Looking at the determinants of efficiency in banking: evidence from Italian mutual-cooperatives

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ABTRACT

Italy has experienced a restructuring and consolidation process in the banking industry since the 1990s that is expected to foster efficiency and competition. Despite the reforms, a peculiarity of the industry is the persistence of small mutual-cooperative banks (Banche di Credito Cooperativo, BCCs) active in narrow markets. The scope of this paper is to analyze the determinants of BCCs' efficiency in the 2006–2011 period. In the first step of the study, a stochastic cost frontier is used to yield bank efficiency. Then the cost efficiency becomes the dependent variable of fixed and random effect models. The reference market of BCCs is the province (NUTS3). We find that BCC cost efficiency is positively affected by market concentration and demand density and inversely related to branching. Importantly, these results are robust to any sample restriction anchored to the distribution of efficiency. While the evidence regarding the credit quality is inconclusive for all BCCs, the sensitivity analysis shows that the risk in local markets is a source of BCC cost inefficiency.

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1. Introduction

The permanence of small single-market entities in banking deserves attention because this industry tends to be dominated by big-players, whatever the country. This holds true for Italy, provided that the deregulation process started in the 1990s and enhanced consolidation and competition. Now, the market configuration is with several big commercial banks, a growing number of medium-sized cooperative banks organized mostly in the form of 'Popolari' Banks and the network of BCCs.

BCCs are very small and operate in narrow markets. This appears to be puzzling as two forces threaten their survival. First, nowadays a crucial role is played by complex financial conglomerates, which force the disappearance of small entities. In a world of big-banks, small credit institutions are expected to disappear. Secondly, BCCs historically operated in narrow isolated local markets, which, now, are no longer protected because the regulatory barriers to geographic expansion have been removed. This reform certainly assured territorial diversity

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in bank organization, but also caused an increase in competition even in very restricted areas. Thus, if local markets become contestable, then it is expected that BCCs will lose their quasi-monopoly power which, in the past, guaranteed a certain degree of profitability.[1]

Notwithstanding the reforms and the expectations of a potential disappearance, BCCs are still active in specific niches. They even reinforce their presence over time. Data from Bank of Italy (2014) show that at the end of 2013 BCCs totaled 385 (411 in 2011), while in the early 1990s there were 700. These figures indicate that the restructuring of the credit market has not ruled out the BCCs, which have embarked on a process of M&A to increase their size. However, the consolidation process in this network occurred involving mostly BCCs, with the result that the number of BCC branches even doubled in ten years, moving from 2226 in 1993 to 4454 in 2013. In relative terms, in 2013 BCC branches made up 14% of total national branches, which is 4 percentage points higher compared with 1993. This process surely reinforces BCC territorial vocation, which tends to expand BCCs' relative role and participation in small markets. In other words, data indicate that BCCs reacted to the national restructuring process by re-organizing their network through within-group M&A and thus increased their presence in local markets.

Based on these arguments, this paper investigates BCC performance by combining two strands of the literature, one focusing on the evaluation of bank efficiency, the other investigating the determinants of efficiency. Despite the huge literature on bank efficiency – exhaustive surveys are Aiello and Bonanno (2015), Berger and Humphrey (1997) and Fethi and Pasourias (2010) – few papers have focused on Italy (Battaglia et al. 2010; Dongili, Rossi, and Zago 2008; Fontani and Vitali 2007; Giannola and Scarfiglieri 1998; Giannola et al. 1997; Girardone, Molyneux, and Gardener 2004). In this regard, the evidence is mixed, but some conclusions can be drawn. Larger Italian banks attain lower efficiency levels than small banks. Bank efficiency is higher in the North of Italy than in the South. Interestingly, a common result from many papers is that Italian mutual-cooperatives perform better than other banks in controlling costs.[2] This outcome is often explained by the competitive advantages that BCCs have over big-banks in terms, for example, of (a) the use of soft instead of hard-information, (b) the lean rather than complex organization and (c) the short operational distance between banks and customers (see, for example, Alessandrini, Presbitero, and Zazzaro 2009; Berger et al. 2005; Carnevali 2005).

With regard to the theme of 'what' explains bank efficiency, it is noteworthy that the results are contrasting and often not comparable, as model specifications differ from one study to another. For instance, much research regards the relationship between efficiency and market concentration, socio-economic external conditions, banking structure, and access to banking services (Battaglia et al. 2010; Bos and Kool 2006; Dietsch and Lozano-Vivas 2000; Girardone, Molyneux, and Gardener 2004). While part of this literature will be reviewed in the set-up of our model (see Hughes and Mester 2008) for a comprehensive survey on this topic), here, it is important to say that the main focus of this paper is the effect on BCC performance exerted by environmental factors. In this sense, the work of Battaglia et al. (2010) is comparable with our work, as it focuses on the efficiency of BCCs over the 2000–2005 period. They estimate stochastic frontiers by referring only to the sample of BCCs and thus proposing 'within-the-group' differences rather than providing efficiency scores retrieved from the estimations of national banking frontiers. As the authors argue, their method allows them to '…avoid estimation bias in efficiency scores to strong heterogeneity in the sample' (Battaglia et al. 2010, 1366). It is also worth mentioning that Battaglia et al.

