the bads is modelled by

$$if \quad (y, b) \in P(x) \quad \textit{and} \quad b = 0 \quad \textit{then} \quad y = 0.$$

In words, this last equation says that the good outputs are "null-joint" with the bad outputs if the only way to produce no bads is by producing zero good outputs. Alternatively, this means that if a good output is produced in a positive amount some bad output must also be produced (Färe *et al.* 2005).

The directional technology distance function generalizes both input and ouput Shephard's distance functions, usually calculated for efficiency estimation purposes, and provides a complete representation of the technology. When bad outputs are present, following Chambers, Chung, and Färe (1996, 1998), and Chambers (2002), it can be defined as:

$$\begin{aligned}\overrightarrow{D}_T(x, y, b; g_{\mathbf{x}}, g_y, g_{\mathbf{b}}) &= \max\{\beta \in \Re : (x - \beta g_{\mathbf{x}},\ y + \beta g_y,\ b - \beta g_{\mathbf{b}}) \in T\}, \\ g_{\mathbf{x}} &\in \Re^N_+,\ g_y \in \Re^M_+,\ g_{\mathbf{b}} \in \Re^H_+,\ (g_{\mathbf{x}}, g_y, g_{\mathbf{b}}) \neq (0^N, 0^M, 0^H),\end{aligned}$$

if $(x - \beta g_{\mathbf{x}},\ y + \beta g_y,\ b - \beta g_{\mathbf{b}}) \in T$ for some β and $dT(y, b, g_y, g_{\mathbf{b}})$ $=\inf\{\delta \in \Re : (y+\delta g_y \in \Re^M_+,\ b-\delta g_{\mathbf{b}} \in \Re^H_+)\}$ otherwise. Note that $(g_{\mathbf{x}}, g_y, g_{\mathbf{b}})$ is a reference vector of inputs and outputs which determines the direction over which the distance function is determined. $\overrightarrow{D}_T(x, y; g_{\mathbf{x}}, g_y, g_{\mathbf{b}})$ represents the maximal translation of the input and output vector in the direction of $(g_{\mathbf{x}}, g_y, g_{\mathbf{b}})$ that keeps the translated input and output vector inside T.

The properties of the directional distance function are the following (Luenberger 1992, 1994, 1995; Chambers, Chung, and Färe 1995, 1996):

1. $\overrightarrow{D}_T(x - \alpha g_{\mathbf{x}},\ y + \alpha g_y,\ b + \alpha g_{\mathbf{b}}; g_{\mathbf{x}}, g_y, g_{\mathbf{b}}) = \overrightarrow{D}_T(x, y, b; g_{\mathbf{x}}, g_y, g_{\mathbf{b}}) - \alpha$;
2. $\overrightarrow{D}_T(x, y, b; g_{\mathbf{x}}, g_y, g_{\mathbf{b}})$ is upper semicontinuous in x and y jointly;
3. $\overrightarrow{D}_T(x, y, b; \lambda g_{\mathbf{x}}, \lambda g_y, g_{\mathbf{b}}) = \frac{1}{\lambda}\ \overrightarrow{D}_T(x, y; g_{\mathbf{x}}, g_y, g_{\mathbf{b}})$, $\lambda > 0$;
4. $(y' \geq y,\ b' \geq b) \Longrightarrow \overrightarrow{D}_T(x, y', b'; g_{\mathbf{x}}, g_y, g_{\mathbf{b}}) \leq \overrightarrow{D}_T(x, y, b; g_{\mathbf{x}}, g_y, g_{\mathbf{b}})$;
5. $x' \geq x \Longrightarrow \overrightarrow{D}_T(x', y, b; g_{\mathbf{x}}, g_y, g_{\mathbf{b}}) \geq \overrightarrow{D}_T(x, y, b; g_{\mathbf{x}}, g_y, g_{\mathbf{b}})$;
6. if T is convex, $\overrightarrow{D}_T(x, y, b; g_{\mathbf{x}}, g_y, g_{\mathbf{b}})$ is concave in (x, y, b).

As shown by Chambers, Chung, and Färe (1996), all known (radial) distance and directional distance functions can be depicted as special cases of the directional technology distance function. One example, which will be used in this paper is the *directional output distance function* (Chambers, Chung, and Färe 1998), which can be defined as:

$$\begin{aligned}\overrightarrow{D}_O(\mathbf{x}, y, b; 0^N, g_y, g_{\mathbf{b}}) &= \max\{\beta \in \Re : (x,\ y + \beta g_y,\ b - \beta g_{\mathbf{b}}) \in T\}, \\ g_y &\in \Re^M_+,\ g_y \neq 0,\ g_{\mathbf{b}} \in \Re^H_+,\ g_{\mathbf{b}} \neq 0^H,\end{aligned} \quad (3.1)$$

if $(x,\ y + \beta g_y,\ b - \beta g_b) \in T$ for some β and $+\infty$ otherwise. $\overrightarrow{D}_O(x, y, b; 0^N, g_y, g_{\mathbf{b}})$ represents the maximal translation of the output vector in the direction of (g_y, g_b)

that keeps the translated output vector inside T. In other words, it seeks for the maximum attainable expansion of desirable outputs in the g_y direction and the largest feasible contraction of the undesirable or bad outputs in the g_b direction. Notice that under the assumption of output free disposability, the directional output distance function is a complete representation of the technology (Chambers, Chung, and Färe 1998):

$$\overrightarrow{D}_O(x,y,s;0,g_y,g_b) \leq 0 \qquad \Leftrightarrow \qquad (y,b) \in P(\mathbf{x}).$$

This function is equal to zero when the observed productive plan is located on the boundary of the output set, i.e., it is efficient. Other relevant properties are found in Chambers *et al.* (1998).

3.1. Activity analysis and empirical implementation

For the estimation of the production technology, parametric and non-parametric methodologies are available. Among these latter, Data Envelopment Analysis (DEA) employs linear programming to construct a piecewise linear representation of the frontier technology.[7] DEA constructs a convex hull around the observed inputs and outputs of the firms in the sample. In the output space, for instance, DEA traces the transformation curve of the outputs that can be produced with a certain level of inputs. With DEA, the inputs-outputs observed in a sample can then be used to measure the distance of each observation from the frontier, and the distance function measures are then employed for the calculation of technical efficiency.

Although no specific functional forms are assumed, the shape of the production frontier is influenced by the assumptions regarding the returns to scale and the disposability of inputs and outputs. Constant returns to scale (CRS) means that an increase of inputs leads to a proportional increase in the outputs. On the other hand, variable returns to scale (VRS) implies that an increase in inputs leads to a non proportional increase in outputs, with an initial tract in which returns are increasing and then with decreasing returns. As other possibilities, the technology could have non-decreasing returns (NDRS) or non-increasing returns (NIRS).

