Competition in Local Banking Markets and the Influence of Rival Proximity

Johann Burgstaller

Institute of Corporate Finance, University of Linz, Altenberger Str. 69, A-4040 Linz
Phone: +43-732-2468-7214, E-Mail: Johann.Burgstaller@jku.at

Preliminary Draft: January 15, 2018

Abstract: This paper analyzes the competitive behavior of Austrian banks with no or only one rival branch within their local home markets (municipalities). For that, we examine the association of several bank-level indicators, calculated for the period 1999-2014, with characteristics of the community and the nearest contestant. While it can be observed that competition measures, at least on average, do not vary tremendously across bank cohorts, rival proximity plays a differential role: monopolists exhibit larger mark-ups with increasing rival distance, whereas competition is strengthened in more remote duopolistic markets. Together with the observation that certain market features affect conduct as well, our results give rise to several policy recommendations.

Keywords: Competition, Banking, Local Markets, Rival Distance.

(J.E.L.: G21, L10, R51).

1 Introduction

Efficiency and competitive conduct are centerpieces in bank behavior due to the manifold consequences they have for the financial services industry itself as well as the general economy. In recent times, the associated processes are complicated by rapid structural and technological change also in banking sectors. With respect to competition, the current main relationships of interest are probably those with risk-taking and financial stability (c.f. Barra *et al.*, 2016). According to Schaeck and Cihák (2014), for example, vital competition fosters bank stability through efficiency. However, Leroy and Lucotte (2017) find that rivalry increases individual risk, but reduces systemic risk because of the risk-taking behavior of individual banks becoming more diverse with more competition. Further efficiency- and competition-related aspects of bank behavior determine the access to credit, as well as the cost and quality of financial services, with the final repercussions for economic development also being of interest for bank customers

and policy-makers.[1] Especially small business lending is widely seen as being facilitated by physical and organizational proximity of lending institutions (see, for example, Agarwal and Hauswald, 2010, Bellucci *et al.*, 2013, or Milani, 2014).

Examinations of the above topics often take place at the country level, but also regional measures are applied. One drawback of many studies is that they employ indicators observed at the regional or even national level to explain disaggregated bank behavior. Liu *et al.* (2013a) and Moch (2013), however, argue that it is unclear whether conclusions drawn from applications of such measures are truly proper for locally-oriented banks in fragmented markets. For many financial institutions, markets are still locally limited, especially in countries like Austria where savings banks and credit cooperatives make up a substantial part of the industry. Additionally, (many) customers (still) think locally in terms of (most of their) financial needs despite the ongoing technological advances and the emergence of new providers. In such local (probably peripheral and structurally weak) areas, regionally focused banks constitute an important part of the economic infrastructure, with functions exceeding those connected with providing access to financial services for small and opaque borrowers. As the ongoing structural changes in the banking industry might leave more and more communities with few branches (down to only one), this calls for a close inspection of the remaining institutions' behavior. Following the Italian example of Coccorese (2009), we therefore study the conduct of single-market banks in mono- and duopolistic conditions in their home municipality. Despite being specific and narrow, such samples offer the advantage that they often consist of homogenous banks with respect to production technology (determined by size, the business model and other characteristics).

Considering banks in their realistic competitive environment (locally, where rivalry really takes place) makes the calculated measures a useful starting point for further analyses, for example with respect to regional growth. For this, all indicators are consitently calculated at the bank(-year) level by use of recent methodological advances in cases where this was not common until recently. However, it should additionally be considered that observed differences in competitive behavior might also stem from diverse local market conditions, and thus an interpretation in terms of conduct is probably not appropriate.[2] Therefore, local market features play an important role in the empirical part of the study, analogical to the typical approach of efficiency analyses (Conrad *et al.*, 2014; Aiello and Bonanno, 2016).

By applying data for Austrian banks and communities for the 1999-2014 period, it can be observed that competition measures, at least on average, do not vary tremendously across bank cohorts. While monopolists are not found to fully exploit their market power, duopolists do not behave entirely competitively either. With more distance to the nearest rival, however, monopolists exhibit larger mark-ups, whereas competition is strengthened in more remote duopolistic markets. Certain market features are found to affect conduct measures as well, thus they do not solely reflect competitive conditions in local banking markets.

The remainder of this paper is structured as follows. Section 2 provides a short sketch of literature that is, at least in one dimension of the application, connected to the examined issue. The measures of bank rivalry being applied in the empirical part of the paper are introduced in

[1] In this respect, the transmission process of monetay policy signals is one field of interest. The respective role of bank competition is examined, for example, by van Leuvensteijn *et al.* (2013), Brissimis *et al.* (2014), and Leroy (2014).

