CENTRO STUDI LUCA D'AGLIANO

www.dagliano.uni-bocconi.it

DEVELOPMENT STUDIES WORKING PAPERS

Banks' Inefficiency and Economic Growth A Micro-Macro Approach

Riccardo Lucchetti, Luca Papi, Alberto Zazzaro

N. 153 May 2001

http://www2.qeh.ox.ac.uk/

Published with the financial support of Banca d'Italia and Fondazione Cassa di Risparmio di Torino

Banks' inefficiency and economic growth: a micro-macro approach[1]

Riccardo Lucchetti
Luca Papi
Alberto Zazzaro

Dipartimento di Economia – Università di Ancona

April 30th, 2000

[1]We wish to thank Steve Bond for kindly providing us with the DPD98 program, Giorgio Calcagnini for providing us with some data on banks' branches and Mariangela Breccia, Romina Farnetti and Diego Sebastianelli for their assistance in collecting the data. We are grateful to Pino Marotta and Alberto Niccoli for very useful comments. Financial support from MURST is gratefully acknowledged. Correspondence to: Prof. Luca Papi, Dipartimento di Economia, Università di Ancona, P.le Martelli, 8, I-60121 Ancona, Italia. Email: papi@deanovell.unian.it

Abstract

This paper offers a methodological contribution to the empirical analysis of the relationships between banking and economic growth by suggesting a new indicator for the state of development of the banking system based on a measure of bank microeconomic efficiency. This choice helps to overcome the problem of causality and to capture the effects of the banks' allocative activity. This new approach is then applied to analyse the relationship between the banking system and economic growth in the Italian regions, through a dynamic panel technique. The empirical results show the existence of an independent effect exerted by the efficiency of banks on regional growth.

JEL codes: O40, G21, C33.
Keywords: Bank efficiency, regional growth.

1 Introduction

In the 1990s, starting from the studies by King and Levine (1993a, 1993b, 1993c), a new body of empirical evidence – both at country level and regional level – has indicated a positive relation between the level of development achieved by the banking system and the growth rates of real variables (per-capita GDP, per-capita productivity, value added of individual industrial sectors, sales by individual firms).

As far as the role of banks in economic growth is concerned, the main weakness in this new strand of literature is, we believe, the variables used to measure the banking system's state of development. These variables are of two types. The first refers to the presence and diffusion of the banking system: here the most commonly used indicators are the ratio between liquid liabilities of the banking system and GDP (Gertler and Rose, 1994; King and Levine, 1993b, 1993c), or, in analysis at the regional level, the proportion of bank branches to the resident population (Ferri and Mattesini, 1997). The second group of variables instead measures the amount of financing intermediated by banks. Among these variables are the ratio between domestic credit and GDP (Rajan and Zingales, 1998), the share of credit granted to the private sector, or the credit granted to the private sector in ratio to GDP (King and Levine, 1993b, 1993c; Levine, 1998, 1999; Beck, Levine and Loayza, 1999).

All these measures give rise to interpretative problems, and they are only partially able to capture the role performed by banks in economic development. Firstly, there is the problem of causality. The growth of the banking system and the amount of credit disbursed are closely influenced by the level of economic development. The wide presence of banks and the importance of bank lending in areas which grow more rapidly than others may be indicative of a reverse causal relation between finance and economic growth. After all, banks grant credit on demand by firms. In order to counter this classic objection, King, Levine and all contemporary authors, like Goldsmith (1969) thirty years ago, resort to the classic argument of *post hoc ergo propter hoc*: the presence of banks and the amount of credit granted are good predictors of growth in subsequent years and can therefore be presumed to be one of its causes. The weaknesses of this argument are equally well known. Firstly, variables may have been omitted which explain both financial development and growth. Secondly, and especially, the capacity of the development of the banking system to predict growth may be due to the simple fact that production must be financed in advance. Consequently, in granting credit, the banks are only making correct predictions about the future growth of the real economy. In short, as Rajan and Zingales (1998, p. 560) have pointed out, "financial development may simply be a leading indicator rather than a causal factor".

As well as being unable to shed adequate light on the causal relation between the development of the banking system and economic growth, these two types of measures have the further shortcoming that they essentially concentrate on the role of banks in stimulating capital accumulation. Yet, as the recent economic literature has shown, the specific role performed by banks in the economic system is not to intermediate savings, but rather to certify the quality of borrowers, monetizing

liabilities which otherwise would fail to find purchasers in the markets (Minsky, 1986; Moore, 1988; Fama, 1985; Stiglitz and Weiss, 1988)[1]. Banks are essential for economic development in that they are a crucial device for the selection of entrepreneurs and the allocation of (first) financial and (then) real resources (Diamond, 1984). If this is the main function of banks, it is to this that the indicators of the banking system's development should, albeit imperfectly, refer.

In this paper, we propose a different approach to the measurement of banking development. The efficiency of the banking process for a whole area can be thought of as a function of the efficiency of the banks that operate in the area. Therefore, we first measure banks' efficiency at a micro level using conventional microeconometric techniques, and then aggregate the results. Next, we interpret this measure of efficiency as a proxy for the ability of banks to recognize the best entrepreneurs.

This approach has two important virtues. First, the efficiency of banks is a measure which suffers less from the simultaneity bias and which is better equipped to clarify the problem of the causality between finance and growth. The ability to use inputs correctly is certainly less dependent of the growth rate of the economy than the amount of bank credit. The level of economic development of an area may influence the costs of banking activity (Sussman and Zeira, 1995), but it hardly influences the available technology for such activity and banks' ability to use it. Besides, if banking loans simply mirrored investment opportunities, then the health (efficiency) of banks would be insignificant for economic growth[2].

Second, microeconomic efficiency seems better able to capture the allocative function of banks, in that the abilities to use the available technology and to combine the inputs into the production process optimally can be considered a necessary condition for the correct allocation of resources.

In this paper, we use microeconomic efficiency of banks to investigate the role of the banking system in the economic growth of the Italian regions. The rest of the paper is organised as follows. The next section discusses the reasons why

[1]This description of banking activity has been offered in the past by prestigious academics like Wicksell, Schumpeter, von Mises, Kalecki and Keynes, and leading bankers like Albert Hahn or Luigi Lugli. For example in 1920 the German banker Hahn wrote: "The activity of banks consists [. . .], if one ignores the legal form and considers the economic significance of the process as decisive, in providing guarantees, in acting as the guarantors of borrowers. They furnish, so to speak, borrowers with the general trust that they lack. On this view, therefore, they are none other than intermediaries of credit in the literal sense of the expression, or in other words the intermediaries of trust" (A. Hahn, 1920, our translation from Italian edition, p. 45). This assertion would most probably meet with general agreement today, with the difference that authors working in the mainstream of the dominant theory (neoclassical or neo-Keynesian if more precise lables are to be employed) would maintain that banks "intermediate trust" by *intermediating savings*, while those who adhere to more heterodox schools of thought (post-Keynesian, post-Kaleckian, neo-Schumpeterian) would claim that banks perform their functions by *creating money*.