(2010) calculate the external variables at regional level. On one hand, their main results suggest that BCC efficiency is insensitive to non-performing loans and regional GDP per capita; on the other hand, cost efficiency decreases with high spatial concentration of the local banking industry and increases with the number of branches.[3]

The contributions of the paper are twofold. The first feature refers to the empirical setting we propose. In the first step, cost efficiency is estimated within the Stochastic Frontier Approach (SFA) by following the specification proposed by Battese and Coelli (1995) and, above all, considering all Italian banks. This allows discernment 'within' and 'between' group differences.[4] In the second step of the analysis, the cost efficiency is regressed against a set of predictors of BCC performance. In this regard, the main interest is to evaluate the effect of local banking conditions that are measured through several determinants defined at provincial level. This introduces the second contribution of the study, which is the choice of provinces (NUTS3) as the reference market of BCCs. An analysis based on regions – as in Battaglia et al. (2010) and Fiordelisi and Mare (2013) – could suffer from aggregation bias. Because BCCs are single-market firms, it is plausible to think that the greater the proximity of BCCs to markets the more precise the investigation of the efficiency-environment nexus will be. Another advantage of our empirical setting comes from the micro-data we use: we refer to the BCC balance-sheet, the contents of which are reliable for territorial studies. Indeed, they incorporate the environmental effects, as they are the result of the financial relationship between BCCs and the 'residents'.[5] Therefore, the research-question on 'whether and how' the BCC efficiency is determined by environmental factors becomes intriguing because it sheds some light on the relationship between the effects of the restructuring process of the entire Italian industry and the performance of the financial entities operating in local markets. Another interesting aspect is related to the period under scrutiny, which covers the years between 2006 and 2011. This was a period of severe instability in financial markets, which has not been deeply studied in terms of the effects on the efficiency of Italian mutual-cooperative banks (the exception is Barra, Destefanis, and Lubrano Lavadera 2014). The present paper contributes to fill this gap firstly by updating the analysis of the level and the dynamics of BCC performance compared with others and secondly by modeling time as a determinant of BCCs efficiency.

The paper is structured into six sections. Section 2 describes the local markets; Section 3 presents the estimating method and reports the frontier estimation; Section 4 focuses on the estimated efficiency scores of BCCs compared with other bank-types; Sections 5 is dedicated to the econometric results of the efficiency equation. Conclusions are given in Section 6.

2. Banking and the periphery in Italy

This section documents some recent developments of local Italian markets. The discussion is conducted at provincial level (NUTS3), which is the geographical disaggregation closest to the operating scale of BCCs. Throughout the paper, reference is made to the period 2006–2011 because of the greater reliability of the micro-data.[6]

An important effect of the restructuring reform is the spatial diffusion of financial services. Several proxies can be used as an indicator of this. In this respect, a valuable index is the bank branches by square kilometer, which measures the density by province. The density differs considerably across areas, varying from 0.007 in the South to 0.021 in the North West in 2006–2011 (Table 1), although it is stable over time (Figure 1(a)). Another

Table 1. Structure and behavior of Italian banking industry by area over the years 2006–2011.

	Market concentration				Bank density				
	HH1 Bank Branches	HH2 Total Assets	Q3 Market Shares Bank Branches	Q5 Market Shares Bank Branches	Branches by square km	Branches per Municipality	Financial Development (Loans/Value Added)	Loans / Deposits	Bad Loans
North-East (23)	0.099	0.354	0.194	0.202	0.0019	8.242	1.185	1.809	3.920
North-West (23)	0.132	0.454	0.251	0.267	0.0021	3.108	1.110	1.656	4.095
Center (21)	0.107	0.338	0.214	0.222	0.0013	7.516	1.119	1.764	5.683
South and Isles (36)	0.147	0.340	0.187	0.192	0.0007	3.504	0.651	1.185	9.820
Italy (103)	0.125	0.368	0.208	0.217	0.0014	5.291	0.968	1.548	6.381

Note: In brackets there is the number of provinces in each area.
Source: own computation on data from Bank of Italy.

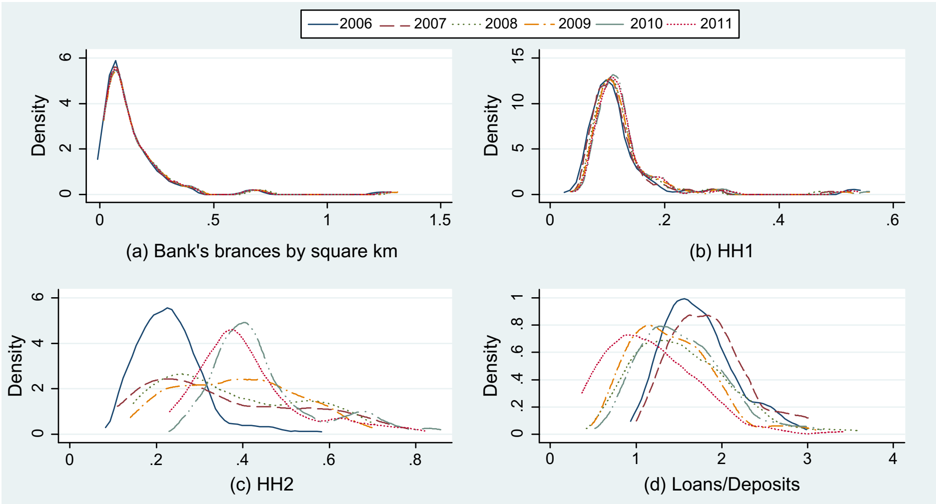

Figure 1. Bank density, market concentration and Loans/Deposits by province (2006–2011).
Source: elaborations on data from Bank of Italy and ISTAT. (a) Bank's branches per square kilometer. (b) HH1=Hirschman-Herfindahl index based on the number of branches per bank by province. (c) HH2=Hirschman-Herfindahl index based on the total assets per bank by province. (d) Loans/deposits.

valuable indicator is the ratio 'Bank Branches/Municipalities' per province, which was, on average, more than 5 in 2006–2011 and ranges from more than 8 branches per municipality in the provinces of the North East to 3.1 and 3.5 in the North West and in the South of the country (Table 1). Along this line of reasoning, further evidence comes from the concentration of provincial markets. Figure 1(b) reports the Hirschman-Herfindahl index calculated using the number of branches per bank (HH1) in every province by year. What emerges is that the concentration is quite time invariant (Figure 1(b)), but huge differences across provinces still persist. On average, HH1 was 0.12 in the years 2006–2011, ranging from the highest value (0.147) in the southern provinces to the lowest (0.099) which is observed in the North East (Table 1). Higher average market concentration has been revealed when considering total bank assets (HH2).[7] In this case, the average value of HH2 is 0.36 (three times higher than the average of HH1) varying from 0.45 (North West) and 0.33 (South and Center). Importantly, when using HH2 an increasing market concentration is observed over time (Figure 1(c)).