Using the techniques of activity analysis, various technologies can be constructed from the K observed, feasible activities. DEA allows also to evaluate the

[7] DEA is deterministic and does not impose any functional form on the technology. For a comparison of strenghts and weaknesses of different methods the reader can refer to Lovell (1993) and Murillo-Zamorano (2004).

distance of each firm in the sample from the best practice frontier. The distance from different specifications of the technology represents a measure of the technical efficiency of production units.[8] Referring to a technology with constant returns to scale (CRS), the linear program problem to solve to compute the directional output distance function, for each observation k' is the following (Chambers, Färe and Grosskopf, 1996)

$$\overrightarrow{D}_O(x_{k'}, y_{k'}, b_{k'}; 0^N, g_y, g_b) = \max\ \beta :$$

$$\begin{aligned} \sum_{k=1}^{K} z_k y_{km} &\geq y_{k'm} + \beta g_y,\ m = 1, ..., M, \\ \sum_{k=1}^{K} z_k b_{kh} &\geq b_{k'h} - \beta g_b,\ h = 1, ..., H, \\ \sum_{k=1}^{K} z_k x_{kn} &\leq x_{k'n},\ n = 1, ..., N, \\ z_k &\geq 0,\ k = 1, ..., K, \end{aligned} \tag{3.2}$$

where g_y and g_b are the direction vectors for the good and bad outputs respecively. In this study we will consider different direction vectors for g_y and g_b, but a benchmark direction is given by $g_y = y'$ and $g_b = -b'$, i.e., in the direction of the observations, with the minus sign for the case of the bad outputs. In this case, also imposing weak disposability on the bad outputs, the linear programme to solve for the directional output distance function is the following

$$\overrightarrow{D}_O(x', y', s'; 0^N, y', s') = \max\ \beta :$$

[8] The radial distance functions *à la* Shephard is related to the technical efficiency *à la* Farrell by the following: $\theta = \frac{1}{D_O(\mathbf{x}, y, \mathbf{s})}$, where θ is the Farrell technical efficiency and $D_O(\mathbf{x}, y, \mathbf{s})$ is the radial Shephard measure defined in the text (see, e.g., Färe and Primont, 1995).

$$
\begin{aligned}
\sum_{k=1}^{K} z_k y_{km} &\geq y_{k'm}(1+\beta),\ m=1,...,M, \\
\sum_{k=1}^{K} z_k b_{kh} &= b_{k'h}(1-\beta),\ h=1,...,H, \\
\sum_{k=1}^{K} z_k x_{kn} &\leq x_{k'n},\ n=1,...,N, \\
z_k &\geq 0,\ k=1,...,K,
\end{aligned} \tag{3.3}
$$

3.2. Specification of banking production

The first and unavoidable problem when dealing with the specification of the banking production is the correct definition of banking outputs and inputs. The agrred consideration of the bank as a multi-ouput multi-input firm leads however to the argiung among economists over the problem of what has to be considered output or input and how to measure them. There is a clear lack of consensus about a common solution to these problems and even in the criteria of classification of the different approaches currently used.[9] Briefly and broadly speaking, the approaches in the literature are the intermediation and the asset approach, where banks are seen as financial intermediaries and the main difference between them is in the focusing on the specialty of the banks over the other financial institutions; the production approach, in which banks are seen as producers of financial services (loans and deposits), and the value added approach, which emphasize the value added in the balance sheets to identify the outputs.

More specifically, the main difference between the intermediation or asset approach and the production and value added approaches lays in the treatment of deposits. While they are considered a typical input for their intermediation function, they are considered a service to the customers likewise the loans by th evalue

[9] The classification criteria can draw from the macroeconomic point of view of the functions of the banks which transform and transfer resources from the units in surplus to those in deficit (intermediation and asset approach) or from a microeconomic point of view for which banks are producers of financial services (production approach). Alternatively, the different approaches may be split between their relationships to the functions carried out by the banks (intermediation, asset and production approach) or on the sources of revenue (user cost and value added approach). See, among others, Berger *et al.* 1993, Berger and Humprey 1997, Fixler and Zieschang 1992.

added and production approach. As far as we know, there are only few attempts to compare directly the results of different approaches,[10] and at any rate the evidence reported does not discriminate about the different ones. In other words, more often than not data availability, the aim of the analysis and the estimation methods have been the important criteria guiding the choice on the approach to be used.

A larger consensus has been reached on how to measure the variables to consider: in general it is common practice to use stock variables, unlike the analysis done for other sectors when flow variables are more common. The main reason for this choice is a substantial proportionality between stock and flow variables in the banking production, given that deposits and loans need a continuous flow of work independently of the demand (Humphrey, 1992).

A further point of discussion follows from the evolution and the modifications of different approaches due to the development of the vast literature on banks' efficiency and performance evaluation. The changes in the structure of the financial systems and the changing role of banks in a more competitive environment have created the need to adapt the different models to the new reality. Therefore, within the same approaches different output and input categories have been modified in relationships with the changing structure of the bank balance sheets or to take into account country specific conditions of the banks (Cavallo and Rossi, 2002).

As for the value added approach,[11] the distinguishing characteristic is the consideration of the changes in the technology of banking production, following the distinction between important outputs and non important, or intermediate, outputs. This brings about the inclusion of purchased deposits (non transaction deposits) or another indicator for the costs of raising loanable funds. Likewise, the intermediation and asset approaches extend the inputs looking for the items on the liability side which characterize the intermediation function of the banks.

[10] Actually the main papers are Favero and Papi (1995) and Tortosa-Ausina (2002). However, notice that the first compares the intermediation and asset approaches finding their results robust to the modification of the specification of banking production, whereas this is not true for Tortosa-Ausina who test the data using the value added and the intermediation approaches. An explanation could be that only in the latter paper there is a comparison of different views of the banking firm.

[11] The production approach is rarely applied since it needs quantities (number of loan operations, of cash withdrawals etc.) and not nominal variables. Likewise the direct application of the user cost (Fixler and Zieschang 1992) is discouraged by the difficulty to find out appropriate data for the opportunity cost to compare outputs and inputs.

A specific consideration may be given to financial capital as an important and expensive source of funds and as a protection against risks of bank's asset portfolio (MacAllister and Manus 1993, Berger and Mester 1997).