[2]A similar reasoning is followed in Samolyk (1994), where the soundenss of a banks affects its ability to attract deposits. Banks' health condition is measured by some balance-sheet indicators like the return on assets (ROA) or the share of nonperforming loans. However, balance-sheet indicators are often affected by economic growth; besides, and more importantly, the presence of financial regulations (i.e. deposit insurance, existence of a lender of last resort) makes the nexus between banks' soundness and their deposit collection very weak.

allocative efficiency of banks may play an autonomous role in explanation of economic efficiency. Section 3 introduces the concept of efficiency and the relevant estimation method. In section 4 a new indicator of the efficiency of the regional banking system is introduced, based on micro data. This variable is then used in the convergence analysis carried out in Section 5. Section 6 concludes.

2 Credit allocation and bank efficiency

The economic literature has identified two broad channels through which banks exert their influence on the process of economic growth. The first of them, which we may call Hicksian (Hicks, 1969), is capital accumulation: by reducing transaction costs and by diversifying risks, banks enable the mobilization of savings to finance the investments necessary to stimulate and sustain economic development. The other, which we may instead call Schumpeterian, emphasises the allocation of credit: development is driven by innovations, the "*different* employment of *existing* services of labour and land" (Schumpeter, 1934, Eng. ed., p. 95), and the role of banks is to identify the enterpreneurs most able to introduce innovations, providing them with the purchasing power necessary to divert the means of production from their previous uses.

Although recent neoclassical theories of endogenous growth recognise the importance of the allocation of credit among uses with differing levels of productivity, in fact they have concentrated mainly on the channel of capital accumulation. In these models, banks do not actually select among customers. Rather, by diversifying (liquidity and credit) risks and reducing transaction costs, they simply enable the financing of entrepreneurial initiatives which ensure high returns, but which, because of their greater illiquidity or the greater information costs associated with them, in the absence of intermediaries would not have been financed[3]. Interesting exceptions are the models of King and Levine (1993c) and Galetovic (1994). In these cases, the entrepreneurial abilities of individuals are uncertain, and banks are obliged to select their clients. Although both models introduce some simplifying hypotheses — for example, that banks possess perfect screening technology — they indicate an analytically rigorous way to analyse the allocative function of banks and its influence on economic growth.

As far as the empirical evidence is concerned, the analyses carried out to date still seem far from capturing satisfactorily the function of banks in the allocation process. Despite constant references to the Schumpeterian view of finance and

[3] In some models (Bencivenga and Smith, 1991; Greenwood and Smith, 1997), the presence of banks mitigates that liquidity risks of individual depositors and thus permits the financing of illiquid but more productive investments. In others, by contrast, the diversification of credit risks makes it possible to delegate the selection and monitoring of firms to banks (Diamond, 1984; Boyd and Prescott, 1986), and by reducing information costs it makes it possible to finance activities which are more productive but also more uncertain and more difficult to evaluate (Greenwood and Jovanovic, 1990), or to increase production specialisation (Galetovic, 1996; Blackburn and Hung, 1998; Cooley and Smith, 1998).

growth, the indicators used to proxy financial development are always quantitative variables, like the amount of liquid liabilities or the credit granted by banks, without any attempt being made to measure the efficiency of banks in the process of resources allocation[4]. The only measure of financial development which seeks to capture allocative aspects is the share of financing granted to the private sector compared with the overall amount of financing supplied to the economy[5]. This approach is based on the two premises that the private sector is more efficient than the public one, and that some sort of crowding-out effect operates among the financing granted to different operators[6]. Obviously, neither of these hypotheses can be taken for granted. But what is more important is that economic development policies pursued by governments matter more than the allocative decisions of banks for the share of credit granted to the public sector in backward areas.

In some other recent papers (King and Levine, 1993b; Beck et al., 1999; Levine et. al., 1999), the importance of the allocation of financial resources for growth has been investigated through the choice of the dependent variable. In particular, in order to discriminate between the Hicksian and Schumpeterian models, the indicators of financial development are regressed on the rate of per-capita capital accumulation and on a measure of the rate of growth of per-capita productivity. As Beck et al. (1999, p. 29) point out, given the greater robustness of estimates which refer to the rate of productivity growth, the results obtained tend to favour the Schumpeterian model: "better functioning banks improve resource allocation and accelerate total factor productivity growth with positive repercussions for long-run growth". However, in the absence of any attempt at direct evaluation of the efficiency of banks in the allocative process, it seems very difficult to determine the extent to which productivity growth is due to prudent choices by banks, and the extent to which it is instead due to the better quality of local entrepreneurs.

In sum, the general reference model currently used in the literature is the following:

$$g = f\left(Y_0,\, C_0,\, X_0\right) \tag{1}$$

where g is the growth rate of the real variable used to measure the level of development, Y_0 is the income level in the initial period, C_0 is the amount of credit

[4]Generally, the total amount of credit (performing and non-performing loans) used in empirical analyses captures aspects relative to both capital accumulation and to the (mis)allocation of credit (non-performing loans); however, these two aspects should have been kept distinct by calculating the credit granted by banks net of non-performing loans.

[5]On this issue see Levine (1997). Similar interpretations can be made of the variable defined by the ratio between credit granted by commercial banks and total credit (including that granted by the central bank). However, this variable, which is used in cross-country studies, is only relevant to some of the less developed countries, where intervention by central banks in the financing of the economy has significant size.

[6]This is obviously the traditional hypothesis that the fundamental engine of economic development is savings, which, for the economy as a whole and at every moment of time, is a given amount. Evidently, this is anything but a Schumpeterian hypothesis: "if we included savings as a major factor initiating economic change", Schumpeter writes (1939, p. 83), "we would be including in our premises part of what we are attempting to explain".

(including bad loans) granted by banks to the economy in the same period, and X_0 is a vector of other financial variables and control variables. Considering a log-linear specification, the model can be written as follows:

$$\Delta y = \beta y_0 + \gamma c_0 + \delta x_0 + \epsilon \tag{2}$$

where lower case letters denote logarithms of the variables and ϵ denotes the error term.

We propose replacing C_0 with a new measure of the development of the banking system which takes explicit account of the efficiency of banks. Specifically, the measure that we suggest is:

$$\widetilde{C}_0 = \frac{C_0}{(1+\iota_0)^{\theta}} \tag{3}$$

where ι_0 is a measure of the inefficiency of banks at the beginning of the period and θ indicates the weight of such inefficiency on the allocative process[7]. By substituting (3) in (2), the function to estimate becomes:

$$\Delta y = \beta y_0 + \gamma c_0 - \widetilde{\theta} \ln(1+\iota_0) + \delta x_0 + \epsilon \tag{4}$$

where $\widetilde{\theta} = \gamma\theta$.

The model described by (4) is a generalization of model (2), in which θ may assume values other than zero. If the Hicksian model prevailed, γ would have to assume positive values, while $\widetilde{\theta}$ would not be significantly different from zero. In the opposite case, were both coefficients differ from zero, the Schumpeterian model could not be discarded. The allocation of credit would perform an *autonomous* function in explaining the role performed by banks in the process of economic growth, the importance of which would be given by the ratio $\widetilde{\theta}/\gamma$.

This is the formulation that we shall use in the following sections to estimate the role fulfilled by banks in the recent economic growth of the Italian regions. However, it is first necessary to clarify how the inefficiency of a local banking system can be measured.

3 Measuring efficiency

The determination of banking efficiency requires the solution of three main issues: the choice of the concept of efficiency, the definition banking inputs and outputs, and the choice of the estimation method.