Furthermore, there has been a relevant increase of big-bank participation in the periphery. The top-3 national banks – as revealed by the total assets averaged over 2010–2011 – owned 21% of bank branches operating in every Italian province. The territorial distribution of this market share shows a minimum of 18.7% in the South and a maximum in the North West (more than 25%) (Table 1). It is also worth pointing out that in 22 out of 103 Italian provinces, the top-3 national banks absorb more than 80% of local total assets.[8]

An important issue concerns the traditional function of banks, namely the transformation of deposits into loans. The Bank of Italy provides the required data, taking into account the residence of customers. Table 1 and Figure 1(d) summarize this information. High values of this ratio mean that the provincial banking sector is issuing out more of its deposits in loans at provincial level, which, in turn, means it releases more income. Over the years 2006–2011, the ratio Loans/Deposits is on average 1.55, with a minimum (1.18) and a maximum (1.81) in the South and in North East respectively. A related aspect to offering funds is that loans are not always repaid. In Italy, bad performing loans are 6.38% of total loans over 2006–2011, with a different incidence across areas. In the North East, bad-loans are low (less than 4%), while they are very high (about 10% of total loans) in the South. Finally, there is also great heterogeneity when looking at the credit provided by banks. This results from the loans-to-GDP ratio, which ranges from the high value observed in the North East (1.85) to the lowest value (around 65% of provincial Value Added) registered in the South (Table 1).

This section highlights that the local banking market conditions are still extremely heterogeneous across Italian provinces. This market differentiation further motivates the understanding of the nexus between the local determinants and BCC efficiency.

3. The stochastic cost frontier

The econometric analysis is carried out in two steps. First, we consider a very large sample of Italian banks and obtain cost efficiency by estimating a stochastic frontier in the specification proposed by Battese and Coelli (1995). To this end, the cost equation is modeled by considering a three-inputs three-outputs model, while the inefficiency equation only controls for bank type (BCC, Popolari and Ltd.) and location effects. In the second step of the analysis, BCC efficiency is used as a dependent variable of a cost efficiency regression aimed at evaluating the effect of individual and local factors on BCC performance. This section briefly presents the methodology used to estimate bank frontiers, while the econometric specification of the BCC efficiency equation is discussed later (see Section 5).

The cost function is estimated by employing the SFA that allows banks to be distant from the frontier also for randomness (Aigner, Lovell, and Schmidt 1977; Meeusen and van de Broek 1997). In this, SFA differs from the Data Envelopment Analysis (DEA), which supposes that the distance from the frontier is entirely due to inefficiency. Again, SFA assigns a distribution to the stochastic component of the model and, thus, allows inference to be made. Inference, however, is not specific to SFA because of advances in bootstrapping in the DEA procedure (Simar and Wilson 2000). A further advantage of SFA derives from the specification of Battese and Coelli (1995), which allows a cleaner efficiency measure to be obtained comparing it with the model where one first estimates inefficiency using a frontier and, second, uses the estimated efficiency-score as the dependent variable in subsequent regression (Greene 1993). As shown by Lensink and Meesters (2014) and Wang and Schmidt (2002), the standard two-step approach suffers from the fact that the inefficiency is assumed to be identically and independently distributed in the main frontier equation, while it is determined by other variables in the inefficiency equation.[9] The following function F_c (.) indicates the cost of producing an output y given a price w:

$$Cost_{it} = F_c(y, w)\ e^{v_c} e^{u_c} \tag{1}$$

From equation (1), the efficiency can be expressed as the ratio of the minimum cost of a potentially efficient bank to the cost actually observed:

$$CE = \frac{F_c(y, w) e^{v_c}}{F_c(y, w) e^{v_c} e^{u_c}} = e^{-u_c} \tag{2}$$

We use the Translog function to model the frontier. It satisfies the assumptions of non-negativity, concavity and linear homogeneity (Kumbhakar and Lovell 2000). After taking into account the constraint of homogeneity[10] in relation to input-prices ($\sum_n \omega_n = 1$), the cost frontier in the log-linear form (w_r is the price of deposits) is:

$$\log\left(\frac{Cost}{w_r}\right) = \beta_0 + \sum_j \beta_j \log y_j + \sum_n \omega_n \log \frac{w_n}{w_r} + \\ +\frac{1}{2}\left[\sum_j \sum_s \beta_{js} \log y_j \, \log y_s + \sum_n \sum_q \omega_{nq} \log \frac{w_n}{w_r} \, \log \frac{w_q}{w_r}\right] + \\ + \sum_n \sum_j \alpha_{nj} \log \frac{w_n}{w_r} \, \log y_j + u + v \tag{3}$$

where *Cost* is total bank costs; y_j represents the *j*th output, with j=1,2,3; w_n is the cost of the *n*th input, with n=1,2,3; α, β and ω are the parameters to be estimated; u is the inefficiency; v is the random error. Finally, we assume that v_{it} is normally distributed with mean zero and u_{it} is distributed as a truncated normal. Again, v_{it} and u_{it} are independently and identically distributed:

$$v_{it} \sim \; iidN(0, \sigma_v^2) \tag{4}$$

$$u_{it} \sim \mathrm{N}^+(z'\eta, \sigma_u^2) \tag{5}$$

where $z'\eta$ is the linear predictor of inefficiency.[11] The econometric specification of the inefficiency component is:

$$u_{it} = \eta_1 \, z_{ltd} + \eta_2 \, z_{pop} + \eta_3 \, z_{center} + \eta_4 \, z_{south} + e_{it} \tag{6}$$

where Z_{ltd} and Z_{pop} are two dummy variables equal to unity if the *i*th bank belongs to the group of Ltd. or Popolari, respectively (the base group comprises the BCC), whereas Z_{centre} and Z_{south} are equal to unity if the headquarter of the *i*th bank is in the Center or in the South of Italy (the base group is formed by banks located in the North of the country). These dummy variables guarantee that the efficiency scores are net of any geographical and institutional fixed effect. Moreover, e_{it} is the erratic component. Finally, efficiency is time-variant, ensuring a change in relative ranking among banks. In other words, this accommodates the case where an initially inefficient bank becomes more efficient over time.