As for the output side of production function, both approaches share an increasing consideration of the multi-output characteristic of the bank production and the inclusion of non traditional activities of the banks. Securities and bonds, liquid and other earning assets and non interest income are a common addition in most part of the literature. The inclusion of the off-balance sheets activities is less common, even if letters of credit and derivatives are becoming increasingly important in banking (Rogers 1998, Stiroh 2000),[12] but up to now their weight is relatively low in the balance sheet accounts, except for the large banks so the bias might not be too large if these items are omitted.

4. Data and preliminary results

In this paper, where the role of the good and bad credit in the efficiency of the banks is the focus of the analysis, we test the hypothesis with two approaches, the value added and the intermediation approach, with data obtained from ABI, the Italian Association of Banks. The choice of the variables is made following the results largely accepted in the literature even at the cost of some oversimplification of the activities of the Italian banking firms so to point out the persistent importance of the traditional loan activity and the distinction of different type of loans according to their quality in terms of the risk of credit.

As for the value added approach, the outputs we consider are the loans to non financial agents (real estate, commercial industrial and personal loans), with the distinction between good loans and problem loans (either bad loans or non performing loans),[13] deposits with retail customers, and non interest income as a proxy for the bank's services in non lending activities. The choice of non interest income versus, or besides, securities seems more appropriate as it represents the result of trading and investment activities in securities and bonds. Labor (number

[12] Omitting non traditional outputs tend to understate profit efficiency. OBS are included as output in Casu *et al.* (2003) whereas in Färe *et al.* (1999) they are included as a quasi fixed input following the work of Berger and Mester (1997): ".. off balance sheet items are included in the model because they are often substitutes for directly issued loans ..". Notice however, that OBS are becoming increasingly a system of transfer of risks.

[13] As for non performing loans, the larger item of total non performing loans instead of the narrower concept of bad loans seem more representative of non good loans as this type of classification entails different admistrative and monitoring procedures for the bank.

of employees) and capital (not only physical but also also intangibles to include the increasing importance of reputation and legal aspects) are the inputs which better capture the technology for the production of the loans.

In the intermediation model outputs and inputs are chosen according to the modified version which allows for the production of the services of payments by the banks. Therefore outputs are loans (again divided between good and bad loans), non interest income and core deposits (transaction deposits) whereas purchased deposits are among the inputs together with labor (total costs in this case) and capital.

Descriptive statistics for the data are presented in table 1. We are using the observations that have reliable data for all the balance sheets items used as proxies for inputs and outputs. In addition, to ensure that the null-jointness property hold, we keep only the observations that have a positive amount of problem loans. Notice that the number of banks change every year and so it is difficult to compare efficiency scores across years.

Since in this study we concentrate on the impact of credit quality, for each year we estimate the directional output distance function and hence technical efficiency using different specifications of the loans. In specification 1, which can be considered our benchmark, we use only the total loans together with the other (good) outputs. In specification 2, following Resti (1994), we use loans net of the bad loans (2A) or net of the non performing loans (2B). Thus in specification 1 and 2A-2B we have only good outputs.

In specification 3, on the other hand, we explicitly take into account the problem loans, and credit those banks that try to reduce them using a directional distance function in which firm simultaneously try to increase the good outputs and try to reduce the problem loans. These latter can be the bad loans (specification 3A) or the non performing loans (3B).

In table 2 (table 3) we report efficiency scores using the value added (intermediation) approach for the different years. Notice that a value of zero would imply that the observation is located in the frontier, i.e., the maximum technical efficiency, while higher values indicate that the performance is lower. Looking at the results, one can notice that the specification 1, 2A and-2B give very similar results. Specification 3A and 3B, on the other hand, give different results from the other specifications consistently across years and approaches (value added and intermediation). This seems to suggest that just using total loans net of problem loans, as suggested for instance in Resti (1994), does not credit firms for their efforts to reduce the problem loans. In addition, the results show that crediting firms for reducing problem loans increases significantly their performances, as shown also in figures 1 to 6, representing the kernel distribution of the efficiency scores for the different specifications.

5. Concluding remarks

Credit quality is an important issue in financial systems and in the real economy. Macroeconomic stability, competition issues and regulatory supervision all affect, and are affected by, banks' credit quality. In this study we estimate the efficiency of Italian banks in the period 1998-2003 taking explicitly into account problem loans using a directional output distance funtion. This latter allows to credit firms for their efforts to reduce bad outputs, i.e., problem loans, while at the same time increasing the production of good outputs.

We find that once problem loans are taken into account, the economic efficiency of banks increase significantly, suggesting that a significant aspect of banking production, credit quality, needs to be considered when evaluating banks' performances. Further analysis is required in order to understand whether the more efficient banks, with efficiency measured in the "traditional" way, i.e., without considering problem loans, are also more efficient with respect to problem loans reduction.

The paper can be improved and extended along different dimensions. A possible extension, would be to investigate how to decompose credit risk between the bad luck and the bad management hypotheses, trying also to infer how regional differences and different corporate governance regimes may explain the results.

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Table 1 - Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
	1998	(K=535)			1999	(K=475)			2000	(K=518)		
Labor (no. Workers)	411.04	1485.10	2	19124.00	203.95	543.82	3	5063.00	304.69	1083.00	2	10550.00
Labor (total costs)	23.39	0.00	0.09	1062.73	11.13	30.13	0.09	275.61	16.74	61.26	0.11	641.16
Capital	32.77	129.09	0.05	1556.47	14.84	53.01	0.05	679.32	22.30	105.26	0.02	1840.91
Purchased deposits	495.38	1896.98	0.81	20301.39	228.07	655.34	0.93	5560.78	382.52	1493.37	0.03	19797.80
Deposits	590.80	2094.01	1.66	24582.01	301.18	789.77	0.83	7529.06	476.54	1742.08	2.05	18795.62
Deposits (a vista)	480.80	1716.89	1.65	22547.42	255.22	684.07	0.05	7109.19	390.21	1415.52	1.91	16894.24
Non interest income	22.66	85.77	0.02	1113.41	8.95	28.60	0.00	279.97	16.96	74.26	0.01	1146.85
Total Loans	766.78	3142.46	1.37	47417.39	406.74	1141.20	2.61	11461.63	696.84	2637.52	2.61	28884.03
Loans net of bad loans	711.10	2900.06	1.34	42683.43	378.95	1052.30	2.25	10398.82	657.26	2495.34	2.61	28541.49
Loans net of NPL	682.22	2779.50	1.34	40397.48	364.65	1012.64	1.03	9962.28	638.32	2438.03	2.33	28347.19
Bad loans	55.68	368.60	0.00	6575.90	27.79	121.22	0.00	1884.09	39.58	233.79	0.00	4112.62
Non performing loans	84.56	476.61	0.01	7199.01	42.09	160.88	0.09	2261.09	58.52	294.69	0.05	4574.18
	2001	(K=616)			2002	(K=618)			2003	(K=579)		
Labor (no. Workers)	364.31	1295.56	3	20223.00	312.85	1034.59	4	16798.00	386.76	1666.62	3	33939.00
Labor (total costs)	20.13	75.87	0.11	1295.00	16.80	48.48	0.09	521.15	22.64	103.44	0.11	2156.00
Capital	26.64	94.83	0.00	1036.00	25.82	107.98	0.04	1363.92	32.41	136.42	0.07	1601.34
Purchased deposits	470.25	1780.09	0.03	32492.00	405.39	1158.11	0.60	11312.86	606.57	3324.58	0.03	73254.00
Deposits	613.67	2334.42	2.53	40147.00	554.50	1731.59	0.12	26971.15	774.62	3627.68	2.38	76922.00
Deposits (a vista)	499.12	1829.12	0.08	28433.00	466.88	1505.35	0.12	24312.58	662.28	3032.65	0.41	63123.00
Non interest income	20.43	88.59	0.02	1421.00	15.82	48.97	0.01	424.86	23.83	121.36	0.02	2604.00
Total Loans	868.79	3389.56	2.93	59572.00	794.26	2664.19	0.29	43272.38	1097.36	5288.30	4.45	112016.00
Loans net of bad loans	835.76	3274.22	2.32	57761.00	767.83	2595.05	0.08	42705.82	1056.63	5105.17	4.31	108480.00
Loans net of NPL	815.25	3208.90	2.32	56755.00	746.68	2490.97	0.08	39756.55	1029.34	4947.15	4.31	104851.00
Bad loans	33.02	157.24	0.00	2695.53	26.44	134.03	0.00	2632.07	40.74	221.66	0.01	3536.00
Non performing loans	53.53	215.14	0.06	3062.84	47.58	214.69	0.02	3515.84	68.03	372.31	0.05	7165.00