[7] In this case, the inclusion of overdue loans in C_0 would be neutralized by the presence of ι_0, provided of course that the inefficiency measure is calculated without considering overdue loans

3.1 The concept of efficiency

The choice of which concept of efficiency to use obviously depends on the type of analysis to be conducted. If the intention is to study the relation between the banking system and the economic growth of a particular area, the focus should be on a concept of *macroeconomic* allocative efficiency, namely the ability to select the projects with the greatest impact on development. However, when one attempts to translate this capacity to select and control investment projects into measurable variables, enormous difficulties arise. Not coincidentally, the large body of empirical literature which has addressed the problem of measuring banking efficiency has concerned itself exclusively with the concept of microeconomic technical efficiency, variously defined, leaving measurement of macroeconomic allocative efficiency entirely unexplored.

Although none of the efficiency measures proposed in the literature directly captures the ability of banks to identify the investment projects more favourable to development, we believe that microeconomic efficiency is a better proxy for macroeconomic efficiency than are the indicators of the financial system's development commonly used in the literature. Firstly, it likely that microeconomic technical efficiency is more or less closely linked to macroeconomic allocative efficiency. Secondly, microeconomic efficiency suffers less than usual financial sector indicators from the bias of the simultaneity between credit and development. Again, it is reasonable to believe that, although a bank's ability to exploit the available technology in the best manner possible may be influenced, to some extent, by the level of development of the region in which it operates, it is relatively independent of that economy's growth rate.

Two main concepts of microeconomic efficiency are analysed in the literature: cost efficiency and profit efficiency. The former measures a bank's ability to produce a given set of outputs at given input prices as economically as possible given the technology available. The latter indicated a bank's capacity to maximise profits given the prices of inputs and outputs[8]. In symbols, analyses of efficiency presupposes the following production process:

$$O = O(p, G, u) \tag{5}$$

where O is the vector of the variables that must be optimised (variable costs in the case of cost efficiency, or profits in the case of profit efficiency), p is the vector of the prices of the inputs, G is a vector of given variables (quantities of output in cost efficiency, its prices in profit efficiency), and u is a residual element which compounds inefficiency and a random error.

Although we are aware that each measure grasps different aspects of efficiency, and may therefore contribute separately to identify the most efficient banks from

[8] An alternative measure for profit efficiency has recently been proposed in order to capture the fact that the products supplied by banks may be of very different quality. This measure considers the capacity of banks to maximise profits for a given level of output quality, rather than for given levels of their prices (cf. Berger et al., 1996; Berger and Mester, 1997).

the allocative point of view, for our purposes we deemed it more correct to refer to cost efficiency. Neither cost efficiency nor profit efficiency directly expresses the ability of banks to identify those investment projects most favourable for development. However, whilst a bank's ability to make profits may not coincide with its ability to finance development, the ability to use the available technology correctly while minimising costs is a necessary condition for the efficient allocation of resources. Moreover, the hypothesis implicit in profit efficiency, namely that banks do not influence the process of price formation, strikes us as implausible when applied to the Italian banking market of the 1980s and 1990s.

3.2 The definition of inputs and outputs

In the case of cost efficiency, (5) can be rewritten as follows:

$$VC = VC(p, q, u) \tag{6}$$

where VC denotes the variable costs and q the quantities produced. Econometric treatment of (6) first requires the definition of the inputs and outputs of banking activity. This, of course, is a vexed question which the large amount of literature on the topic has been unable to resolve.

With respect to the most commonly used definitions[9], here we prefer to adopt a hybrid approach where banking outputs comprise both stock variables and flow variables. In particular, bank products are defined as total loans and deposits, and proceeds from services. The use of stock variables to approximate the value of output can be justified on the ground that loans and deposits require the constant production of services, so that they constitute an acceptable proxy for banking output (Sealey and Lindley, 1977). In order to capture the quality of output, and therefore the level of protection against risk ensured by a particular balance sheet structure (McAllister and McManus, 1993), we have only considered performing loans. Finally, we have also considered certain items on the profit and loss account (commissions and proceeds from brokerage services) in order to capture the contribution made to output by banking services which are not reflected in the amount of loans and deposits[10].

The production factors considered are intermediated funds, labour and fixed capital. The relative prices have been respectively approximated by the ratio between interest rates on bank liabilities and the total of intermediated funds[11], by the ratio between expenditure on personnel and number of employees, and by the ratio between costs, sundry expenses and amortisation, on the one hand, and intermediated funds on the other. In the last case, the use of intermediated funds, rather

[9] For a brief survey of the most widely used approaches see Favero and Papi (1995).

[10] This latter component is of particular importance in Italy, where banks carry out most of their customers' transactions in state securities for them.

[11] The long-standing problem of the twofold nature of deposits in the definition of banking inputs and outputs has been solved here by following Berger and Humphrey (1991), i.e. by including the cost of funding among the inputs and the volume of deposits among the outputs.

than the value of capital, reflects the distortions to which capital is subject when reported in the accounting records of banks (Mester, 1987).

3.3 Estimation method

The techniques usually employed in the analysis of the efficiency of credit agencies[12] can be grouped under two broad headings: DEA techniques (also called non-parametric) and stochastic frontier techniques[13].

In this paper we use a parametric estimate with a stochastic frontier in which, following the usual practice in the applied literature, the disturbance term is assumed as deriving from the sum of a normal random variable and a semi-normal random variable. We prefer a parametric technique for two principal reasons. First, defining the optimal technology in terms of a restricted number of estimable parameters allows one to check, albeit heuristically, whether the function estimated is coherent with the *a priori* hypotheses about the technology (for example about the nature of the returns to scale) and its evolution over time. Verification of this kind is impossible with DEA techniques, because the production possibility frontier is defined by the envelope of techniques used by the efficient units in the sample. Secondly, a parametric estimate allows one to associate the estimates of the efficiency of individual units with certain statistical properties: in our case, the fact that unbiased estimators of efficiency exist at the level of the individual bank means that it is possible to construct unbiased estimators at the region level.

The efficiency variable was constructed using a classic stochastic frontier technique (cf. Aigner et al., 1977) with a Cobb-Douglas function applied to a cost function. The choice of a simple function like Cobb-Douglas, rather than a flexible functional form, was due to data problems. Since there very little cross-section variation among the factor prices in our dataset, a more general functional form would have caused problems of identification. Experiments with a translog functional form yielded disappointing results, because the coefficients estimated displayed such marked temporal variability that it could not be attributed to changes in technology, but rather to severe problems of multicollinearity[14].

Finally, the choice of the semi-normal as distribution for the inefficiency term is standard practice in the literature, even though different solutions have been proposed: for example, the exponential or gamma distributions (see eg chapter 2 in Fried *et al.*). Experiments with the exponential distribution did not substantially alter the efficiency rankings, and we consequently opted for the more common solution. There is still the possibility that poor specification may make the scores

[12] For a complete and up-to-date survey see Berger and Humphrey (1997).

[13] For a survey of DEA and stochastic frontier methods see the special issue of *Journal of Econometrics* on the topic (no. 1-2, 1990) or Fried et al. (1993). A succinct but recent survey is provided by Kalijaran and Shand (1999).

