Competition and Financial Stability of European Cooperative Banks

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Abstract

We assess the dynamic relationship between competition and bank risk (both in the short and long run) in the European cooperative banking between 1998 and 2009. We obtain three main results. First, we show that bank market power negatively Granger-cause banks' stability meaning that there is a positive relationship (both in the short and long run) between competition and stability supporting the competition-stability view proposed by Boyd and De Nicolò (2005). Second, we do not find evidence that there is a statistically significant relationship between the Herding measure and the Z-Score. Third, we show that the financial crisis from 2007 have had a negative impact on cooperative bank stability, but it did not changed the relationship between competition and stability

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1 Introduction

Cooperative banks were a driving force for socially committed business at a local level accounting for around one fifth of the European banking system (market share of deposits and credits are 21% and 19%, respectively). In 2010[1], there were 3,900 cooperative banks with 65,000 branches, more than 770,000 employees, 50 million members, 180 million clients, 3,100 Euro billions of deposits, and 5,600 Euro billions of total assets.

A large number of papers analyzed cooperative banks focusing on their productive efficiency (Battaglia et al., 2010), diversification (Mercieca et al., 2007), probability of default (Fiordelisi and Mare, 2012). A debated issue is if cooperative banks are more stable than commercial banks. During the recent financial crisis, cooperative banks have been performing better than cooperative banks, e.g**.** Jose Manuel Barroso **(**President of the European Commission) stated in 2011: *"Co-operative businesses that have stayed faithful to co-operative values and principles and the co-operative banks which rely on members' funds and are controlled by local people have generally been able to resist the crisis very well"*[2] .This is consistent with various papers (Groeneveld and de Vries, 2009; Hesse and Čihák, 2007; Groeneveld, 2012) providing empirical evidence that cooperative banks are more stable than commercial banks since they have a great deal of soft information (which is hard to collect) on the creditworthiness of members/customers, and therefore much less

[1] Source of data: European Association of Co-operative Banks (2011).
[2] Source: European Association of Co-operative Banks (2012), http://www.eacb.eu/en/cooperative_banks/what_they_say_about_us.html

likely to make lending mistakes. Conversely, there are various studies suggesting that cooperative banks are more fragile than commercial banks (Goodhart, 2004; Brunner et al., 2004; and Fonteyne, 2007) and have higher default rates: e.g. Fiordelisi and Mare (2012) document the default rate of Italian cooperative banks was four times higher than the one of commercial banks in the period before the financial crisis (1997-2006). To reconcile these two opposite views, it is necessary to take into account the supervisory authority behavior. Specifically, cooperative banks are probably more stable than commercial banks (as shown by the first view), but supervisors are more prone to let distressed cooperative banks undergo into default (in periods of stability of the banking industry) rather than distressed commercial banks, consistently with the Too-Big-To-Fail policy (as shown by the second view).

Without the aim of entering the debate if cooperative banks are more fragile than commercial banks[3], the debate about the financial stability of cooperative banks show three key issues that need to be considered. First, cooperative banks are different from commercial banks and their stability is influenced by different factors. Second, competition is likely to be one of the key factors influencing banking stability, but its influence is likely to be different for commercial and cooperative banks. Third, it is necessary to account for banking supervisor's behaviour to assess the link between competition and risk.

[3] This paper does not aim to discuss cooperative bank fragility. Rey and Tirole (2007), Beck et al., (2009), Hesse and Čihák (2007) and Fonteyne (2007) are useful sources from a theoretical, empirical and policy perspective, respectively.

Surprisingly, while there is a substantial literature investigating the link between competition and bank stability focusing on commercial banks, there are no studies for cooperative banks.

How does competition affect the stability of cooperative banks? Does the financial stability of cooperative banks increase/decrease in the case of higher competition? The purpose of this paper is to empirically address these questions. By analyzing a large sample of cooperative banks in the European Union between 1998 and 2009, we obtain three main results. First, we show that bank market power negatively Granger-cause banks' stability meaning that there is a positive relationship (both in the short and long run) between competition and stability supporting the competition-stability view proposed by Boyd and De Nicolò (2005). Second, we posit that cooperative bank closure policies may suffer from an implicit "Too-Many-To-Fail" problem as suggested by Acharya and Yorulmazer (2007). We do not find evidence that there is a statistically significant relationship between the Herding measure and the Z-Score. This result is particularly interesting for policy makers suggesting that the level of industry homogeneity does not influence the cooperative banking stability. Third, we show that the financial crisis from 2007 has had a negative impact on cooperative bank stability, but it has not changed the relationship between competition and stability

A major contribution of our paper is that we uncover new evidence on the relationship between competition and stability in the EU cooperative banking. Various studies

have addressed this issue focusing on the commercial banking (Boyd and De Nicolò 2005; De Nicolò and Lucchetta, 2009; Schaeck et al., 2009; Casu and Girardone, 2009; Fiordelisi et al., 2011). However, there is a lack of empirical evidence in cooperative banking. Furthermore, we analyze the period 1998-2009 that includes the onset (2007) and two years into the financial turmoil, therefore we are able to investigate the competition and risk relationship pre- and post-crisis. Third, we account for the supervisor's behaviour and our results are interesting for academics, practitioners and policy makers.