The data source used to estimate the efficiency is ABI (Italian Banking Association), which comprises the balance sheets of 96% Italian banks. Individual bank variables are used to estimate the three-inputs three-outputs frontier models (equation (3)). Appendix Table A1 displays the variables employed in defining the frontier, which were modeled by referring to the intermediation approach (Sealey and Lindley 1977). Appendix Table A2 reports the summary statistics. Regressions were performed through the simultaneous estimation of equations (3) and (6) and were run by using more than 3700 bank-observations. Results from estimating the cost frontier are in Table 2.

After observing that the coefficients of the Translog frontier are almost all significant,[12] the first meaningful result regards gamma, which is the ratio of the variance of the inefficiency to the variance of the composite error. The estimated gamma parameter is always

Table 2. Banking cost frontier in Italy. Translog results (2006–2011).

	Cost
β_0	−3.713***
β_1 (*Loans*)	0.729***
β_2 (*Commission Income*)	−0.241***
β_3 (*Securities*)	0.442***
ω_1 (*Labor Cost/Cost of Deposits*)	1.128***
ω_2 (*Cost of capital/Cost of Deposits*)	0.344***
β_{11}	0.092***
β_{12}	−0.100***
β_{13}	−0.086***
β_{22}	0.056***
β_{23}	−0.004
β_{33}	0.047***
ω_{11}	−0.025 .
ω_{12}	−0.095***
ω_{22}	0.122***
α_{11}	−0.060***
α_{12}	0.084***
α_{13}	−0.030***
α_{21}	0.068***
α_{22}	−0.065***
α_{23}	0.008
Z_{LtD}	0.092***
Z_{Pop}	0.157***
Z_{centre}	−0.127***
Z_{south}	0.032
σ^2	0.064***
$\gamma = \frac{\sigma_u^2}{\sigma^2}$	0.323***
Log-likelihood	229.414
LR test	47.814***
	(14.33)±

Significance levels: ***=0.001; **=0.01; *=0.05; '.'= 0.1; ' ' = 1.
+ 1% LR critical value as in Kodde and Palm (1986).
Source: own elaboration of data from ABI and Bank of Italy.

high, indicating that inefficiency significantly contributes to determining the distance from the frontier. This evidence is confirmed by the Likelihood Ratio test, which verifies the correct model specification of an SFA. It considers the H_o that all the parameters in equation (6) are equal to zero: if this hypothesis is accepted, then the OLS estimates will be consistent because the composite error comprises only randomness. Results indicate that the LR is 47.814 and, therefore, H_o is rejected at 1% (Table 2).

With regard the results related to equation (6), it is also important to underline that the dummy variable Z_{Ltd} has a positive sign, implying that the average level of cost efficiency is higher for BCCs than for Ltd. The sign of the Z_{Pop} coefficient is also positive, thereby indicating that BCCs obtain higher cost efficiency levels than Popolari. To explain the geographical effect, banks with their main office in the Center of Italy obtain low inefficiency compared with banks of Northern Italy.

4. Cost efficiency across bank type

This section presents the estimated cost efficiency and aims to understand better BCC performance compared with the other banks. A brief investigation is conducted in to what extent BCC efficiency differs from the rest of the sample and this discussion is complemented by calculating some balance-sheet ratios.[13]

Table 3. BCCs' and other banks' performance. Bank size, efficiency scores and some balance-sheet ratios, by year.

	BCCs						
	2006	2007	2008	2009	2010	2011	2006–2011
Income diversification	0.25452	0.20855	0.17811	0.24047	0.24748	0.23898	0.22814
Loans diversification	0.34658	0.33555	0.32512	0.32714	0.30569	0.31187	0.32567
Loans/deposits	1.29296	1.35194	1.42448	1.38888	1.41727	2.07432	1.48684
Equity/total assets	0.01712	0.01850	0.01594	0.01229	0.01551	0.01263	0.01539
Cost efficiency	0.90653	0.89640	0.89382	0.89726	0.89541	0.90531	0.89904
Size*	241	257	278	301	318	328	286
No. of BCCs**	431	436	428	414	406	404	2519
	Other banks						
	2006	2007	2008	2009	2010	2011	2006–2011
Income diversification	0.42092	0.29260	0.23903	0.39408	0.42302	0.40802	0.36323
Loans diversification	0.40031	0.38062	0.38410	0.39782	0.34836	0.35499	0.37861
Loans/deposits	2.53152	2.34515	2.39291	1.97645	2.61914	3.08037	2.47589
Equity/total assets	0.09150	0.09214	0.09916	0.10927	0.09836	0.09916	0.09837
Cost efficiency	0.87392	0.86392	0.85452	0.86599	0.86703	0.87342	0.86611
Size*	7,029	7621	8132	7784	7811	8621	7884
No. of other banks**	255	257	261	272	242	227	1514

Note: *Average value of total assets, expressed as the ratio between the total assets and the number of banks of each group. Constant values in millions of euros – NIC Index Istat, base year = 1995.
**The number of bank changes year-by-year because (i) the dataset does not comprise the balance-sheet of some minor and small banks in 2010 and 2011; (ii) some banks have ceased to operate; (iii) a few banks were involved in a very limited number of M&A.
Source: own elaboration of data from ABI.

Table 2 indicates that BCCs dominated the industry, as they amount to, on average, 63% of the sample. Moreover, it emerges that bank size ranges from €7029 million in 2006 to €7884 million in 2011. In this respect, BCCs are very small compared with the others. Their size is, on average, €286 million, which is about 30 times smaller than the average size of other banks (€7884 million). Data also suggest that BCCs activities are not diversified. This holds either in terms of income diversification (the ratio is, on average, 0.23 for BCCs, 0.36 for others) or loans diversification (0.33 versus 0.38). The ability to transform Deposits into Loans is lower for BCCs than others (on average 1.49 versus 2.48). Interestingly, the ratio Equity/Total Assets of BCCs is significantly lower than that observed for the other two bank groups: on average, it is 0.015 for BCCs and 0.098 for others. This implies that BCCs show a higher financial dependence than others, regardless of assets risk, unlike the regulatory capital ratios.