[14] The condition number calculated for the matrix of the price correlations in logarithms and their cross-referenced products ranges from a minimum of 166.97 for 1988 to a maximum of 272.83 for 1994. Considering that the collinearity problem begins to arise for a condition number greater than 20, the fact speaks for itself.

non-comparable over time. However, in our case the parameters of the cost functions were sufficiently stable for us to conclude that, even if the levels of the inefficiency estimates were not entirely accurate, their evolution over time would still be preserved. In any event, the introduction of the temporal dummies in the panel estimates presented in Section 5 renders this problem inconsequential.

4 A new indicator for regional banking efficiency

The data used in this paper were taken from a sample comprising almost all Italy's commercial banks, with the sole exception of cooperative credit banks. Our sample represented a large proportion of the banking sector in all the Italian regions (more than 75% when measured in terms of bank branches), except for Trentino-Alto Adige where the large number of cooperative banks significantly reduced the sample's representativeness (just under 40% of the total number of bank branches in the region). The period analysed was from 1982 to 1994[15]. Information about balance sheets and profit and loss accounts was provided by ABI for the initial years and extracted from the Bilbank database for the year 1994.

Table 1: Description of the sample

	1982	1985	1988	1991
No. banks	196	196	215	198
VC	394.851	428.041	509.586	841.727
Q_1	3113.180	3710.850	5974.470	9585.630
Q_2	18.881	26.586	39.318	55.596
P_1	35.338	52.264	65.168	85.356
P_2	0.013	0.015	0.015	0.017
P_3	0.108	0.093	0.061	0.066

Legend:

VC : total variable costs
Q_1 : output 1 (sum of loans and deposits)
Q_2 : output 2 (proceeds from customer services)
P_1 : price of input 1 (unit cost of labour)
P_2 : price of input 2 (unit cost of fixed capital)
P_3 : price of input 3 (unit cost of intermediated funds)

Table 1 gives the size of our sample for various years as well as the average values of the variables considered during the econometric analysis of efficiency.

[15]The choice of the time period was constrained, at this stage of the research, by the availability of the archives at the Centrale dei Bilanci. Nevertheless the years analysed represent a period in which banks acquired greater operational freedom after the 1970s, years which were characterised by various administrative restrictions.

The data summarised in Table 1 were used to estimate a Cobb-Douglas cost function (see the previous section), i.e. a log-linear function:

$$vc_i = b_0 + b_1 q_{1i} + b_2 q_{2i} + b_3 p_{1i} + b_4 p_{2i} + b_5 p_{3i} + \epsilon_i \tag{7}$$

where i denotes the i-th bank and lower case letters are for logarithms. The error term ϵ_i is given by the sum u_i + v_i, in which u_i is the disturbance term ($N(0, \sigma_u^2)$) and v$_i$ is the inefficiency term ($|N(0, \sigma_v^2)|$).

Table 2: Cost function estimates

	1982	1985	1988	1991
b_0	-0.625	-1.755	-1.231	-1.494
	(-2.779)	(-5.463)	(-3.731)	(-4.092)
b_1	0.922	0.956	1.004	0.990
	(35.506)	(39.877)	(91.327)	(33.202)
b_2	0.087	0.053	0.011	0.020
	(3.519)	(2.326)	(1.103)	(0.703)
b_4	0.192	0.127	0.204	0.173
	(8.535)	(4.255)	(8.087)	(5.296)
b_5	0.572	0.532	0.580	0.582
	(11.441)	(11.630)	(14.267)	(10.834)
σ	2.867	3.151	2.290	2.162
	(4.247)	(3.724)	(4.679)	(3.752)
λ	0.141	0.147	0.141	0.137
	(14.389)	(18.389)	(14.261)	(12.701)
Log-lik.	60.052	55.976	55.232	53.582

t-statistics in brackets.

We imposed the requirement of linear homogeneity ($b_3 + b_4 + b_5 = 1$) on the cost function – using the price of labour as the numeraire – and estimated equation (7) with the maximum likelihood method. Although the literature suggests methods to estimate cost frontiers with panel data (e.g. Cornwell et al., 1990; Park et al., 1998), we preferred to conduct separate estimates for the four years in order to take account of changes in technology during the period and to avoid the imposition of any predetermined temporal structure on the behaviour over time of the individual efficiency scores. As is customary in the applied literature on stochastic frontiers, rather than estimating the two variances σ_u^2 and σ_v^2, we estimated two parameters σ and λ defined as e $\sigma = \sqrt{\sigma_u^2 + \sigma_v^2}$ and $\lambda = \frac{\sigma_v}{\sigma_u}$, which are evidently invertible transformations of the original parameters.

Estimation results are given in Table 2. The coefficients estimated display substantial stability, suggesting the existence of a technology which varies gradually over time and of shares of output which are practically stable. In particular, the estimations reveal slight economies of scale in more traditional products (loans and

deposits), given that the value of b_1 is slightly less than 1, but marked increasing returns in the production of services. Moreover, the dispersion of the efficiency measures declines mainly in the last years of the period, probably because the banking sector became more competitive at that time.

In order to calculate the efficiency estimates for individual banks, we used the technique developed by Jondrow et al. (1982), where inefficiency is measured as the expected value of v_i given ϵ_i, i.e.

$$\hat{v}_i = E(v_i|\epsilon_i) = \frac{\sigma\lambda}{1+\lambda^2}\left(\frac{\phi(\lambda\epsilon_i)}{\Phi(\lambda\epsilon_i)} + \lambda\epsilon_i\right) \tag{8}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are, respectively, the density and distribution functions of a standardised normal random variable. When performing the calculations, obviously, we substituted the true values of the parameters with their maximum likelihood estimates.

Table 3: Inefficiency scores of the banking systems

	1982	1985	1988	1991
Piemonte	16.2%	16.1%	15.8%	17.7%
Valle D'Aosta	19.2%	18.6%	18.3%	20.9%
Liguria	16.3%	16.8%	14.4%	14.3%
Lombardia	14.4%	12.3%	11.0%	12.6%
Trentino-Alto Adige	16.9%	11.5%	11.3%	10.4%
Veneto	10.6%	10.4%	8.5%	9.3%
Friuli-Venezia Giulia	11.6%	12.5%	11.5%	10.5%
Emilia-Romagna	9.7%	10.7%	11.0%	10.0%
Toscana	14.2%	13.3%	13.2%	14.0%
Umbria	13.4%	15.7%	14.3%	13.2%
Marche	11.4%	14.6%	13.5%	11.8%
Lazio	21.6%	25.7%	19.5%	16.6%
Abruzzi	13.6%	16.3%	15.5%	13.7%
Molise	13.1%	20.6%	20.7%	18.6%
Campania	20.6%	25.2%	24.3%	23.3%
Puglia	19.9%	20.1%	21.0%	17.8%
Basilicata	14.5%	17.4%	19.9%	19.7%
Calabria	12.9%	13.8%	14.2%	14.5%
Sicilia	17.0%	22.3%	19.2%	13.3%
Sardegna	21.7%	23.6%	18.7%	25.3%

Note that v_i is the logarithm of the ratio between the cost effectively sustained by the bank and the cost that it would have sustained had it been efficient. It can therefore be interpreted as a percentage of the costs theoretically obtainable.