Regarding our econometric approach, first, we estimate competition using the Lerner Index of Monopoly Power, recently used in various works (Maudos and De Guevara, 2007; Turk Ariss, 2010, Radic et al., 2011, among the others), that represents the extent to which market power allows firms to fix a price above marginal cost. We estimated the Lerner index for a large data set comprising both listed and unlisted banks. Second, we use panel data and Generalized Methods of Moments (GMM), to control for endogeneity and country-specific effects, in order to test whether changes in competition predict variations in bank risk measures. We also control for the impact that various factors at the bank level have on the competition-risk relationship, such as the bank size, the industry concentration and the herding behaviors.

The remainder of the paper is structured as follows. Section 2 has the literature review and the research hypotheses. The econometric framework, the data and variables

appears in section 3. Section 4 discusses the empirical results and robustness checks and section 5 concludes.

2 Literature review and research hypotheses

In this paper, we empirically assess if an increase in competition predicts higher instability of cooperative banks. The issue of the relationship between competition and risk was largely assessed in commercial banking from both a theoretical and empirical standpoints.

Focusing on theoretical papers, there are two views concerning the impact of competition on financial stability. The 'competition-fragility' view (Allen and Gale, 2004, among others) argues that higher competition leads to more risk in banking. Yet we have theories that suggest that things may not be so simple (De Nicolò and Lucchetta, 2009), in that higher competition may transform the nature of banking and induce banks to become more relationship-oriented (Boot and Thakor, 2000). As such, the 'competition-stability' view (Boyd and De Nicolò, 2005, among others) argues against bank concentration, claiming that the considerable market power of only few banks will cause them to raise the interest rate on loans, which will adversely select the firm with risky projects, with a negative impact on the stability of the banking system.

Recently there has been a spurt in empirical studies trying to measure the effects of competition and market power on stability. Various papers have empirically tested the relationship between banking market structure and risk focusing on credit risk (Hakenes, and Schnabel, 2010; Fiordelisi et al., 2011), interest rate risk (Delis and Kouretas, 2011) or the broader default risk (Repullo, 2004; Schaeck et al., 2009, Berger et al., 2009; Turk Ariss, 2010; Jiménez et al., 2010) providing mixed evidence. For example, Boyd et al. (2006) and De Nicolo and Loukoianova (2007) show that financial instability increases in lower competitive markets, while Jiménez et al. (2010) find the opposite evidence (i.e. risks decrease as bank market power increase). Schaeck et al. (2009) analyze banks operating in 45 nations over 1980–2005 and find that more competitive and more concentrated banking systems are less likely to experience a systemic crisis and increase time to crisis. Berger et al. (2009) analyzes a large sample of banks in 23 developed countries and observe that, even if an increase in bank market power lead to riskier portfolios, the effect on stability could be offset by a greater franchise value. In an attempt to reconcile the empirical evidence on the relationship between competition and stability in banking, Beck et al. (2011) show that a greater competition is generally associated with a larger impact on banks' risk-taking activities in countries with stricter activity restrictions, more herding in revenue structure, less concentrated banking markets and more generous deposit insurance.

While the literature reviewed above focuses on commercial banking, as far as we are aware there is a lack of studies specifically on the cooperative banking industry. This is

surprising since cooperative banks are different from commercial banks and it is not possible to give for granted that the competition-stability link is the same of that estimated for commercial banks. In this spirit, the EU policy makers recognizes for differences in setting the new regulation: e.g. Michel Barnier (EU Commissioner responsible for internal market and services) stated in 2011 that *"We are totally faithful to Basel's spirit, letter and level of ambition. But you cannot apply rules to 8.200 banks as you would to 20 banks. That is why we take into account the specificities of the European banking sector, with its mutual or co-operative banks and its bank and insurance groups"*[4].