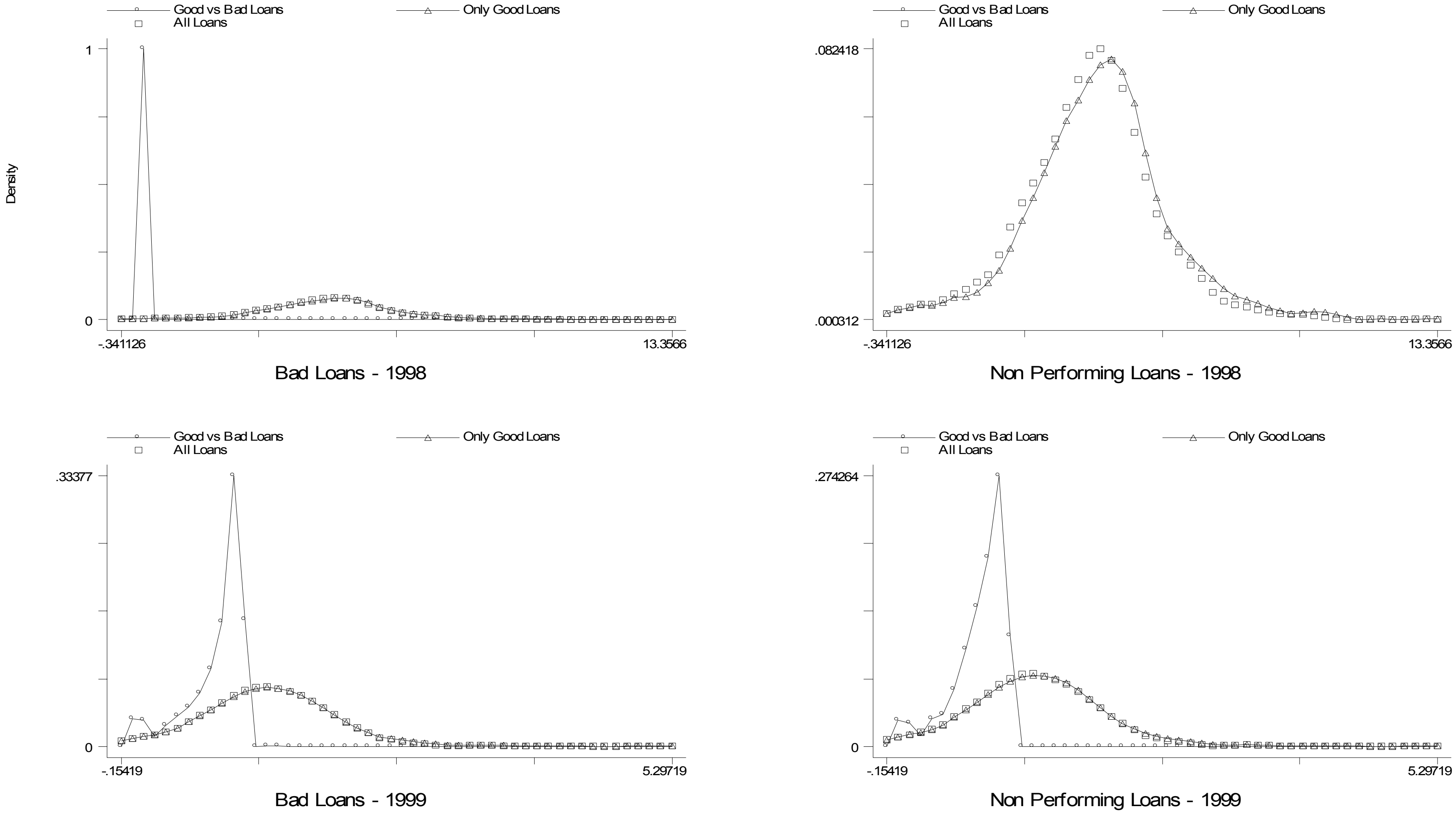
Million euros

Table 2 - Efficiency scores (Value Added Approach)