Moving from the efficiency of individual banks to measurement of regional efficiency, we used a weighted average in which the weights were the presence of bank i in region j. Since we did not possess information about loans by each bank disaggregated by region, we based our analysis on the number of bank branches. By doing so, we implicity introduced two hypotheses: the first, which is highly plausible, is that a bank's production function is the same in every region; the second, which is perhaps more debatable, is that the efficiency of the branches of bank i in the various regions is independent of their location. However, adoption of this second hypothesis was obligatory with the data available to us. In actual fact, choosing the region as the geographical unit of analysis made this hypothesis less stringent than might appear, because the implicit condition is only that the bank branches located in each region are on average equally efficient. Moreover, since we were interested in the allocative efficiency of banks, it should also be pointed out that the granting of larger amounts of credit is usually handled by the central branches of banks, not by local branches.

The indicator we propose for the inefficiency of the banking system of each region is therefore defined as follows:

$$\hat{\iota}_{jt} = \sum_{i=1}^{N} w_{ijt}\hat{v}_{it} \tag{9}$$

where i refers to the banks and j refers to the regions; w_{ij} is the number of bank j's branches in region i[16].

The results of this procedure are summarised in Table 3. As far as we know, this is the first attempt to measure the efficiency of regional banking systems taking account of the banks effectively in operation, rather than merely ones with their headquarters in a region. The econometric results plot a map of banking efficiency which largely confirms received beliefs about geographical financial disparities in Italy, but which in certain respects contradicts them, showing in particular that the regions of the North-East are more efficient, and mitigating the differential between North and South.

5 Bank efficiency and growth: empirical evidence

5.1 Panel estimators

Our empirical analysis of the effects of the banking system's efficiency on regional growth employed tools used to study long-term growth, and in particular

[16] Jondrow at al. (1982) suggest that v_i can be alternatively estimated using the mode of the conditional distribution rather than its expected value. We have used the mean rather than the mode in order to improve the properties of the aggregate index. Since this is a weighted average, the unbiasedness of $\hat{v}_i$ as an estimator of v_i is transferred to $\hat{V}_j$ as estimator of V_j. Moreover, the use of the region as the unit of aggregation suggests that the measurement errors committed at the level of the individual bank are attenuated when one moves to the area level on the basis of a standard argument on the variance of weighted sum of random variables.

so-called "convergence regressions". These regressions typically analyse the effect on growth of the initial income level (plus some control variables) in a cross-section context (the literature is enormous: an outstanding example is Mankiw et al., 1992). Within this methodology, use of panel estimators has recently been growing. These latter enable the analyst to incorporate into a single effect, unobserved and specific to each geographical unit used, all the characteristics of that unit not comprised among the control variables. In symbols:

$$y_{i,t} = \tilde{\beta} y_{i,t-1} + \phi z_{i,t} + \eta_i + u_{i,t} \tag{10}$$

where, with respect to the symbols used in equation (4), $\tilde{\beta} = \beta + 1$ and the vector z comprises the variables hypothesised as determining the steady state income level: for example, the quantity of human capital, variously measured, or the level of infrastructures. The term η_i incorporates all the unobserved determinants of the steady state, whose variation over time is nil or negligible.

The use of longitudinal data in the empirical literature is relatively recent. This is because it presupposes the use of dynamic panel techniques which are still being developed: it is well known, in fact, that traditional techniques to estimate linear models with longitudinal data produce inconsistent estimators when lagged values of the dependent variables are among the independent variables and the temporal span of the sample is limited.

If we consider a model like equation (10), the fact that the individual effect η_i does not vary over time means that — for $\tilde{\beta} \neq 0$ — it is necessarily correlated with $y_{i,t-1}$, which makes the OLS estimator inconsistent. It can be shown (see Nickell, 1981) that the traditional estimators in a static context (Within and GLS) suffer from the same problem.

It is therefore necessary to use other techniques. The most important precedents in applied studies of growth determinants are Knight et al. (1993), Islam (1995) and Caselli et al. (1996). While the first two studies use Chamberlain's (1982) II technique, Caselli et al. use a GMM estimator, rightly arguing that this approach avoids regressor endogeneity problems.

The use of panel techniques has been criticised by Barro (1997), mainly because of the amplification of measurement error and the overlapping of business cycle effects and long-period growth. From an econometric point of view, both criticisms stem from the fact that the estimator in differences entirely ignores cross-section variability to concentrate on intra-temporal variability. Moreover, the use of equations in differences often raises the practical problem of 'weak' instruments (namely, instrumental variables that have little correlation with the explanatory variables) and this severely impairs the efficiency of the estimator.

To deal with the problem, like Beck et al. (1999) and Levine et al. (1999), we used the Arellano and Bover (1995) estimator, which combines equations in differences and levels in a GMM logic[17].

[17]The calculations were made using the DPD98 program kindly made available to us by Steve

A brief illustration of this estimator may conveniently begin with a version of equation (10) in first differences:

$$\Delta y_{i,t} = \tilde{\beta}\Delta y_{i,t-1} + \phi\Delta z_{i,t} + \Delta u_{i,t} \tag{11}$$

Since the differentiation eliminates the term η_i, if it were not for the correlation between $y_{i,t-1}$ (present in $\Delta y_{i,t-1}$) and $u_{i,t-1}$ (present in $\Delta u_{i,t}$), application of OLS would yield consistent[18] estimates of equation (11). However, this problem can be easily avoided by noting that all the observed values of y_i antecedent to time t can be used as instruments. On this consideration alone, the estimator used in Caselli et al. (1996) is obtained. Arellano and Bover (1995), however, point out that it is possible to achieve more efficient estimates in the presence of predetermined variables whose correlation with the individual effect is constant over time. The first differences of these variables can be used as instruments in equation (10). The Arellano and Bover estimator, in fact, is the one which results when equations (10-11) are treated as a system to be estimated jointly.

This estimator had performed very convincingly in a recent article by Blundell and Bond (1998), which analyses the properties of various panel estimators by means of Monte Carlo experiments. It should also be noted that the properties of the class estimators that we used have been studied for a very large number of individuals (the regions in our case). In this application, one may justifiably ask whether the decision to concentrate on the twenty Italian regions impedes interpretation of the results[19].

5.2 The estimated model

The specification used for the estimates, which reflects that of the theoretical model outlined in previous sections, is the following:

$$y_{i,t} = \alpha + \tilde{\beta}y_{i,t-1} + \gamma c_{i,t-1} - \tilde{\theta}\ln(1+\hat{\iota}_{i,t-1}) + \delta x_{i,t-1} + \xi_t + \eta_i + v_{i,t} \tag{12}$$

where the dependent variable is per-capita value added at factor cost and at 1990 prices.

As regards the parameters, $\tilde{\beta}$ is the key parameter in the convergence analysis, and it should be significantly less than 1 for conditional convergence to come about[20]. The two parameters for the model set out in Section 2 (see equation (4)) are γ and $\tilde{\theta}$, which are respectively associated with the variables C and ι. The latter

Bond.

[18] Though not efficient, given that the disturbance term is serially correlated by construction; moreover, the form of the serial correlation is known, so that a GLS strategy can be applied.

[19] Nevertheless, increasing the sample size is not theoretically possible, and in any case many of the variables that we used are imprecise indicators of the theoretical variables, so that overly detailed examination of the estimates is probably inappropriate.

[20] Unit root tests in a panel context have been systematically performed by various authors (e.g. Evans, 1998). Since we are not interested in pursuing this point, we shall not conduct formal tests of this type.

is the indicator of the inefficiency of the regional banking system obtained using the methods described in Section 3.