An analysis of efficiency yields interesting evidence regarding the marked differences in banking behavior. BCCs result to perform better than other banks. On average, cost efficiency is 0.90 for BCCs and 0.87 for other banks. This implies that, in order to be full efficient, BCCs should reduce the inputs of only 10% offering the same banking services (or similarly they should increase outputs of 10% with the same inputs). With regard the other banks, the inefficiency rate is 13%. As can be seen from Table 3, the evidence that BCCs perform better than other banks holds even year-by-year: the average level of cost efficiency is 83% for BCCs and 75% for the others in 2006, declines up to 2008 and shows a slight even irregular recovery in the two subsequent years. In 2011, the distance between BCCs and their counterparts is less than 9% percentage points of efficiency. These time-changes highlight two facts. On the one hand, it is a fact that BCCs and the other banks register high cost efficiency during each year under scrutiny. On the other hand, BCCs always perform better

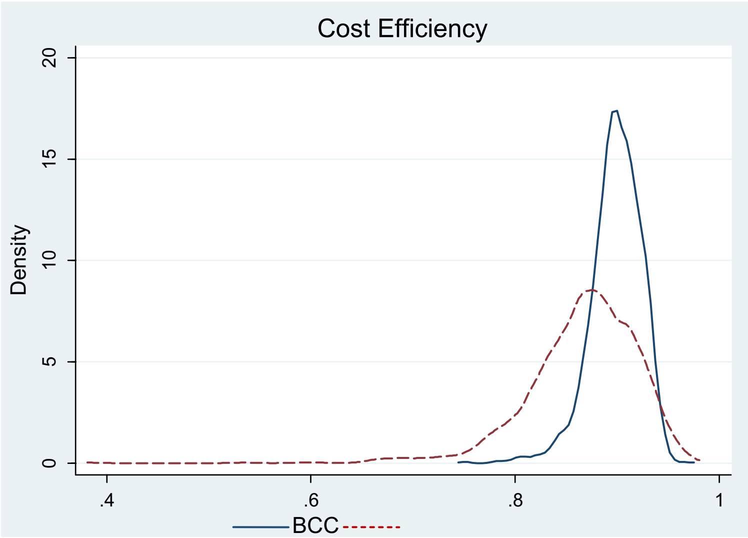

Figure 2. Distribution of cost efficiency of Italian banks over the 2006–2011 period. BCCs versus other banks.

than the other banks, in the sense that BCCs make better use of inputs and outputs than any other group. The difference found in the average values is confirmed when considering the entire distributions of cost efficiency. Figure 2 considers all the bank-year observations and reveals a substantial heterogeneity between and within bank-groups.

5. Explaining BCC cost efficiency

The analysis has proved that the Italian banking sector is still highly heterogeneous and that the BCCs perform better than other banks. This section combines these two outcomes and presents the results obtained when estimating the role of provincial market conditions on BCC performance. Subsection 5.1 presents the equation of cost efficiency. Subsections 5.2 and 5.3 focus on the role played by individual and external variables, respectively.

5.1. The cost efficiency equation

Cost efficiency varies between zero and unity. Thus, a Tobit model would be appropriate to estimate an efficiency equation, as made by others (Casu and Molyneux 2003; Gillen and Lall 1997; Huang and Fu 2013; Jimborean and Brack 2010; Shao and Lin 2001). However, Tobit models perform well only if upper and lower bounds come from non-observability, thereby implying that the variability in the range [0;1] does not itself support the use of a Tobit model. Indeed, when no zero and unity observations of the dependent variable are in the sample, the results from Tobit models overlap those obtained from standard OLS (Maddala 1991; McDonald 2009). Based on this, the following transformation is adopted: $CE^{\mathrm{TRANS}}=\ln(CE/(1-CE)$ where CE is the cost efficiency of BCCs that were retrieved from the joint-estimations of equations (3) and (6) made in the first step of the analysis. Therefore, the efficiency equation is given by:

$$CE_{it}^{TRANS} = \omega_0 + \omega_1 X_{it}^{I} + \omega_2 X_{it}^{E} + e_{it} \tag{7}$$

where CE_{it}^{TRANS} is the transformed cost efficiency of the *i*th BCC at time *t*. X^{I} and X^{E} comprise, respectively, a set of individual and environmental variables meant to exert an effect on BCC performance. Finally, e_{it} is a random disturbance. The efficiency determinants defined at bank level are related to the capital structure, size and diversification of BCCs activities, while the variables at provincial level are meant to gauge the relationship between efficiency and market concentration, spatial diffusion of banking services, density of demand, credit risk and the role of economic development of each province.

The empirical strategy followed to estimate equation (7) is to apply random effects and fixed effects models and to control for endogeneity by considering the Hausman-Taylor specification (Hausman and Taylor 1981). Table 4 displays the results. The first three columns of data report the estimates obtained when considering the equation of cost efficiency. In more detail, column 1 presents the estimates from a random effects model, column 2 refers to results from a fixed effects model, while column 3 shows the Hausman-Taylor estimates. Table 5 displays the results obtained when a sensitivity analysis is performed by using the fixed effects model. To this end, we restrict the sample according to the cost efficiency distribution: the sample in column 1 refers to the 1st and the 99th percentiles of BCC cost efficiency; column 2 reports the results when considering the BCCs comprising between the 5th and the 95th percentiles of the efficiency distribution; the distribution around the 25th and the 75th percentiles is analyzed in column 3.[14]

Table 4. The determinants of BCC cost efficiency. Estimations from RE, FE and HT models (2006–2011).