Specification	Mean	Std. Dev.	Min	Max
	1998	(K=535)		
1. Total Loans	4.74	1.69	0	13.02
2A. Loans net of Bad Loan	4.88	1.74	0	13.16
2B. Loans net of NPL	4.97	1.77	0	13.20
3A. Loans & Bad Loans	0.96	0.17	0	1.00
3B. Loans & NPL	0.98	0.13	0	1.00
	1999	(K=475)		
1. Total Loans	1.33	0.67	0	5.14
2A. Loans net of Bad Loan	1.34	0.69	0	5.24
2B. Loans net of NPL	1.35	0.70	0	5.26
3A. Loans & Bad Loans	0.78	0.28	0	1.36
3B. Loans & NPL	0.76	0.26	0	1.00
	2000	(K=518)		
1. Total Loans	2.23	1.13	0	12.58
2A. Loans net of Bad Loan	2.23	1.14	0	12.50
2B. Loans net of NPL	2.23	1.13	0	12.15
3A. Loans & Bad Loans	0.81	0.26	0	1.06
3B. Loans & NPL	0.79	0.26	0	1.00
	2001	(K=616)		
1. Total Loans	2.68	1.32	0	15.20
2A. Loans net of Bad Loan	2.69	1.31	0	15.18
2B. Loans net of NPL	2.70	1.32	0	15.18
3A. Loans & Bad Loans	0.96	0.25	0	3.14
3B. Loans & NPL	0.87	0.19	0	1.00
	2002	(K=618)		
1. Total Loans	2.64	1.22	0	12.87
2A. Loans net of Bad Loan	2.67	1.24	0	12.92
2B. Loans net of NPL	2.70	1.25	0	12.92
3A. Loans & Bad Loans	0.97	0.33	0	6.47
3B. Loans & NPL	0.92	0.20	0	1.15
	2003	(K=579)		
1. Total Loans	2.14	0.89	0	7.11
2A. Loans net of Bad Loan	2.16	0.90	0	7.11
2B. Loans net of NPL	2.18	0.91	0	7.12
3A. Loans & Bad Loans	0.92	0.20	0	1.24
3B. Loans & NPL	0.91	0.19	0	1.00

Table 3 - Efficiency scores (Intermediation Approach)

Specification	Mean	Std. Dev.	Min	Max
	1998	(K=535)		
1. Total Loans	13.30	6.06	0.00	46.85
2A. Loans net of Bad Loan	14.66	7.52	0.00	57.71
2B. Loans net of NPL	15.56	8.11	0.00	59.95
3A. Loans & Bad Loans	0.95	0.18	0.00	1.00
3B. Loans & NPL	0.97	0.13	0.00	1.00
	1999	(K=475)		
1. Total Loans	1.48	0.69	0	4.70
2A. Loans net of Bad Loan	1.51	0.73	0	5.79
2B. Loans net of NPL	1.53	0.75	0	5.97
3A. Loans & Bad Loans	0.65	0.28	0	1.00
3B. Loans & NPL	0.65	0.24	0	1.00
	2000	(K=518)		
1. Total Loans	1.86	0.97	0	9.32
2A. Loans net of Bad Loan	1.88	1.01	0	10.61
2B. Loans net of NPL	1.89	1.02	0	10.75
3A. Loans & Bad Loans	0.84	0.27	0	1.16
3B. Loans & NPL	0.82	0.26	0	1.00
	2001	(K=616)		
1. Total Loans	2.89	1.30	0	11.25
2A. Loans net of Bad Loan	2.90	1.31	0	11.71
2B. Loans net of NPL	2.90	1.32	0	11.90
3A. Loans & Bad Loans	0.98	0.34	0	6.79
3B. Loans & NPL	0.85	0.19	0	0.99
	2002	(K=618)		
1. Total Loans	2.15	0.94	0	9.01
2A. Loans net of Bad Loan	2.17	0.96	0	9.58
2B. Loans net of NPL	2.20	0.98	0	9.75
3A. Loans & Bad Loans	0.95	0.28	0	3.45
3B. Loans & NPL	0.88	0.22	0	1.00
	2003	(K=579)		
1. Total Loans	1.55	0.88	0	7.19
2A. Loans net of Bad Loan	1.60	0.93	0	8.09
2B. Loans net of NPL	1.65	0.97	0	8.61
3A. Loans & Bad Loans	0.76	0.27	0	1.07
3B. Loans & NPL	0.76	0.24	0	1.00



Good vs Bad Loans
Only Good Loans
All Loans
Density
1
0
-.341126
13.3566
Bad Loans - 1998
Good vs Bad Loans
Only Good Loans
All Loans
.082418
.000312
-.341126
13.3566
Non Performing Loans - 1998
Good vs Bad Loans
Only Good Loans
All Loans
.33377
0
-.15419
5.29719
Bad Loans - 1999
Good vs Bad Loans
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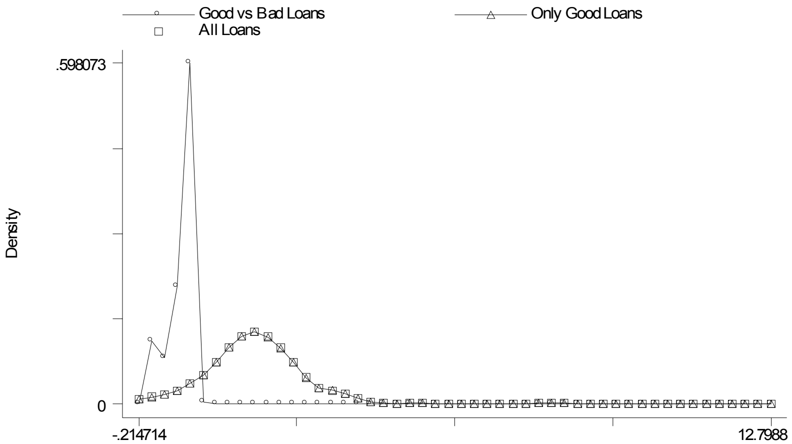
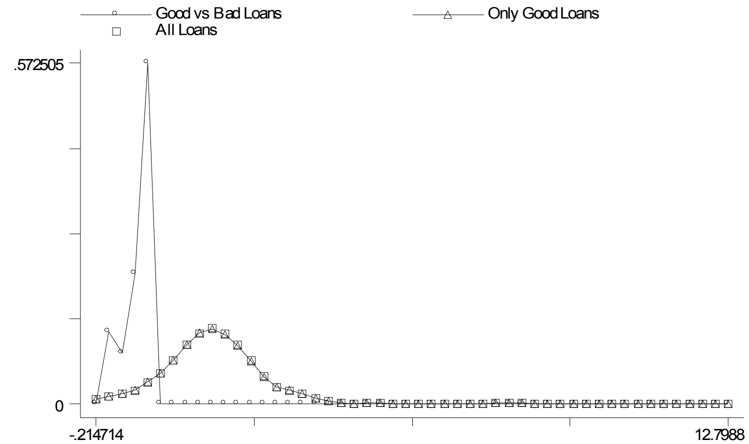
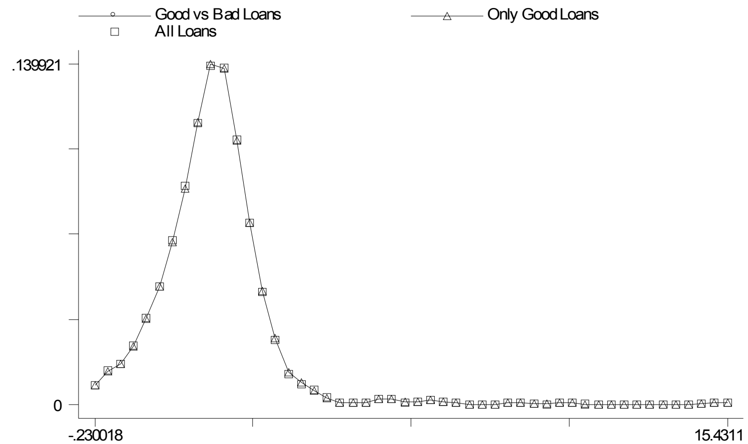
Non Performing Loans - 1999