There are just few papers loosely related to the research question addressed in this paper. The closest is Liu et al., (2012) that investigate the link between competition and stability focusing on Regional banks (among which cooperative banks) in 11 European countries between 2000 and 2008. Consistently with most recent studies focusing on commercial banking (e.g. Beck et al., 2011), this paper estimates bank stability using the Z-score and competition using the Lerner index by estimating a dynamic panel non-linear model. Without explicitly focusing on cooperative banks (i.e. substantially different from savings banks), Liu et al., (2012) show that there is a positive link between competition and bank stability and that cooperative banks have a positive marginal effect on bank stability. Hesse and Cihak (2007) analyze the stability of cooperative banks (measured using the Z-score) by estimating a linear regression model with some dummy variables capturing if the

[4] Source: European Association of Co-operative Banks (2012), http://www.eacb.eu/en/cooperative_banks/what_they_say_about_us.html

bank is a commercial, saving or cooperative banks. Without taking into account the competition in the banking industry, the authors conclude that cooperative banks are more stable than commercial banks.

Our paper contributes to these studies in various ways. First, we focus on cooperative banks: as such, we selected a homogenous data set rather than rely on dummy variables to control for differences across commercial, savings and cooperative banks. Second, we estimate bank stability and competition using specific measures, as the Z-score and the Lerner Index that have been increasingly used in most recent papers focusing on commercial banks. Third, we account for the impact that regulator intervention may have on the relationship between competition and bank risks. While the too-big-to-Fail or Too-Important-To-Fail views do not apply to cooperative banks, we recognize that cooperative bank closure policies may suffer from an implicit "Too-Many-To-Fail" problem as suggested by Acharya and Yorulmazer (2007). Specifically, when the number of bank failures is large, the regulator finds it ex-post optimal to bail out some or all failed banks, triggering incentives to herd and increasing the risk that many banks may fail together. Similarly to Beck et al., (2011), we investigate the assumption that competition will have a stronger impact on bank stability in more homogeneous banking system (where herding behaviour is more likely).

3 Empirical approach

This section describes the data we use in our analysis (section 3.1), and the Lerner index used to measure competition (section 3.2). Next, we outline the control variables selected (section 3.3) and the econometric model employed (section 3.4).

3.1 Data

Our data consist of bank financial statements taken from Bureau van Dijk Bankscope database and macroeconomic information obtained from Eurostat, the statistical office of the European Union. We restrict our analysis to cooperative banks from the five largest cooperative banking sectors in Europe (i.e. Austria, France, Germany, Italy and Spain) over the period between 1998 and 2009. In 2010, cooperative banks in these five countries accounted for 85% of total assets hold by all EU cooperative banks.

Our final sample comprises 1701 bank of Austrian, French, German, Italian and Spanish cooperative banks (accounting for 4%, 5%, 61%, 29% and 1% of the observations, respectively). Table 1 reports the sample summary statistics.

< INSERT HERE TABLE 1 >

Competition in the French cooperative banking seems to be lower, while the Spanish sector displays the lowest mean market power. This is consistent with the Herfindahl–Hirschman Index, which is the highest for France. On the other hand, the Z-Score shows the same rank perhaps suggesting that, on average, French cooperative banks are more stable than in other countries. France has also the biggest cooperative banks and the most efficient with the value of the cost income measure (0.53) well below the sample average.

3.2 Measuring competition: the Lerner Index

Following recent studies (Maudos and de Guevara, 2007; Casu and Girardone 2009; Turk Ariss, 2010; Fiordelisi et al., 2012, among the others), we estimate the Lerner index of Monopoly Power (*LER*) as a measure of cooperative bank market power. This Index represents the extent to which market power allows firms to fix a price above marginal cost and it is calculated as follows:

$$LER = \frac{p - MC}{p} \tag{1}$$

where p is the price of output Q and is calculated as total revenue (interest plus non-interest income) divided by total assets, MC is the marginal cost. The estimation of the marginal cost of the production is the most difficult task. Following most recent papers, we estimate

a translog cost function with two inputs, one single output and a time trend. The final specification is as follows:

$$\ln TC = \alpha_0 + \alpha_1 \ln Q + \frac{\alpha_2}{2} \ln Q^2 + \sum_{j=1}^{2} \beta_j \ln P_j + \frac{1}{2} \sum_{j=1}^{2} \sum_{k=1}^{2} \delta_{jk} \ln P_j \ln P_k + \frac{1}{2} \sum_{j=1}^{2} \gamma_j \ln Q \ln P_j + \tau_1 T + \frac{\tau_2}{2} T^2 + \tau_3 T \times \ln Q + \sum_{j=1}^{2} \psi_j T \ln P_j + \varepsilon_{it} \quad (2)$$

where TC is total costs, that is the sum of personnel expenses, other administrative expenses and other operating expenses; Q is the cooperative banks' single output proxied by total assets; P_1 and P_2 are the inputs to the production process of cooperative banks, respectively the price of labor (i.e. personnel expenses over total assets), and the price of physical capital (i.e. other administrative expenses plus other operating expenses over total fixed assets). $\alpha, \beta, \delta, \gamma, \tau, \psi$ are coefficients to be estimated; and ε_{it} is a two-components error term: $\varepsilon_{it} = u_{it} + v_{it}$, where v_{it} is a two-sided error term.[5]