Variable C was measured using an indicator (henceforth FIN) which represents the ratio between loans disbursed in the region by banks and special credit institutions and the regional GDP. It is this variable that we suppose has an effect on growth which may be attenuated by the presence of an inefficient banking system.

Vector x contains other financial variables and control variables. Particular care was taken over selecting the auxiliary financial variables. Since it was our intention to investigate the presence of an independent effect of bank efficiency on economic growth, we regarded it as important to consider various channels of influence between the financial and real sectors, in order to prevent the influence of bank efficiency from becoming indistinguishable from the effects of other variables. It was for this reason that, in addition to the efficiency variable and the FIN variable, we considered two further financial variables: PRIV and BLOC.

PRIV is the share of bank loans granted to the private sector on total loans, while BLOC is the share of loans by cooperative banks (former artisan and rural banks) on credit provided by all commercial banks in the region. We expected all the financial indicators to have positive sign. FIN, in fact, can be viewed as an indicator of the economy's level of financing, which normally correlates positively with the level of economic activity. PRIV should instead capture some of the functions typical of intermediaries. The hypothesis is that a regional banking system which allocates a larger amount of credit to the private sector is more careful in its selection and monitoring of customers. Finally, BLOC should indicate the relative importance of local banks which, by virtue of their close relations with the local community and their ownership structure, should alleviate the information problems between borrowers and financers[21], thereby fostering the growth of the small and medium-sized firms that are so important to Italy's economy[22].

As control variables, we used three indicators intended to capture aspects relative to the availability of human capital, transport costs, and the efficiency of the legal system. As a proxy for human capital (CAPUM) we adopted the ratio between enrolments at upper secondary school and enrolments at lower secondary school. Given the time period analysed, we regarded this indicator as more significant than the illiteracy rate often used in convergence analyses[23]. Moreover, this indicator enabled us to take account of the school drop-out rate, although this displays differences in the age structure of the population between the northern and southern regions.

[21] The specific charecteristics of Italian local banks have been described and analysed empirically by Angelini et al. (1997) and Cannari and Signorini (1997).

[22] Inclusion of the BLOC variable was also necessary for a technical reason: since the efficiency indicator was constructed excluding most of the small banks from the sample, it is likely that there is a correlation between error in the efficiency measure and the weight of small banks in the local system considered. Consequently, the BLOC variable was also included in order to alleviate the adverse consequences on the estimator of $\tilde{\theta}$ of mismeasurement of ι.

[23] With regard to Italy, the illiteracy rate has been used by Cosci and Mattesini (1998).

As an indicator of transport costs (TRA) we used the ratio between kilometres of motorway, main roads and railways and the region's size in square kilometres. In principle, as also shown by the recent literature on economic geography[24], the relation between this variable and the regional growth rate is ambiguous. While on the one hand lower transport costs encourage the location of production units, on the other they reduce, in the presence of supply-side constraints, the costs of shipping goods and increase the substitutability of local goods with imported ones.

Finally, we sought to take account of the efficiency of the legal system and the amount of protection for property rights. This is an aspect investigated by numerous authors (La Porta et al., 1997; 1998) and it is now being analysed by empirical studies on finance and growth at the international level[25]. Since our analysis was carried out at the regional level, where the law is the same for all regions, we decided to refer to the efficiency of the regional judicial system. For this purpose, we constructed an indicator (LEG) taking account of the number of received and discharged bankruptcies in each year, weighted by their average size. The indicator chosen was the following:

$$\text{LEG} = \frac{\text{Discharged Bankr.}}{\text{Received Bankr.}} \times \sqrt{\frac{\text{Average assets at discharge time}}{\text{Discharged Bankr.}}} \qquad (13)$$

where the implicit hypothesis is evidently that the time taken to discharge a bankruptcy is an increasing and concave function of its size. This variable was naturally expected to enter the convergence regression with positive sign.

All the variables are measured at the beginning of each three-year period to which the variation in the dependent variable refers, and they are in logarithms with the exception of the LEG variable. The inclusion of the term ξ_i is equivalent to the introduction of dummy variables, and it was necessary in order to purge the estimate of business cycle effects and incorrect measurement of efficiency.

5.3 Estimation results

The results of the empirical analysis are set out in Table 4, which gives the estimates of the coefficients associated with the main explanatory variables[26]. The table shows three different specifications. The first column comprises all the variables indicated by the model described earlier, while the other two refer to slightly different specifications where some explanatory variables are omitted.

[24] For a recent survey see Ottaviano and Puga (1997).

[25] Rajan and Zingales (1998) approximate the degree of protection for creditors' rights with the index of accounting standards in countries constructed by the Center for International Financial Analysis and Research. Levine (1998, 1999), Beck et. al. (1999) and Levine et. al. (1999) instead control for the importance of normative aspects with the legal origin of the country, as proposed by La Porta et al. (1997, 1998).

[26] In order to facilitate reading, the coefficients of the constant and of the temporal dummies have been omitted. All of them are statistically significant.

Table 4: Panel estimates

y(-1)	0.890	0.926	0.805
	(13.891)	(19.088)	(11.571)
Ineff.	-0.499	-0.457	-0.849
	(-1.300)	(-1.557)	(-2.253)
FIN	0.114	0.053	0.231
	(3.344)	(1.747)	(3.083)
BLOC	0.014	0.001	0.016
	(0.594)	(0.167)	(0.808)
PRIV	0.158	0.153	
	(2.218)	(4.180)	
CAPUM	0.137	0.070	0.147
	(1.290)	(1.268)	(1.514)
TRA	0.025		0.147
	(0.276)		(1.417)
LEG	0.000	0.000	-0.001
	(0.059)	(1.134)	(-0.690)
Sargan test	10.46418	13.11036	8.288778
df	62	54	54
p	1	1	1
sc(1)	-1.633	-2.116	-0.64
p	0.102	0.034	0.522
sc(2)	-0.573	-0.434	-1.637
p	0.567	0.664	0.102

t-statistics in brackets.

The diagnostic tests shown are the ones conventionally used in this type of context. The Sargan test takes as its null hypothesis the validity of the over-identification conditions implicit in the GMM estimate. In ur estimates the null hypothesis is accepted in all cases. The serial correlation tests performed on the residuals of equation (11) yielded the results expected: the presence of a first-order negative serial correlation (note that the disturbance of the equation in differences is Δv_t) and the absence of a second-order serial correlation.

Our results show the existence of a rate of conditional convergence equal to around 3% per year. This value is more or less in line with the findings of cross-section analyses for Italy by Barro and Sala-i-Martin (1991), Cosci and Mattesini (1997) and Ferri and Mattesini (1997), while it conflicts with the results obtained by Paci and Pigliaru (1995) and Mauro and Podrecca (1995), who found no convergence among the Italian regions in the 1980s. Also the coefficients of the control variables show the expected sign (except in one case, in which however the coefficient was not significantly different from 0), although some variables do not

display particular significance, most notably human capital[27]. In these cases, the small size of the sample and measurement error probably played a substantial role.