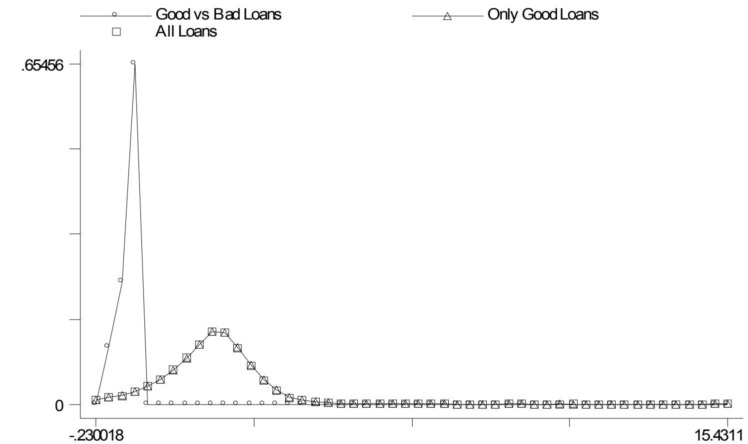
Bad Loans - 2000



Non Performing Loans - 2000



Bad Loans - 2001



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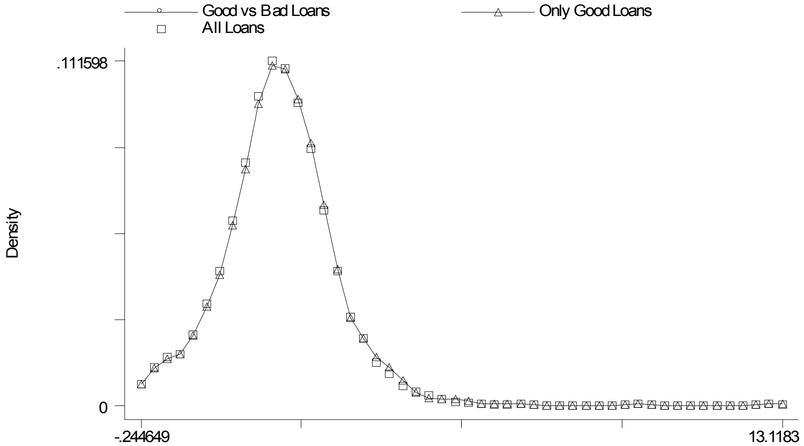

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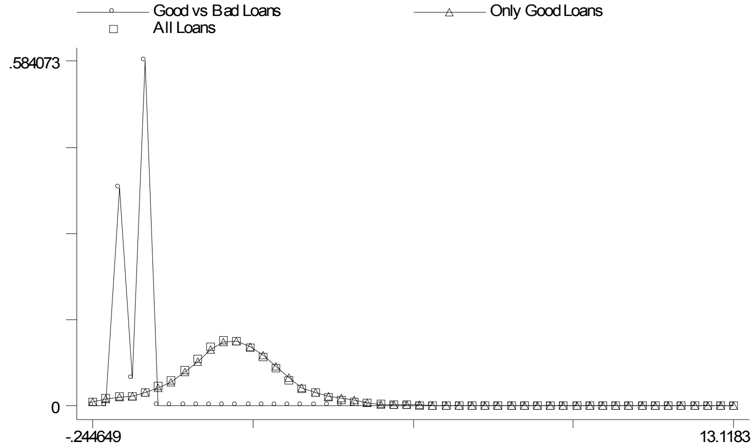

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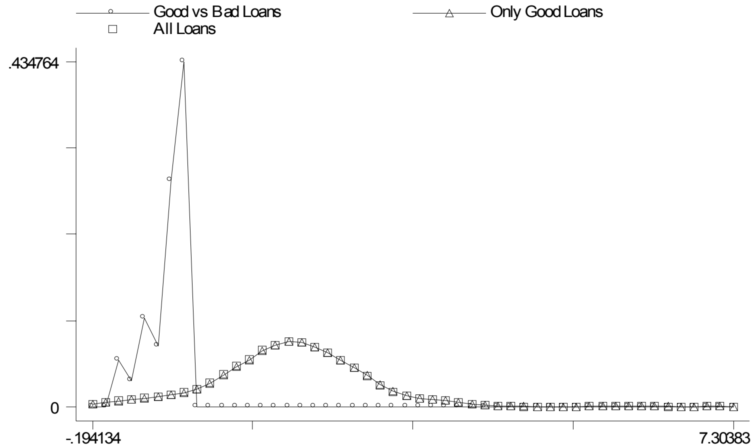
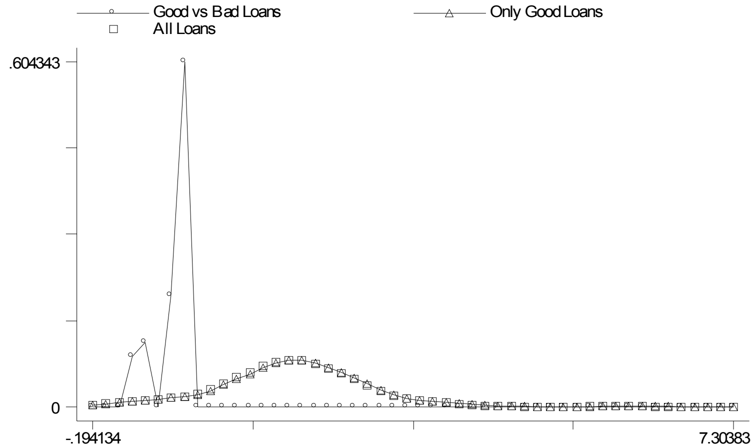
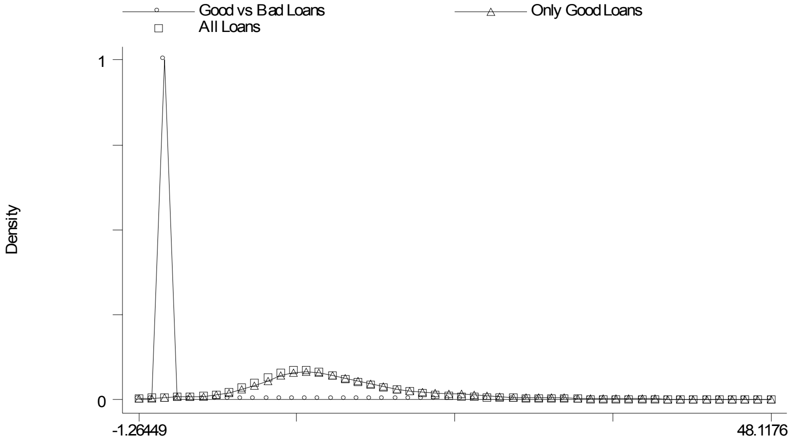