	Dep. Var.: BCCs cost efficiency					
	Fixed effect model		Random effect model		Hausman Taylor model	
Intercept	14.1848	**	3.2267		13.6109	**
BCCs individual level						
Size						
Ln(Total assets)	0.0574	*	−0.0703	***	0.0340	
Diversification						
Loans	−0.1918	**	−0.3631	***	−0.1796	**
Income	1.6548	***	1.5540	***	1.6183	***
Capital structure						
Equity/Total assets	−1.7907	***	−1.7436	***	−1.8090	***
Provincial level						
Market concentration	0.0626	**	0.0415	*	0.0575	**
Credit quality	−0.3004		−0.2984		−0.2338	
Demand density	0.0011	**	0.0010	**	0.0013	***
Branches density	−62.7752		−36.2377	**	−60.4645	***
GDP per capita	−0.0079	**	−0.0064	*	−0.0074	**
Time	−0.0064	*	−0.0002		−0.0060	**
Obs	2133		2133		2133	
F-Fisher (*p*-value)	88.45 (0.000)		–		–	
Wald (*p*-value)	–		905.09 (0.000)		939.48 (0.000)	
Hausman test (*p*-value)	–		80.23 (0.000)		2.72 (0.9095)	

Legend: *$p<0.1$ **$p<0.05$ ***$p<0.001$.
Source: see Table 1.
P-values are in brackets.

5.2. Cost efficiency and BCC individual factors

This section presents the estimates obtained when analyzing the effect on efficiency exerted by BCCs' individual variables. The first issue regards the role of size. While much research documents that efficiency is directly related to size, there is no consensus on the sign of the effect. Some authors show that the effect is positive (Andries 2011; Drake 2001), whereas others argue that efficiency decreases with size (Pilloff 1996). In our setting, SIZE is measured by the logarithms of total assets of each BCC.[15] It emerges that cost efficiency tends to increase with size. This indicates that economies of scale are at work: following Hauner (2005) it appears that dimension affects the costs of inputs, even in the case of Italian BCCs.

Diversification of activities is relevant for BCC efficiency. It is argued that income from traditional bank activities suffers lower volatility than other financial uses and then the higher the share of risky activities the lower the exposure to systematic risk (Vallascas and Keasey 2012). However, it is not certain that the higher betas coming from diversification compensate the costs for diversifying the sources of income (Baele, De Jonghe, and Vennet 2007; Wagner 2010). This means that there is no expectation on the link between income diversification and bank efficiency. In this paper, diversification is measured as income diversification and loans diversification (see Table 3). Results from income diversification suggest that the business model matters, as the estimated coefficients are positive, implying that Italian BCCs would gain from diversifying their business rather than focusing only on intermediation (income diversification). With regard to loan diversification, the effect is negative. From this, it appears that BCCs would save costs by offering traditional services (loans) to their member-customers.

Table 5. Sensitivity analysis. Estimations from fixed effect model.

	Cost efficiency distribution					
	1%-99%		5%-95%		25%-75%	
Intercept					2.4254**	
BCCs individual level						
Size						
ln(Total assets)	0.0541	*	0.0854	**	0.1069	**
Diversification						
Loans	−0.1804	**	−0.2563	***	−0.1014	
Income	1.6335	***	1.5767	***	1.1651	***
Capital structure						
Equity/Total assets	−1.8125	***	−1.7692	***	−0.8102	**
Provincial level						
Market concentration	0.0591	**	0.0601	**	0.0528	**
Credit quality	−0.3803	*	−0.5042	**	−0.5203	**
Demand density	0.0010	**	0.0011	**	0.0009	**
Branches density	−74.21		−90.24	*	−127.41	**
GDP per capita	−0.0074	**	−0.0075	**	−0.0040	
Time	−0.0043		−0.0037		−0.0008	
Obs	2124		2010		1263	
F-Fisher (*p*-value)	85.96 (0.000)		69.33 (0.000)		34.99 (0.000)	

Legend: $^{*}p<0.1$ $^{**}p<0.05$ $^{***}p<0.001$.
Source: see Table 1.
P-values are in brackets.

Another aspect that the study addresses is the relationship between efficiency and the capital structure. Indeed, the financial capital is related to exposure to risk in a sense that the more indebted a bank the higher the risk of failure that arises in situations of systemic crisis (Acharya and Viswanathan 2011). In other words, less equity implies higher risk taken and greater leverage, which results in higher borrowing costs. Again, a high level of leverage directly affects funding costs, since paid interests imply less profitability for the bank in the income statement (Berger and Mester 1997). From these arguments, it is reasonable to assume that more leveraged BCCs face high funding costs and then register low efficiency scores. In our regressions, the capital structure is proxied by the ratio Equity/Total Assets, which ranges from 0 (highly leveraged BCC) to 1 (financial independence). From an empirical point of view, the equity-to-total assets ratio is found to affect negatively the cost efficiency, meaning that an increased amount of capital, for instance as the requirement of regulation, can act as a binding restriction and thus is perceived by BCCs as a cost. Furthermore, the evidence also confirms that the most indebted BCCs register high financial cost and thus low cost-efficiency.

These conclusions are robust to every sample of BCCs used in the sensitivity analysis (Table 4). However, the average effect displayed in Table 4 hides two specificities that the sensitivity analysis helps to capture. For instance, looking at Table 4 we learn that the impact of BCC size is always significant but varies across efficiency distribution. Restricting the regression to the 1263 observations lying in the third and fourth quartiles of the efficiency distribution (column 3 of Table 5) yields a size effect on cost efficiency which is almost two times higher than that obtained when excluding the extreme outliers of the distribution, that is the observations between the 1% and 99% of the distribution (column 1). Finally, the sensitivity exercise shows that the role of leverage in the middle of the efficiency distribution is lower than that estimated when using wider samples (Table 5).

5.3. Cost efficiency and environmental factors

Turning back to the specific objective of the paper, it is worth discussing the empirics on how the provincial market conditions affect BCC performance. The presentation begins with market concentration, which enters into regressions to gauge the effect of the consolidation process observed in banking markets. It is measured using the Herfindahl Index and Total Assets (HH2) in each province, as defined and discussed in Section 2. This is an issue addressed in many works (Casu and Girardone 2010; Dongili, Rossi, and Zago 2008; Fontani and Vitali 2007) aimed at verifying whether a higher industry concentration influences bank efficiency. The uncertainty of the outcome is due to the fact that, on the one hand, the operations of consolidation have resulted in an increase in size with an eye to probable and expected increases in efficiency levels. On the other hand, high concentration can cause an increase in banks market power and, therefore, a reduction of bank efficiency (Turati 2008). We find that market concentration is positively related to BCC efficiency. This evidence is robust to every check (Table 5) and is consistent with the efficient structure hypothesis (Berger 1995; Goldberg and Rai 1996). Phrased differently, in local concentrated banking markets, each BCC is induced to be more and more efficient, exploiting economies of scales and thus acquiring stronger market positions in the narrow reference markets. This explains and motivates the sign on the estimated parameter: in provinces with high market concentration there would be a dominance of efficient BCCs. Arguments that increased market concentration leads to efficiency improvements are also provided by Demirgüç-Kunt and Levine (2001) and Casu and Girardone (2010).