From equation (1), the marginal costs can be derived as follows:

$$MC = \frac{TC}{Q} \left[\alpha_1 + \alpha_2 \ln Q + \sum_{j=1}^{2} \gamma_j \ln P_j + \tau_3 T \right] \quad (3)$$

[5] The v_{it} are assumed to be independently and identically normal distributed with zero mean and variance σ^2_v and independent of $u_{it} = \{u_i \exp[-n(t-T)]\}$ where u_{it} is a one-sided error term capturing the effects of inefficiency and assumed to be half-normally distributed with mean zero and variance and n is an unknown parameter to be estimated capturing the effect of inefficiency change over time. We apply the common restrictions of standard symmetry and homogeneity in prices to the translog functional form.

We calculated the Funding Adjusted LER, as suggested by Maudos and de Guevara, (2007) and Turk Ariss, (2010): specifically, MC are derived from the estimation of the cost function (1) that omits funding costs as one of the inputs. This enables us to account for market power that may have previously been exercised in the deposit market: specifically, by excluding funding costs, we obtain a clean proxy of pricing power that is not affected by market power which had previously originated in the deposit market while raising funds.

3.3 Variables

A comprehensive set of variables is considered in the analysis in order to control for the effect of other determinants on the relationship between competition and risk. These are added to the model to take into account bank heterogeneity, market concentration, size of the banks and operating efficiency, and a qualitative binary variable for the onset of the financial crisis. Specifically, these variables permit to get more robust inference.

The Herding measure, as in Beck et al. (2011), is built as the within country standard deviation of the non-interest income (i.e. fee commissions). We also consider two additional dummy variables if banks operate in countries in the lower two quintiles of the Herding distribution (taking value 1 or 0 otherwise), or if they are comprised in the lower three quintiles of the distribution (taking again value of 1 or 0 otherwise).

The Hefindhal-Hirschman Index conveys the information on concentration proxied by the sum of the squares of the market shares (in terms of asset size) of each individual bank in a given country. Furthermore, the natural logarithm of total assets controls for the size and the ratio of operating cost and the operating income serves as efficiency measure. Also, a qualitative dummy variable is considered for the onset of the financial crisis that takes value of 1 if data refer to years from 2007 to 2009, 0 otherwise.

< INSERT HERE TABLE 3 >

3.4 Econometric approach

To investigate the relationship between banks' competition (measured using the Lerner Index) and stability (measured by the Z-score), we rely on Granger causality techniques. This approach has the advantage to allow us to test unique time-ordered and signed relationships among pairs of variables.[6] While Granger causality tests have several limitations,[7] this approach has been widely used to analyze inter-temporal relationships in the economic literature (e.g. Jaeger and Paserman, 2008; Assenmacher-Wesche and Gerlach, 2008) as

[6] Granger's (1969, p. 428) notion of causality states that "… y_t is causing x_t if we are better able to predict x_t using all available information than if the information apart from y_t had been used". Granger's suggestion to regress x_t on its own lags and a set of lagged y_t has become a standard procedure. If lagged y_t provides a statistically significant explanation of x_t, y_t "Granger" causes x_t.
[7] For example, Granger-testing does not prove economic causation between two variables but identifies gross statistical associations.

well as in banking studies (e.g. Fiordelisi et al., 2011, Fiordelisi and Molyneux, 2010; Casu and Girardone, 2009; Williams, 2004; Berger and DeYoung, 1997).

Specifically, in order to disentangle the inter-temporal relationships between competition and stability, we estimate the following equation:

$$Z_{i,t} = f(Z_{i,t-1}, LER_{i,lag}, X_{i,lag} * LER_{i,lag}, K_{j,t}) + \varepsilon_{i,t} \quad (4)$$

where the *i* subscript denotes the cross-sectional dimension across banks, *t* denotes the time dimension, *Z* is the Z-score expressing the bank stability, *LER* is the Lerner Index expressing bank market power, x is a factor that we posit to influence the relationship between competition and stability, K_{js} are control variables (as detailed in Section 3.3) and $\varepsilon_{i,t}$ is the error term.