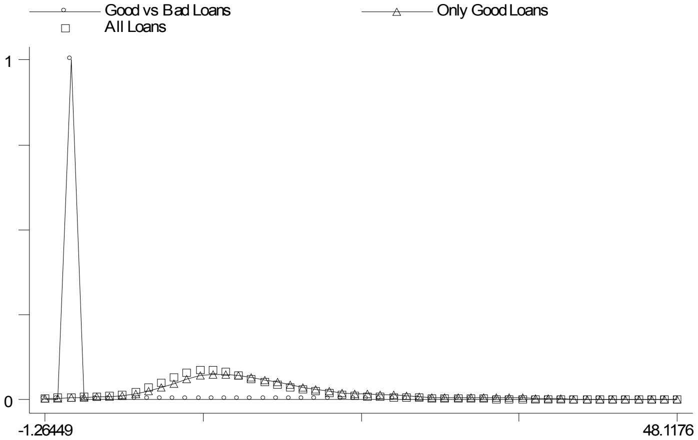
Bad Loans - 2003



Non Performing Loans - 2003



Bad Loans - 1998



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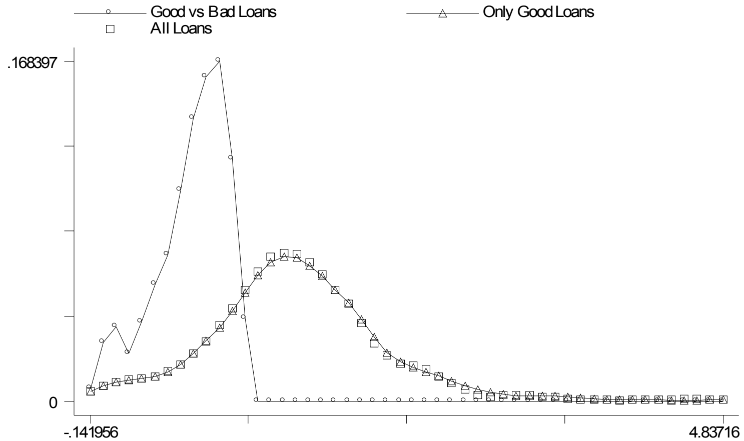
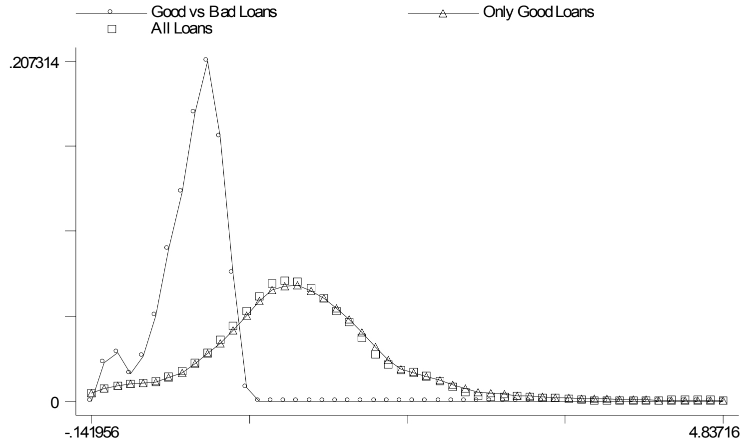
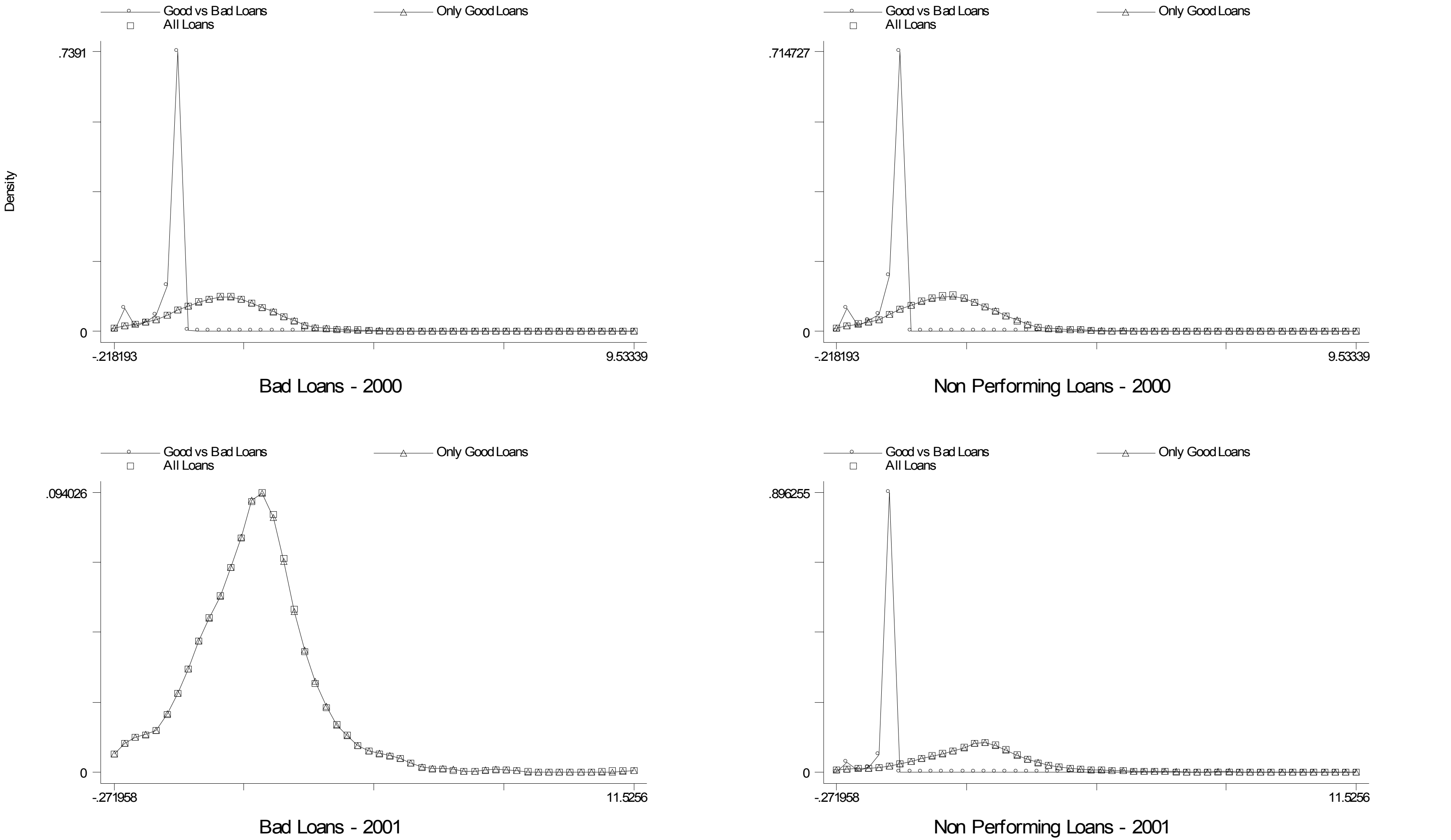
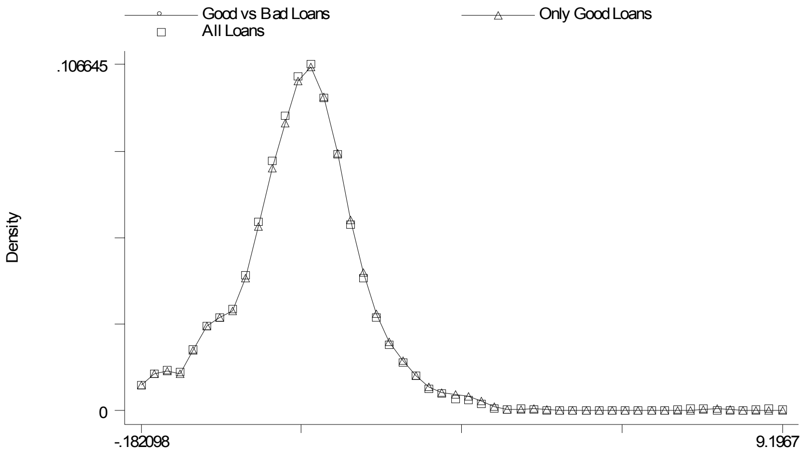