Regarding the spatial access to banking services, it is reasonable to argue that banking efficiency in the local market can also be affected by the branching that has occurred in Italy over the last 20 years, after the removal of barriers to expand banking activities. In more detail, it can be expected that the higher the number of branches the less BCC efficiency. This is why a large number of branches exerts the negative effects of individual efficiency because the operating costs to provide banking services increase. Moreover, local markets with a high number of branches (in terms of spatial dimension) would suffer from over-dimensioning, which acts against efficiency. However, the sign may be different, as the big-bank participation in small markets can be positive due to the increases in the capital brought by big banks, the expertise brought in risk management and increases in competition (Delis and Papanikolaou 2009; Hannan and Prager 2009). This phenomenon is measured province-by-province with the number of bank branches per square kilometer (cf. Figure 1(a)). Results are in line with the expectation against branching as the estimated parameter of Branch Density is always negative (Tables 4 and 5). This means that Italian BCCs suffer from the huge branch opening process occurring throughout the country. The estimated negative sign might be due to the fact that the presence of many bank branches in local markets forces individual BCCs to invest more for serving more customers (other than members), whose expectations remains to increase their benefits from loans and deposits at advantageous conditions. Other things being fixed, the increased number of bank branches in local markets and the BCCs' strategies act against BCC.

Another issue that the study addresses regards the effect on efficiency due to demand effects. The hypothesis is that BCCs that operate in markets with a lower density of demand face higher expenses to find customers asking for banking services (Fries and Taci 2005). Thus, the higher the density demand, the higher will be the banking efficiency levels. These effects are gauged by the demand density expressed as total deposits per square kilometer. Estimations displayed in Tables 4 and 5 show that BCC cost efficiency is positively related to demand density, whatever the method used to estimate equation (9). The evidence supports the hypothesis: BCCs working in provinces with a high level of deposits face, *ceteris paribus*, lower costs in mobilizing deposits and making loans.

In order to gauge the effects of systemic market risk on individual efficiency, we refer to the variable Credit Quality, which is expressed as the bad loans to total loans. Here, the question is: do BCCs gain or lose from operating in local markets with poor credit-quality? It is likely that BCCs operating in risky markets are exposed to potential efficiency losses caused by higher costs of screening and monitoring activities. Results depend on the sample we consider. When using all BCCs, individual cost efficiency is not related to the local financial markets riskiness (Table 4). However, credit quality matters when looking at different samples across efficiency distribution. What clearly emerges is that the relationships with the member-customers – which are long-dated and based on the use of soft-information – are not enough to protect BCCs from market riskiness. On this see also Gutiérrez (2008) and Coccorese (2009).

Finally, it is reasonable to assume that the level of local economic development is an important factor of bank performances, because it affects numerous factors related to the demand and supply of banking services (mainly deposits and loans). To this end, the income per capita (Y/POP) is used as measure of development. It is expected that provinces with higher *Y*/*POP* are assumed to have a banking system operating in a mature environment and this results in more competitive interest rates and efficiency margins. They can also exert more financial activity. The results given in Tables 3 and 4 show a negative relationship between cost efficiency and economic development, which is consistent with the view according to which the higher the development of an area the higher the operating and financial costs the BCCs would incur in offering services (Dietsch and Lozano-Vivas 2000).

6. Conclusions

The central theme of this paper is the efficiency of BCCs, which, despite the reforms, remain important players in local markets. This issue is addressed from two different perspectives, one focusing on the analysis that generates the bank efficiency, one investigating the role of individual and local market-specific factors affecting BCC efficiency.

While the study shows that BCCs perform better than other banks, and thus supports the viability of BCCs in local markets (Fiordelisi and Mare 2013), its most important contribution regards the analysis of the determinants of BCC efficiency. In this respect, we find that BCC cost efficiency is inversely correlated with the individual financial independence and the loans diversification, while the contrary holds regarding income diversification and size. Finally, over the period 2006–2011, the study emphasizes the positive relationship between efficiency and market concentration. Other robust insights come from the demand density and the branch density, which positively affect cost efficiency. The evidence from credit quality indicates that BCCs' cost efficiency appears not to be related to the riskiness of local banking markets. This outcome can be interpreted as the effect of potential higher interest rates that BCCs charge to 'marginal' borrowers when these are rationed by other banks.

Notes

1. The process of institutional reforms has been regulated by several norms, such as, for instance, the 2002 budget law, the 262/2005 law and the 353/2006 Legislative Decree. Details on these reforms are in Giannola (2009), Messori, Tamburini, and Zazzaro (2003) and Silipo (2009).
2. This result is found in Ayadi et al. (2009), Battaglia et al. (2010), Giannola et al. (1997), Giannola and Scarfiglieri (1998), Girardone, Molyneux, and Gardener (2004), Giordano and Lopes (2006, 2012), Fontani and Vitali (2007), Dongili, Rossi, and Zago (2008) and Turati (2004).
3. Another recent paper focusing on BCC performance is Fiordelisi and Mare (2013), which defers from ours because they analyze how efficiency affects the probability of default of cooperatives instead of analyzing the determinants of individual efficiency as we do. After controlling for regional environmental variables meant to be good predictors of default, Fiordelisi and Mare (2013) prove that, over the 1997–2009 period, the probability of BCC to survive increases with efficiency.
4. As Bos and Kool (2006) argue, studies that do not take into account differences between bank-type yield inappropriate conclusions about bank performance. On the contrary, using a wide sample of banks allows net efficiency measures to predict how BCCs are ranked under the assumption that banks operate in an equivalent environment.
5. The relationship between individual efficiency and external determinants might be evaluated at branch level, whatever the bank-type. However, data at branch level are not available in Italy – as well as in many other countries – because they are classified as sensitive-statistics.
6. Two different data-aggregations are needed for addressing the issues we pose. The first concerns data at bank level, while the second regards the geographical aggregation we refer to.