In this context of convergence, the coefficient associated with the inefficiency variable assumes the negative sign that we expected for all the specifications considered. The zero setting hypothesis is not rejected at a 5% level of confidence, although the value of the t-statistic is never particularly low. This result assumes even greater importance if one considers that our variable ι shows, as said, a less marked amount of geographical disparity than might have been expected on the basis of the previous empirical evidence. Moreover, we find the expected signs and statistically significant effects for almost all the financial variables. Our empirical results therefore support the hypothesis that the banking system is associated with variations in income through various channels. Particularly significant are both the FIN variable and our indicator of the inefficiency of regional banking systems. This confirms the importance of the influence exerted by financial variables operating not only through capital accumulation, as already emphasised in the literature, but also through the degree of banking efficiency in a particular geographical area. To return to the opposition between the Hicksian and Schumpeterian channels mentioned earlier, it is possible to argue that our results cannot exclude the importance of both channels.

These results also appear to be sufficiently robust in the light of the fact that our specifications considered various financial variables in order to control for the possible presence of other channels as carefully as possible. Interesting in this regard is the importance of the PRIV variable, which to a certain extent may also be interpreted as a variable tied to the most typical functions of banks, those of selecting and monitoring customers[28]. It will be remembered that PRIV refers to the total loans granted by all banks, including local banks and smaller ones, which were partially excluded in our measure of regional banking efficiency. This fact may help explain why the other financial variable, BLOC, has a low significance level [29]. It should be noted, moreover, that the BLOC variable was also included, as said, in order to eliminate some of the distorting effects of measurement error on the variable ι, so that the coefficient associated with the BLOC variable should have in any case a rather weak interpretative significance.

[27] Similar results have been obtained by Mauro and Podrecca (1994) and Paci and Pigliaru (1995).

[28] A similar variable has been used by Cosci and Mattesini (1997), who find that the ratio between credit to the private sector and GDP has a significant bearing on the growth of the Italian provinces, although it is restricted to certain periods and in particular specifications of their model.

[29] With reference to Italy, the importance of smaller cooperative banks has been documented by several studies. For example, Cosci and Mattesini (1997) find a positive relation between local growth and the number of cooperative banks operating in the area, while Cannari and Signorini (1997) find that cooperative banks, compared with other banks, ration their clientele to a lesser extent and have less risky portfolios.

6 Conclusions

The initial hypothesis of this paper was that banks are essential for explanation of economic growth, because they mainly perform the function of selecting and monitoring entrepreneurs, and therefore of allocating financial (and real) resources. There is by now general consensus on this function in the economic literature. However, the studies that have sought to investigate it empirically have not kept pace with theoretical developments. In the majority of cases, applied studies have used financial development indicators which refer to structural aspects of the banking system, neglecting the allocative function performed by banks.

This paper's aim is to offer a methodological contribution to the empirical analysis of the relationships between banks and economic growth by suggesting a measure of bank microeconomic efficiency as a new proxy for the state of development of the banking system. This measure contributes to overcome the problem of causality and to capture the allocative function of banks.

In particular, the paper has proposed a specification of the growth equation which makes it possible to isolate the role played by the allocative function of banks in the growth process. In so doing, the paper provides an empirical contribution to the question of the channels through which the banking system affects the real sector. This methodology was then applied to investigate the relationship between the banking system and economic growth in the Italian regions. For the first time, an inefficiency index of the Italian regional banking systems was calculated which took account of all the banks operating in each region, giving each of them a weight corresponding to their presence in that region. These inefficiency indices were then used to analyse the convergence among regions in Italy. Our empirical evidence points out the existence of an independent effect exerted by bank efficiency on real growth which corroborates the presence of a Schumpeterian channel, emphasising the allocative function of banks.

References

[1] Aigner D., Lovell K., Schmidt P. (1977), "Formulation and Estimation of Stochastic Frontier Production Function Models", *Journal of Econometrics*, 6(1), pag. 21-37.

[2] Angelini P., Di Salvo R. e Ferri G., (1997), "Disponibilità e costo del credito per le piccole imprese: relazioni di clientela e banche cooperative", in Cesarini, F., Ferri, G., Giardino, M. (eds.), *Credito e sviluppo*, il Mulino, Bologna.

[3] Arellano Manuel e Bond Steven (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence", *Review of Economic Studies*, 58, 277-297

[4] Arellano Manuel e Bover Olympia (1995), "Another Look at the Instrumental Variable Estimation of Error-Components Models", *Journal of Econometrics*, 68, p. 29-51.

[5] Barro Robert J. (1997), "Determinants of Economic Growth: A Cross-Country Empirical Study", *NBER Working Paper* n. 5698

[6] Barro R.J., Sala-i-Martin X. (1991), "Convergence across States and Regions", *Brookings Papers on Economic Activity*, n. 1, pp. 107-58.

[7] Beck T., Levine R., Loayza N. (1999), "Finance and The Sources of Growth", *mimeo*, World Bank.

[8] Bencivenga V.R., Smith B.D., "Financial Intermediation and Endogenous Growth", *Review of Economic Studies*, vol. 58, pp. 195-209

[9] Berger A.N., Humphrey D.B. (1991), "The Dominance of Inefficiencies over Scale and Product Mix Economies in Banking", *Journal of Monetary Economics*, vol. 28, pp. 117-48.

[10] Berger, A.N., Humphrey, D.B. (1997), "Efficiency of Financial Institutions: International Survey and Direction for Future Research", *Board of Governors of the Federal Reserve System, Finance and Economics Discussion Paper Series*: 1997/11, February 1997.

[11] Berger, A.N., Mester, L.J. (1997), "Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions?", *Journal of Banking and Finance*, vol. 21, pp. 895-947.

[12] Blackburn, K., Hung, V.T.Y., (1998), "A Theory of Growth, Financial Development and Trade", *Economica*, 65(257), p. 107-24.

[13] Blundell, Richard e Bond, Stephen (1998) "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", *Journal of Econometrics*; 87(1), p. 115-43.

[14] Boyd, J., Prescott, E. (1986), "Financial Intermediary-Coalitions, *Journal of Economic Theory*, vol. 38, pp. 211-32.

[15] Cannari, L., Signorini, L.F. (1997), "Rischiosità e razionamento: un'analisi dell'efficienza allocativa delle banche di credito cooperativo e dei divari Nord-Sud", in Cesarini, F., Ferri, G., Giardino, M. (eds), *Credito e sviluppo*, il Mulino, Bologna.

[16] Caselli, Francesco, Esquivel, Gerardo e Lefort, Fernando, (1996), "Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics", *Journal of Economic Growth*, 1, 363-389

[17] Chamberlain, Gary (1982), "Multivariate Regression Models for Panel Data", *Journal of Econometrics*, 18, 5-46

[18] Cooley, T.F. e Smith, B.D. (1998), "Financial Markets, Specialization, and Learning by Doing", *Research in Economics*, 52, 333-61.

[19] Cornwell, Christopher, Schmidt, Peter, Sickles, Robin C. (1990), "Production Frontiers with Cross-Sectional and Time-Series Variation in Efficiency Levels" *Journal of Econometrics*; 46(1-2) pages 185-200.

[20] Cosci, S., Mattesini, F. (1997), "Credito e sviluppo nelle province italiane", in Cesarini, F., Ferri, G., Giardino, M. (eds.), *Credito e sviluppo*, il Mulino, Bologna.

[21] Diamond, D. (1984), "Financial Intermediation as Delegated Monitoring", *Review of Economic Studies*, vol. 51, pp. 647-63.

[22] Evans, Paul (1998), "Using Panel Data to Evaluate Growth Theories" *International Economic Review* vol. 39(2), pp. 295-306.