We use three lags and estimate an AR(3) process for the competition, efficiency and stability variables. This enables us to test the long-term relationship between competition and risk. While previous study assesses this relationship over one year, we believe that competition can take more than one year to influence bank stability. Following Casu and Girardone (2009), Granger causality is assessed as the joint test of the null hypothesis that the three lags are equal to zero. If the probability is less than 10%, then the null hypothesis that *x* Granger- causes *y* is rejected at the 10% significance level. We also assess the 'long-run effect' of x over the y by testing for the restriction that the sum of all lagged

coefficients is zero; a rejection of the restriction implies that there is evidence of a long-run effect of x on y.

The introduction of the lagged bank stability is necessary since it is possible that a bank, that has shown higher instability in the past, is more likely to experience the same event in the future than a bank which has not experienced the event (Heckman, 1981a, b). The introduction of a lagged dependent variable among the predictors creates complications in the estimation as the lagged dependent variable is correlated with the disturbance (even under the assumption that $\varepsilon_{i,t}$ is not itself correlated). To tackle this problem, we use the Generalized Method of Moments (*GMM*) estimators developed for dynamic panel models (Arellano and Bover, 1995; Blundell and Bond, 1998). Specifically we use the two-step system GMM estimator with Windmeijer (2005) corrected standard error.[8]

4 Results

Granger causality is used in a panel data setting to analyze the relationship between competition and risk. The GMM method gives unbiased estimators of the relationship

[8] The estimated asymptotic standard errors of the efficient two-step GMM estimator are severely downward biased in small samples therefore we correct for this bias using the method proposed by Windmeijer (2005).

between the variables employed in the analysis. As robustness check, we use three different specifications of the model.

In the first model, we analyze the relationship between competition and stability by considering a set of variables to control for other possible determinants of bank overall risk. As reported in Table (4), we show that bank market power negatively Granger-cause banks' stability meaning that there is a positive relationship between competition and stability: when competition is low (i.e. market power is high), stability is low. We observe this positive link between competition and stability in all of three estimated coefficients for the lagged Lerner index (statistically significant at the 10% level or less) and we also find a highly statistically significant long-run effect denoted both by the significance of the test and by the increase on the magnitude of the coefficients. This seems to support the competition-stability view proposed by Boyd and De Nicolò (2005). This finding is consistent with the evidence provided by various studies on commercial banking (Beck et al. 2006; Schaeck et al., 2009, among the others), showing that banks become more risky in less competitive markets. This can give useful insights to policy makers in the current redesign of the supervisory approach for cooperative banks.

We also find the Hefindhal-Hirschman Index is negatively related to the Z-score, suggesting that bank stability is lower in more concentrated markets: this is consistent with the previous finding suggesting that more competition is likely to happen in less concentrated markets. In addition, this shows another interest parallel with commercial

banking (i.e. Fiordelisi et al., 2011). The financial crisis variable provides evidence that bank stability declined during the financial crisis.

We found a weak relationship between operating inefficiency and bank stability. The inefficiency measure is statistically significant (at the 10% level or less) for the one year lag term: specifically, an increase in banking inefficiency predicts a decrease in banking stability. This suggests that it is crucial for cooperative banks to work efficiency to survive in competitive industries. Despite the estimated coefficients for the two- and three years lagged cost-income variables are not statistically significant (at the 10% level), we find a statistically significant evidence of a negative long-run effect of the relationship between cooperative bank stability and efficiency.

< INSERT HERE TABLE 4 >

In the second model, we take into account that cooperative bank closure policies may suffer from an implicit "Too-Many-To-Fail" problems as suggested by Acharya and Yorulmazer (2007). Specifically, we investigate the assumption that competition will have a stronger impact on bank stability in more homogeneous banking system (where herding behaviour is more likely). As such, we introduce three variables obtained by interacting lagged Lerner Index with a dummy capturing the bank herding behaviour. As reported in Table (5), we show that all lagged Lerner Index negatively influence bank stability (at the

10% level or less). Our results also confirm the existence of the negative long run-effect between market power and stability.

We do not find evidence that there is a statistically significant relationship between the Herding measure and the Z-Score. This result is particularly interesting for policy makers. First, we do not find evidence that the level of homogeneity influence the cooperative banking stability. Second, our finding do not support the view that the expansion of cooperative banks into non traditional business lines (i.e. non-interest income activities) could be driven by tougher competition that in turn leads to a higher insolvency risk (see Mercieca et al., 2007, for the negative implications of diversification in the case of small European banks; Goddard et al., 2008, for evidence from the US market). Although diversification should be carefully considered by policy makers for its impact on the safety and soundness of the overall banking system, the deviation of the non-interest income seems to not be statistically related to changes in cooperative banks risk taking.