[2] Environmental influences are considered, for instance, in the cross-country study of Carbó *et al.* (2009).

Section 3, Section 4 describes data, constructed variables and the empirical approach. Then, Section 5 reports both the results for calculated competition measures and their determinants. The final Section 6 concludes.

2 A Short Review of Connected Literature

For surveys of the history and measurement of competition indicators we refer to Liu *et al.* (2013b) or Degryse *et al.* (2015). The measures applied here are the Lerner index (Lerner, 1934), the efficiency-adjusted Lerner index of Koetter *et al.* (2012), the profit elasticity or Boone indicator (Boone, 2008; Boone *et al.*, 2013), and an interest spread in the spirit of Gischer *et al.* (2015).[3] More details on calculation are provided in Section 3. It is often concluded that indicators of rivalry are rather complements than substitutes, as each one is based on different assumptions, has its advantages and limitations, thus they measure different things (Léon, 2014).

Competition in very disaggregated Italian markets is analyzed by Coccorese (2009) for banks with no or only one rival within the municipality. By use of conduct parameters and H-statistics, he concludes that the behavior of local monopolists significantly deviates from pure monopoly conduct. According to Coccorese (2009), it appears that nearby competition (among other factors) is sufficient to hinder such banks from fully exploiting their market power. The duopolistic setting, for the same reasons, leads the observed institutions to virtually behave competitively.

Interest rates faced by bank customers have been examined with respect to the distance to rival banks mainly for the U.S. case (c.f. Degryse and Ongena, 2005, Degryse *et al.*, 2009, Agarwal and Hauswald, 2010). While loan rates typically are found higher if the lending bank is nearer, they seem to decrease the less distant a competing bank is to the borrower. However, Bellucci *et al.* (2013) find exactly the opposite results for Italy. Interest rates charged and paid by small rural banks (and their profitability) are also often related to the presence of multi- or out-of-market banks at the regional level. Prominent examples of such studies are Park and Pennacchi (2009) or Hannan and Prager (2009), and oftentimes, both loan and deposit rates are found to be lower if there is more presence of (larger) banks that primarily operate outside the small incumbents' markets. Local banks may not suffer in terms of profits, though, which is also due to larger outside rivals to not competing that fierce, especially with respect to deposits (see e.g. Hannan and Prager, 2004). But for all that, these studies do not provide examinations of the one-on-one situations in very small markets studied in this paper. Thus, results may only be insufficiently comparable because in those much larger markets, both incumbents and rivals may be very different from the ones sampled here.

A large portion of the literature applying regional measures of competition also deals with the relation to bank and system stability. Liu *et al.* (2013a) argue that many banks do not operate and compete nationwide, thus their performance and stability depends on regional competitive and economic conditions. They calculate Lerner indices for (large, NUTS 1) European regions and report that regional competition affects bank-level stability (measured by the z-score) in

[3]Measures based on conjectural variation as well as the popular H-statistic are not employed in this paper. Regarding the latter, some comments on its applicability can be found in Section 3.

a non-linear (U-shaped) fashion: while more rivalry increases stability (the z-score goes down) when starting at low levels, a stimulus to regional competition threatens stability if it is already high. By making use of adjusted Lerner indices, Kick and Prieto (2015), however, observe that with higher individual mark-ups at the level of German banks, their (distress) risk goes down. A more competitive environment (measured at the district level using the Boone indicator), on the other hand, appears to result in increasing risk levels. From that, one may conclude that the relation of bank rivalry and risk(-taking) is complex and measure-dependent.

Another strand of the literature is that on the connection of financial architecture and (regional) economic growth. In these studies, the banking sector mostly is represented by presence (of distinct types of banks), activity in terms of (credit) volumes or, in more recent studies, by financial development and quality proxied by bank efficiency. An application at a very disaggregated level is Destefanis *et al.* (2014), who use data on local labor market areas (SLL) in Italy to examine the role of bank efficiency for regional development in the sense of Hasan *et al.* (2009).[4] Noticeably, they select the examined areas based on the presumed degree of bank competition (SSL with only one or two bank head offices). According to their results, regional financial quality (measured by the profit efficiency of banks with their head office within that area) contributes less to economic growth in monopolistic environments. This is interpreted in terms of banks in monopolistic SLL being more able to increase their profits (through indulging in rent-seeking behavior), with consequences on local growth.