[23] Fama, E. (1985), "What's Different About Banks?" *Journal of Monetary Economics* vol. 15, pp. 29-39.

[24] Favero, C.A., Papi, L. (1995), "Technical Efficiency and Scale Efficiency in the Italian Banking Sector: A Non-Parametric Approach", *Applied Economics*, vol. 27, pp. 385-95.

[25] Ferri, G., Mattesini, F. (1997), "Finance, Human Capital and Infrastructure: An Empirical Investigation of Post-War Italian Growth", *Temi di discussione*, n. 321, Banca d'Italia.

[26] Fried, H.O., Knox Lovell, C.A. e Schmidt, S.S., (1993), *The Measurement of Productive Efficiency*, Oxford University Press.

[27] Galetovic, A. (1994), "Credit Market Structure, Firm Quality, and Long-run Growth, *Discussion Papers in Economics*, n. 171, Woodroww Wilson School, Princeton University.

[28] Galetovic, A. (1996), "Specialization, Intermediation, and Growth", *Journal of Monetary Economics*, vol. 38, pp. 549-59.

[29] Gertler, M. Rose, A. (1994), "Finance, Public Policy and Growth", in Caprio, G., Atiljas, I. e Hanson, J.A. (eds.) *Financial Reform: Theory and Experience*, Cambridge University Press, New York, pp. 13-45.

[30] Goldsmith, R.W. (1969), *Financial Structure and Development*, Yale University Press, New Haven.

[31] Greenwood, J., Jovanovic, B. (1990), “Financial Development, Growth, and the Distribution of Income”, *Journal of Political Economy*, vol. 98, n. 5, pp. 1076-107.

[32] Greenwood, J., Smith, B.D. (1997), “Financial Markets in Development, and The Development of Financial Markets”, *Journal of Economic Dynamics and Control*, vol. 21, pp. 145-81.

[33] Hahn, A.L., (1920), *Volkswirtschaftliche Theorie des Bankkredits*, Verlag J.C.B., Tubingen, It. ed., *Teoria economica del credito*, 1990, ESI, Napoli.

[34] Hicks, J.A. (1969), *A Theory of Economic History*, Oxford Clarendon Press, Oxford.

[35] Islam, Nazrul (1995) “Growth Empirics: A Panel Data Approach” *Quarterly Journal of Economics*; 110(4), p. 1127-1170

[36] Jondrow, James et al. (1982) “On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model” *Journal of Econometrics* 19(2-3) pages 233-38.

[37] Kalirajan K.P., Shand R. (1999), ”Frontier Production Functions and Technical Efficiency Measures”, *Journal of Economic Surveys*, vol. 13, n. 2, pp. 149-172.

[38] King, R.G., Levine, R. (1993a), “Financial Intermediation and Economic Development”, in Mayer, C., Vives, X. (eds.). *Capital markets and financial intermediation*. Cambridge University Press, 1993, p. 156-89.

[39] King, R.G., Levine, R. (1993b), “Finance and Growth: Schumpeter Might be Right”, *Quarterly Journal of Economics*, vol. 108, n. 3, pp. 717-38.

[40] King, R.G., Levine, R. (1993c), “Finance, Entrepreneurship, and Growth: Theory and Evidence”, *Journal of Monetary Economics*, vol. 32, n. 3, pp. 513-42.

[41] Knight M., Loayza N., Villanueva D. (1993), “Testing the Neoclassical Theory of Economic Growth”, *IMF Staff Papers*, 40(3), p. 512-41

[42] La Porta, R. Lopez-de-Silanes, F., Shleifer, A. (1997), “Legal Determinants of External Finance”, *Journal of Finance*, vol. 52, pp. 1131-50.

[43] La Porta, R. Lopez-de-Silanes, F., Shleifer, A., Vishny, R.W. (1998), “Law and Finance”, *Journal of Political Economy*, vol. 106, December, pp. 1131-50.

[44] Levine, R. (1997), “Financial Development and Economic Growth: Views and Agenda”, *Journal of Economic Literature*, vol. 35, June, pp. 688-726.

[45] Levine, R. (1998), "The Legal Environment, Banks, and Long-Run Economic Growth", *Journal of Money, Credit, and Banking*, vol. 30, n. 3, Part 2, pp. 596-613.

[46] Levine, R. (1999), "Law, Finance, and Economic Growth", *Journal of Financial Intermediation*, vol. 8, pp. 8-35.

[47] Levine, R., Loayza, N., Beck, T. (1999), "Financial Intermediation and Growth: Causality and Causes", *mimeo*, World Bank.

[48] Mankiw, N.G., Romer D. e Weil D.N. (1992), "A Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics*, 107(2), p. 407-37.

[49] Mauro, L., Podrecca, E. (1994), "The Case of Italian Regions: Convergence or Dualism?", *Economic Notes*, vol. 24, n. 3, pp. 447-72.

[50] McAllister, P.H., McManus, D. (1993), "Resolving the Scale Efficiency Puzzle in Banking", *Journal of Banking and Finance*, vol. 17, n. 2-3, pp. 389-406.

[51] Mester, L. (1987), "A Multiproduct Cost Study of Savings and Loans", *The Journal of Finance* vol. 42, n. 2, pp. 423-45.

[52] Minsky, H. (1986), *Stabilizing an Unstable Economy*, Yale University Press.

[53] Moore, B.J. (1988), *Horizontalists and Verticalists: The Macroeconomics of Credit Money*, Cambridge University Press, Cambridge.

[54] Nickell S. (1981), "Biases in Dynamic Models with Fixed Effects", *Econometrica*, 49, 1417-26

[55] Ottaviano, G.I.P., Puga, D. (1997), "Agglomeration in the Global Economy: A Survey of the 'New Economic Geography'", *CEPR working paper* n. 1699

[56] Paci, R., Pigliaru, F. (1995), "Differenziali di crescita tra le regioni italiane: un'analisi cross-section", *Rivista di Politica Economica*, vol. 85, n. 10, pp. 3-34.

[57] Park, B.U., Sickles R.C., Simar, L. (1998), "Stochastic Panel Frontiers: A Semiparametric Approach", *Journal of Econometrics*, 84, 273-302

[58] Rajan, R.G., Zingales, L. (1998), "Financial Dependence and Growth", *The American Economic Review*, vol. 88, pp. 559-86.

[59] Samolyk, K.A. (1994), "Banking Conditions and Regional Economic Performance. Evidence of a Regional Trade Channel", *Journal of Monetary Economics*, 34, pp. 259-78.

[60] Schumpeter, J.A. (1934), *Theorie der wirtschaftlichen Entwicklung*, 4th ed., Engl. ed., *Theory of Economic Development*, Harvard Univ. Press, Cambridge, Mass. 1959.

[61] Sealey, C.W., Lindley, J.T. (1977), “Inputs, Outputs, and a Theory of Production Cost at Depositary Financial Institutions, *The Journal of Finance*, vol. 32, n. 4, pp. 1251-66.

[62] Stiglitz, J.E., Weiss, A. (1988), “Banks as Social Accountants and Screening Device for the Allocation of Credit”, *NBER Working Paper*, n. 2710.

[63] Sussman, O., Zeira, J. (1995), “Banking and Development”, *CEPR Discussion Paper*, n. 1127.