Data on individual banks are from the Italian Banking Association (ABI). When considering the provincial level (NUTS3) we use different data sources (Bank of Italy, Italian Institute of Statistics, Istituto Tagliacarne). The period under scrutiny covers the years 2006–2011. This is why the implementation of International Accounting Standards (IAS) occurred in 2005 and banks' balance sheets before-and-after IAS are not comparable.

7. Data needed to calculate HH2 is the value of total assets by the *i*th bank in every province j (TA_{ij}). Because this information is not freely available in Italy, as well as in many other countries, we proceed through this calculation: $TA_{ij}=TA_i*b_{ij}$, where TA_i is the balance-sheet amount of Total Asset (TA) of the *i*th bank and b_{ij} is the proportion of branches of bank i in province j ($b_{ij}=BB_{ij}/BB_j$). This procedure is proposed by Carbò Valverde et al. (2003).
8. Alessandria, Aosta, Como, Imperia, Mantova, Milan, Novara, Pavia, Torino, Belluno, Arezzo, Grosseto, Massa, Siena, Lecce, Agrigento, Caltanissetta, Enna, Messina, Ragusa, Siracusa, Trapani (data at level of single province are available upon request).
9. Following Battese and Coelli (1995) allows us to address the issues brought up by Lensink and Meesters (2014) and Wang and Schmidt (2002). Phrased differently, we use a variant of the SFA traditional two-step approach, as in the first step we basically exploit all the advantages provided by the stochastic frontiers specification proposed by Battese and Coelli (1995), while the common use of two-step procedure refers to Battese and Coelli (1992).
10. Using a translog, linear homogeneity also requires standard symmetry ($\beta_{js} = \beta_{sj}$ and $\omega_{nq} = \omega_{qn}$) and linear restrictions of the cost function ($\sum_n \omega_{nq} = 0$ and $\sum_n \alpha_{nj} = 0$).
11. As in many other recent papers in the banking efficiency literature (see, for example, Battaglia et al. 2010; Giordano and Lopes 2008; Lensink and Mester 2012) the assumptions on v_{it} and u_{it} are those originally proposed by Battese and Coelli (1995), also because modeling other 'possible correlated structures of the technical inefficiency effects and the random errors in the frontier' (Battese and Coelli 1995, 327) goes beyond the scope of this work.
12. We implement an LR test to verify the correctness of the Cobb-Douglas versus the Translog. Under H_0 there is the more parsimonious model, which is rejected at 1%.
13. The balance-sheet ratios are (a) the income diversification defined as [Income Commissions/(Income Commissions+Net Interests Income)]; the loans diversification expressed as (1–Loans/Total Assets); the Loans/Deposits ratio and the Equity/Total Assets ratio.
14. Here it is important to provide some model diagnostics. To this end we consider two tests. The Hausman test is conducted to assess the appropriateness of random or fixed effects models. Failure to reject Ho indicates that the random specification is valid. Results are in favor of fixed effect specification. Furthermore, the Hausman-Taylor specification is compared with the fixed effects model. In the Hausman-Taylor specifications, all variables at bank level are treated as endogenous, while environmental variables are assumed to be exogenous. Even in this case, the test supports the fixed effect model, given that the difference in estimated coefficients is not statistically different. This implies that bank-level variables may be treated as exogenous.
15. It is important to say that the size-efficiency nexus may not be the same whatever the size, because nonlinear effects can arise (Andries 2011; Berger and Mester 1997). To this end, we have augmented the basic equation with $SIZE^2$ and, alternatively, with the logarithm of SIZE. In both cases, estimations are not significant, implying that there is no-linearity (results are available upon request).

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Table A1. Definition of the variables included in the cost functions.

Variables	Name	Description
y_1	Loans	Loans to customers. It includes current accounts, repurchase agreements, mortgages, credit cards, personal loans and salary-backed loans, transactions relating to financial leasing and factoring, business loans, structured debt securities and other securities
y_2	Commission income	Revenues arising from non-traditional loans and deposits of banks. It includes incomes from trading of financial instruments and currencies, custody and administration of securities, business consulting, management of insurance products, collection and payment services, collection services.
y_3	Securities	Sum of loans to other banks, equities and bonds
x_1	Labor	Number of employees
x_2	Capital	Gross Banking Product, expressed as the sum of loans, direct and indirect funding.

Variables	Name	Description
x_3	Deposits	Debts to customers
w_1	Labor cost	Ratio of the personnel expenses to the number of employees
w_2	Cost of capital	Ratio of the other expenses (commission expenses, operating costs, depreciation of fixed assets, the administrative costs that do not relate to personnel expenses and the interest expenses that do not relate to those calculated on deposits) to the Gross Banking Product
w_3	Cost of deposits	Ratio of the interest expenses to the debts to customers
Costs (y, w)	Total costs	$w_1x_1 + w_2x_2 + w_3x_3$=Administrative expenses + Depreciation of fixed assets + Interest expenses + Operating costs + Commission expenses

Table A2. Average values of costs, input and output (2006–2011).
(constant values in millions of euros – NIC Index Istat, base year = 1995).

Variables	Obs.	Mean	S.D.	Min	Max
Cost	3766	161,456.60	856,024	378.2148	20,100,000
$y_{1=}$loans to customers	3766	1,712,072	8,435,175	1.45	182,000,000
y_2 = commission income	3766	27,212.08	133,176	0.72	2,880,022
y_3 = securities	3766	716,470.30	5,922,604	206.47	154,000,000
w_1 = labor cost	3758	53.14	20.50	7.12	712.77
w_2 = cost of capital	3766	0.0595	1.0283	0.000048	44.81
w_3 = cost of deposits	3741	0.0135	0.0344	0.000008	1.25

Source: See Table 1.