Some studies observing growth effects through the regional quality of financial intermediation control for local competition without putting it into the center of interest. For example, and by using data on NUTS 2 regions across 12 European countries, Belke *et al.* (2016) record a positive relation of efficiency-adjusted Lerner indices with GDP per worker growth. By contrast, in the results of Hakenes *et al.* (2015), the Lerner index is not significantly associated to regional growth at the level of German districts. More direct observations of effects from competitive behavior on measures of regional growth come, for instance, from Inklaar *et al.* (2015). Higher regional bank mark-ups (Lerner indices) indicate higher SME output growth in Germany. For Spain, related results at the provincial level are reported by Fernández de Guevara and Maudos (2009), who regress real growth rates of firm sales on regional Lerner indices. The effect of market power on growth they report, however, is non-linear, being positive with high initial competition levels (and vice versa). Ogura (2012), who applies data at the level of Japanese prefectures, argues that with relatively low competition (measured by less large banks being present in local markets), the higher price-cost margins that arise are associated with increased credit availability for younger (new) firms.

3 Competition Measures

For the assessment of banks' competitive behavior and its determinants, this paper measures competitive conduct directly at the bank level (and not through market structure). The assessment applies mark-up measures as the Lerner index (price-cost spread) and the efficiency-adjusted Lerner index. Furthermore, the Boone indicator and an interest rate spread are

[4]Further studies in this fashion are Hakenes *et al.* (2015), but also Aiello and Bonanno (2016) and Belke *et al.* (2016).

calculated, all at the bank-year level. As a fifth measure, we also considered to employ the H-statistic of Panzar and Rosse (1987), which measures to which extent changes in input prices are reflected in (equilibrium) revenues. However, due to the criticism it attracted in recent times, we abstained from that. Bikker *et al.* (2012), for example, argue that the H-statistic, even if correctly calculated, is an unreliable, possibly even unsuitable, measure of competition without extra information and in markets containing firms of widely differing size (which points to either disequilibrium or at least locally constant average cost). Bikker *et al.* (2012) also state that H is no monotonic measure of competition since it may take on similar values with different market structure scenarios. For this reason, Shaffer and Spierdijk (2015, 345) render it useless for practical purposes, since it "can either be positive or negative for any degree of competition".

3.1 Lerner Index

The Lerner index (Lerner, 1934) is calculated as the mark-up of output price over marginal cost (divided by price) as

$$LI_{it} = \frac{p_{it} - mc_{it}}{p_{it}} \tag{1}$$

Banks are often seen as producing only one aggregate output good, thus price is proxied by total income divided by total assets. Competition is found low if prices are in some sense "too high" relative to the marginal cost of producing one more unit of output, due to market power or price collusion (Bolt and Humphrey, 2015). The Lerner index measures the actually exercised monopoly power and ranges between zero (perfect competition) and the inverse of the price elasticity of demand (in monopoly or collusion).

To estimate marginal cost, we employ a standard log-linear cost function in the spirit of the intermediation approach of bank production (Sealey and Lindley, 1977), with one aggregate output q and the three inputs personnel, fixed assets and financial funds with prices p_l, p_k and p_d. The usual restriction of linear homogeneity in input prices is imposed by dividing total cost (tc) and (the remaining) input prices by p_d to obtain:

$$\ln \frac{tc_{it}}{p_{d,it}} = b_0 + b_1 \ln \frac{p_{l,it}}{p_{d,it}} + b_2 \ln \frac{p_{k,it}}{p_{d,it}} + a \ln q_{it} + \boldsymbol{g}\, \boldsymbol{x}_{it} + e_{it} \tag{2}$$

or, respectively (dropping bank and time subscripts i and t, and introducing z):

$$\ln \frac{tc}{p_d} = b_0 + b_1 \ln w_l + b_2 \ln w_k + a(z) \ln q + \boldsymbol{g}\, \boldsymbol{x} + e \tag{3}$$

where $\boldsymbol{x}$ is a vector of (logged) netputs and control variables. Estimation follows Delis *et al.* (2014) and Clerides *et al.* (2015), who argue that semi-parametric methods provide more robust and more accurate estimates of mc than parametric methods. Thus, we apply the PLSC (partial linear smooth coefficient) approach to obtain bank-year observations on marginal cost.[5] The final model – Equation (3) – is linear in the regressors, but the coefficient of output is allowed