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We run an additional model to check if the financial crisis brought in a decrease in the stability of the cooperative banking sector. As shown in Table 6, consistently with previous findings in tables (4) and (5), we find that the Lerner Index is statistically significant (at the 10% level or less) and negatively related to bank stability both in the short and long run. We also find that the financial crisis from 2007 have had a negative impact on cooperative bank stability. In order to check if the financial crisis changed the

relationship between competition and stability, we introduce two lagged terms by combining the dummy capturing the financial crisis with the Lerner Index. We do not find statistically significant evidence that these interacting terms predict changes in bank stability. This is particularly interesting for policy makers showing that the financial crisis did not change the relationship between competition and stability. All other estimated coefficients are consistent with the results presented in tables (4) and (5).

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5 Conclusions

Cooperative banks are a driving force for socially committed business at a local level accounting for around one fifth of the European banking system. Despite their importance, there is a lack of studies assessing the relationship between competition and financial stability in cooperative banking. Our paper empirically fills this void using a large sample of cooperative banks in the European Union between 1998 and 2009

We show that bank market power negatively Granger-cause banks' stability meaning that there is a positive relationship between competition and stability: when competition is low (i.e. market power is high), stability is low. The positive link between competition and stability is observed both in the short and long run and support the competition-stability

view proposed by Boyd and De Nicolò (2005). We also provide empirical evidence that bank stability is lower in more concentrated markets and declines during the financial crisis. In addition, we observe that an increase in banking efficiency predicts an increase in banking stability

In the second step, we take into account that cooperative bank closure policies may suffer from an implicit "Too-Many-To-Fail" problems as suggested by Acharya and Yorulmazer (2007). Specifically, we investigate the assumption that competition will have a stronger impact on bank stability in more homogeneous banking system (where herding behaviour is more likely). We do not find evidence that there is a statistically significant relationship between the Herding measure and the Z-Score. This result is particularly interesting for policy makers suggesting that the level of industry homogeneity does not influence the cooperative banking stability.

In the final step, we show that the financial crisis from 2007 have had a negative impact on cooperative bank stability, but it did not changed the relationship between competition and stability

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Table 1

Descriptive statistics

This table presents the descriptive statistics of our sample of cooperative banks in the European banking between 1998 and 2009.

Variable	Symbol	Obs	Mean	Std. Dev.	Min	Max
Output Price	P	16,503	0.1603	0.0100	0.1100	0.2663
Marginal Cost	MC	16,503	0.1181	0.0573	-0.1048	0.3824
Lerner Index	LER	16,503	0.2575	0.3645	-0.6162	1.0417
Herding measure	HERD1	16,503	129,858.00	126,591.60	10,402.22	659,147.50
Efficiency	EFF	16,503	0.8328	1.1168	0.1199	3.7537
Z-Score	Z	16,503	1.9836	0.3230	-1.8225	2.5919
Concentration	HHI	16,503	0.0002	0.0003	0.0000	0.0012

Table 2

Correlation Matrix

This table presents the correlation matrix of the variables used in the empirical analysis for our sample of cooperative banks in the European banking between 1998 and 2009.

Variable	P	MC	LER	HERD1	EFF	Z	HHI
P	1						
MC	-0.1190	1					
	(0)						
LER	0.2417	-0.9900	1				
	(0)	(0)					
HERD1	-0.0609	-0.0254	0.0187	1			
	(0)	0.0011	0.0163				
EFF	-0.3722	0.3733	-0.4215	-0.0624	1		
	(0)	(0)	(0)	(0)			
Z	0.0699	0.0603	-0.0513	0.1816	0.1608	1	
	(0)	(0)	(0)	(0)	(0)		
HHI	-0.1751	-0.0243	0.0027	0.8117	-0.0591	-0.0094	1
	(0)	(0.0018)	(0.7252)	(0)	(0)	(0.2285)	

Note: Significant level in parenthesis.

Table 3

Variables Definition

This table defines the variables used in the paper. The source of data is Bankscope.