Bad Loans - 1999

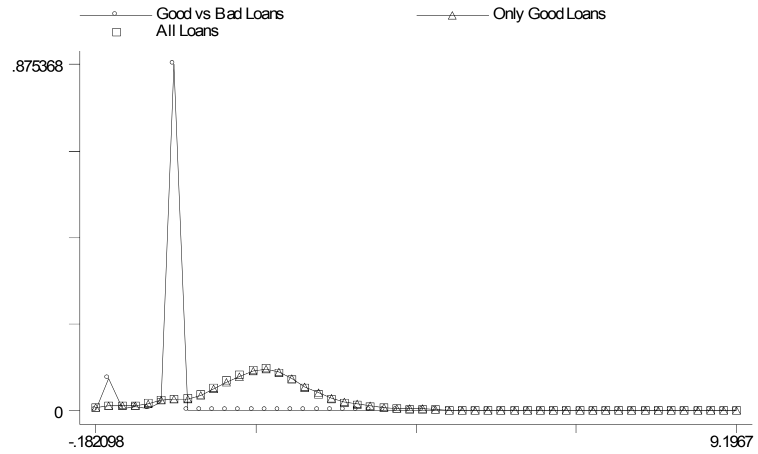


Non Performing Loans - 1999

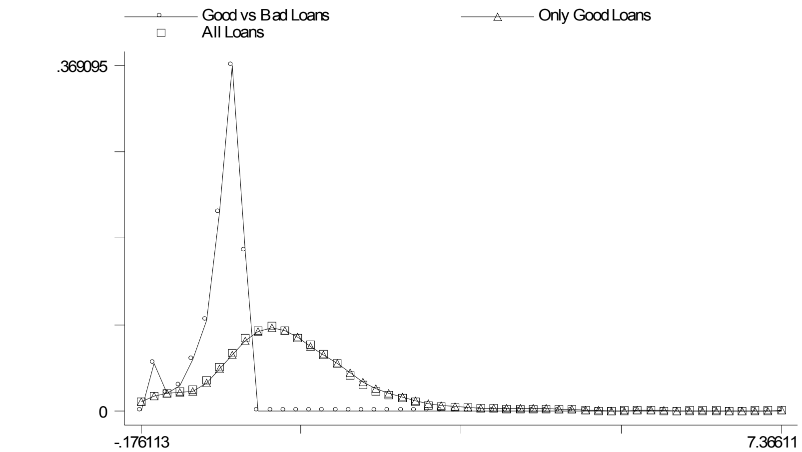

Good vs Bad Loans
Only Good Loans
All Loans
Density
.7391
0
-.218193
9.53339
Bad Loans - 2000
.714727
Non Performing Loans - 2000
.094026
-.271958
11.5256
Bad Loans - 2001
.896255
Non Performing Loans - 2001



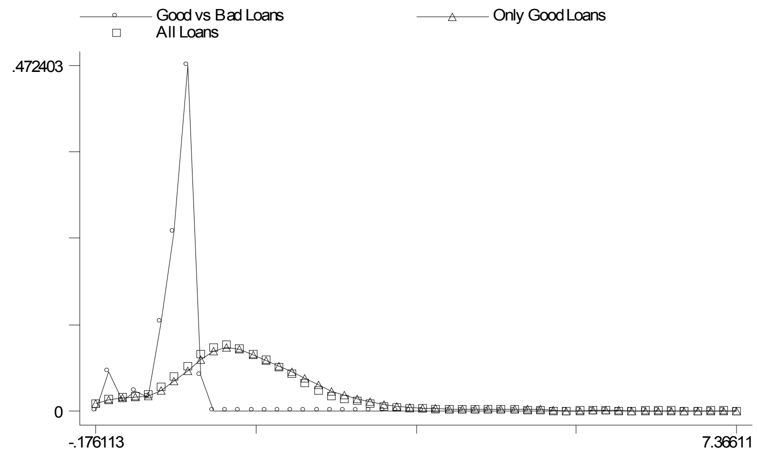
Bad Loans - 2002



Non Performing Loans - 2002



Bad Loans - 2003



Non Performing Loans - 2003