Variables	Symbol	Definition and calculation method
Z-score	Z	The ratio synthesizes a measure of overall banking risk. It is the sum of the return on assets (ROA) and the equity ratio (equity over total assets) divided by the sample standard deviation of ROA.
Lerner Index [b]	LER	This represents the extent to which market power allows the bank to fix a price (P) above its marginal cost (MC).
Output Price [b]	P	Following recent studies (Berger et al 2009 and Turk Ariss 2010) and assuming that the banks produce an heterogeneous flow of services that is proportional to their dimension, we use banks' total asset as a proxy of their overall activity (Cetorelli, 2003) and we estimate average price as total revenues (interest and non interest income) on total asset
Marginal cost s [b]	MC	Marginal cost of the product are obtained by estimating a single output translog cost function and using firm-fixed effect to handle the average heterogeneity among banks and a technology shift trend to capture the average changing in production technology in our sample period
Efficiency	EFF	Operating Efficiency is measured by the ratio between the operating cost and operating income.
Herding measure 1 [c]	HERD1	This is a measure of banking industry heterogeneity obtained as the within country standard deviation of the non-interest income, as in Beck et al., (2011)
Dummy for the Herding measure 1 (33%) [c]	D_HERD1	This is a dummy variable, i.e. D_HERD1= 1 if the bank operates in a country in the lowest third of HERD1 distribution (i.e. banking operating in more homogenous banking industries); D_HERD1 = 0 otherwise
Dummy for the Herding measure 1 (50%) [c]	D_HERD3	This is a dummy variable, i.e. D_HERD3= 1 if the bank operates in a country in the lowest half of HERD1 distribution (i.e. banking operating in more homogenous banking industries); D_HERD3 = 0 otherwise
Bank Asset Size	Size	This is measured by the natural logharitm of total assets.
Concentration [b]	HHI	This is measured by the Herfindahl–Hirschman Index, i.e. the sum of the squares of the market shares of each individual bank in a given country.
Financial Crisis	FINCIR	This is a dummy variable, i.e. FINCRI= 1 if the data refer to 2007, 2008 or 2009; FINCRI= 0 otherwise

Table 4

The link between Bank stability and Competition in Cooperative banks

The Table reports the results from the estimation of equation (4) to disentangle the inter-temporal relationships between bank stability (measured by the Z-score) and competition. We estimate autoregressive models with three lags *AR* (3) for the risks and competition variables. We use the two-step *GMM* estimators developed by Blundell and Bond (1998) with Windmeijer (2005) corrected standard error (reported in brackets). A significance level lower than 10% enables to reject the null hypothesis of no causality from *x* to *y*. A coefficient > 0 implies a positive causation from *x* to *y*; a coefficient < 0 indicates a negative causation from *x* to *y*. The Hansen test of over-identifying restrictions for the GMM estimators: the null hypothesis is that instruments used are not correlated with residuals and so the over-identifying restrictions are valid. Arellano-Bond (AB) test for serial correlation in the first-differenced residuals. The null hypothesis is that errors in the first difference regression do not exhibit second order serial correlation. All variables are summarized in table 1. The symbols *, **, and *** represent significance levels of 10%, 5% and 1% respectively.

	Model 1	
Dependent variable Z: Z-Score	Coef.	Std. Err.
Z_{t-1}	0.430***	0.094
Z_{t-2}	0.202***	0.065
Z_{t-3}	0.119	0.087
LER_{t-1}	-0.244***	0.053
LER_{t-2}	-0.123**	0.057
LER_{t-3}	-0.097*	0.05
CI_{t-1}	-0.026***	0.009
CI_{t-2}	-0.007	0.013
CI_{t-3}	-0.016	0.018
HHI_{t-1}	-0.040**	0.019
SIZE	-0.025	0.090
FINCRI	-0.038*	0.022
Intercept	1.055	1.133
Granger long-run effect		
$LER_{-1,-3}$	-0.4641***	0.1164
$CI_{-1,-3}$	-0.0486**	0.0214
Sample composition: Cooperative banks in EU-5, between 1998-2009		
Observations:	8,756	
No. of banks	1,701	
Hansen test, 2nd step, $\chi(140)$	229.56	
AB test AR(1), *p-value*	0.005	
AB test AR(2), *p-value*	0.926	

Table 5

The link between Bank stability and Competition in Cooperative banks: the herding behaviour

The Table reports the results from the estimation of equation (4) to disentangle the inter-temporal relationships between bank stability (measured by the Z-score) and competition. We estimate autoregressive models with three lags *AR* (3) for the risks and competition variables. We use the two-step *GMM* estimators developed by Blundell and Bond (1998) with Windmeijer (2005) corrected standard error (reported in brackets). A significance level lower than 10% enables to reject the null hypothesis of no causality from *x* to *y*. A coefficient > 0 implies a positive causation from *x* to *y*; a coefficient < 0 indicates a negative causation from *x* to *y*. The Hansen test of over-identifying restrictions for the GMM estimators: the null hypothesis is that instruments used are not correlated with residuals and so the over-identifying restrictions are valid. Arellano-Bond (AB) test for serial correlation in the first-differenced residuals. The null hypothesis is that errors in the first difference regression do not exhibit second order serial correlation. All variables are summarized in table 1. The symbols *, **, and *** represent significance levels of 10%, 5% and 1% respectively.

	Panel A		Panel B	
Dependent variable Z: Z-Score	Coef.	Std. Err.	Coef.	Std. Err.
Z_{t-1}	0.402***	0.095	0.404***	0.095
Z_{t-2}	0.213***	0.067	0.211***	0.071
Z_{t-3}	0.127	0.086	0.129	0.087
LER_{t-1}	-0.228***	0.049	-0.255***	0.056
LER_{t-2}	-0.15**	0.065	-0.148**	0.074
LER_{t-3}	-0.093**	0.045	-0.112*	0.059
$D_LER1*LER_{t-1}$	-0.031	0.133		
$D_LER1*LER_{t-2}$	0.166	0.146		
$D_LER1*LER_{t-3}$	0.145	0.152		
$D_LER2*LER_{t-1}$			0.025	0.121
$D_LER2*LER_{t-2}$			0.154	0.193
$D_LER2*LER_{t-3}$			0.137	0.169
CI_{t-1}	-0.025***	0.008	-0.028***	0.009
CI_{t-2}	-0.007	0.011	-0.011	0.022
CI_{t-3}	-0.004	0.026	-0.007	0.043
$HERD1_{t-1}$				
HHI_{t-1}	-0.039**	0.017	-0.048**	0.021
SIZE	-0.046	0.113	-0.038	0.11
FINCRI	-0.046***	0.017	-0.034	0.043
Intercept	1.325	1.448	1.249	1.394
Sample composition:	Cooperative banks in EU5 (1998-2009)		Cooperative banks in EU5 (1998-2009)	
Observations:	8,756		8,756	
No. of banks	1,701		1,701	
Hansen test, 2nd step, $\chi(137)$	217.23***		220.07***	
AB test AR(1), *p-value*	0.013		0.012	
AB test AR(2), *p-value*	0.652		0.882	
Granger long-run effect				
$LER_{-1,-3}$	-0.471***	0.1208	0.514***	0.1271
$CI_{-1,-3}$	-0.0356	0.0251	-0.0467	0.0306
$D_LER1*LER_{t-1,-3}$	0.2793	0.3379	0.3159	0.4103

Table 6

The link between Bank stability and Competition in Cooperative banks: the financial crisis

The Table reports the results from the estimation of equation (4) to disentangle the inter-temporal relationships between bank stability (measured by the Z-score) and competition, where x is the financial crisis Lerner measure. We estimate autoregressive models with three lags *AR* (3) for the risks and competition variables. We use the two-step *GMM* estimators developed by Blundell and Bond (1998) with Windmeijer (2005) corrected standard error (reported in brackets). A significance level lower than 10% enables to reject the null hypothesis of no causality from *x* to *y*. A coefficient > 0 implies a positive causation from *x* to *y*; a coefficient < 0 indicates a negative causation from *x* to *y*. The Hansen test of over-identifying restrictions for the GMM estimators: the null hypothesis is that instruments used are not correlated with residuals and so the over-identifying restrictions are valid. Arellano-Bond (AB) test for serial correlation in the first-differenced residuals. The null hypothesis is that errors in the first difference regression do not exhibit second order serial correlation. All variables are summarized in table 1. The symbols *, **, and *** represent significance levels of 10%, 5% and 1% respectively.

	Model 1	
Dependent variable Z: Z-Score	Coef.	Std. Err.
Z_{t-1}	0.431***	0.098
Z_{t-2}	0.219***	0.069
Z_{t-3}	0.121	0.09
LER_{t-1}	-0.242***	0.055
LER_{t-2}	-0.122**	0.054
LER_{t-3}	-0.098*	0.053
$FINCRIS*LER_{t-1}$	0.153	0.185
$FINCRIS*LER_{t-2}$	0.015	0.121
CI_{t-1}	-0.027***	0.009
CI_{t-2}	-0.009	0.01
CI_{t-3}	-0.019	0.018
$HERD1_{t-1}$		
HHI_{t-1}	-0.038**	0.019
SIZE	-0.038	0.097
FINCRI	-0.034**	0.016
Intercept	1.166	1.226
Granger long-run effect		
$LER_{-1,-3}$	-0.3638***	0.0860
$CI_{-1,-3}$	-0.0542***	0.01866
$FINCRIS*LER_{t-1,2}$	0.1686	0.2805
Sample composition: Cooperative banks in EU5, between 1998-2009		
Observations:	8,756	
No. of banks	1,701	
Hansen test, 2nd step, $\chi(138)$	214.86***	
AB test AR(1)	0.005	
AB test AR(2)	0.994	