[5]The PLSC method represents a semi-parametric approach which, in a two-step procedure, uses local regression techniques to obtain estimates of a for each bank i at time t. For further details, see Clerides *et al.* (2015),

to change "smoothly" with the value of the smoothing variable z, which should shift mc and vary across banks and time (Clerides *et al.*, 2015, 278). In choosing $z = \ln w_l + \ln w_k$, we follow Clerides *et al.* (2015).[6] Marginal cost is then obtained by multiplying the first derivative with respect to output by average cost (ac) per unit of output:

$$mc = \frac{\partial\, tc}{\partial\, q} = a(z)\, \frac{tc}{q} = a(z)\, ac \tag{4}$$

3.2 Efficiency-Adjusted Lerner Index

The "traditional" Lerner index measures realized (actually exercised) market power and its calculation implies the assumption that all banks exhibit the same level of efficiency (Polemis, 2016, S88). Koetter *et al.* (2012) provide a more realistic measure that aims for capturing the *potential* degree of monopoly power (Clerides *et al.*, 2015). For example, Lerner indices might be relatively low (indicating more competitive behavior in comparison with peer banks) if banks do not fully exploit their pricing opportunities or spend inefficiently much on input factors (expense-preference behavior). Thus, Koetter *et al.* (2012) propose to adjust the Lerner index with respect to efficiency differences (in profits and costs) obtained by Stochastic Frontier Analysis (SFA).[7] One part of the calculation here is based on a translogarithmic cost function with linear homogeneity (of degree 1) in input prices:

$$\begin{aligned} \ln \frac{tc}{p_d} &= b_0 + b_1 \ln w_l + b_2 \ln w_k + a_q \ln q \\ &\quad + \frac{1}{2}\, b_{11} \ln w_l^2 + \frac{1}{2}\, b_{22} \ln w_k^2 + b_{12} \ln w_l \ln w_k \\ &\quad + \frac{1}{2}\, a_{qq} \ln q^2 + a_{1q} \ln w_l \ln q + a_{2q} \ln w_k \ln q + \boldsymbol{g}\, \boldsymbol{x} + d + \ln u + v \end{aligned} \tag{5}$$

where d are time dummies, and the (SFA) error term consists of $\ln u$ and v (both vary with i and t). The random error v has a two-sided distribution (i.i.d. normal), firm-specific inefficiency u is (i.i.d.) half-normal (restricted to be positive). Given the output level of the bank, cost (in)efficiency measures the difference between minimum and observed costs (Koetter *et al.*, 2012, 465). Marginal cost can (analoguous to Delis *et al.*, 2014, 545) be obtained via:

$$mc = \frac{\partial\, tc}{\partial\, q} = (a_q + 2\, a_{qq} \ln q + a_{1q} \ln w_l + a_{2q} \ln w_k)\, \frac{tc}{q} \tag{6}$$

Furthermore, the estimated cost function is used to obtain predicted costs and, as a second "step", an alternative profit function (Equation (5) with profits as the dependent variable) is estimated by SFA to retrieve potential profits.[8] These predicted values correspond to costs and

Brissimis *et al.* (2014), and the references therein. Clerides *et al.* (2015, 279) also argue that the PLSC approach takes heterogeneities in banks' production technologies into account by not imposing a specific functional form (as it would be the case with the translog function typically applied with parametric estimation). The estimations for this paper are carried out by use of the `R` package `np` (Hayfield and Racine, 2008).

[6] Delis *et al.* (2014) apply the average of w_l and w_k.

[7] For a further application of SFA in calculating efficiency-adjusted competition measures, see Coccorese (2014).

[8] Following Restrepo-Tobón and Kumbhakar (2014), the profit function is estimated withouth imposing linear homogeneity. The adaptation using positive and negative profit indicators (to be explained in more detail in Section 3.3 below) proposed by Bos and Koetter (2011) is applied as well.

profits that could be reached if bank i would operate like its fully efficient peers (with factors $\boldsymbol{x}$ being controlled for). The efficiency-adjusted Lerner index (ALI) is then calculated as:

$$ALI = \frac{\pi^* + tc^* - mc^* \cdot q}{\pi^* + tc^*} \tag{7}$$

with starred variables representing frontier estimates from SFA.

The ALI estimates should be higher than the conventional LI by definition, as the latter are presumed to underestimate market power. However, it has to be kept in mind that forgone profits and high costs may appear for manifold reasons that are probably not strictly attributable to inefficiency. Examples given by Bolt and Humphrey (2015) comprise regional differences in loan demand (reduced bank revenues in low-income areas), and disparities in banks' use of cost-saving practices (e.g. branch closures, ATMs, IT use in loan applications assessment and credit monitoring, and so on), in personnel talent and skills, the funding mix or loan concentration. Additional examples for costs not to be mistaken for "slack" are expenses made to produce outputs of higher quality or to capture and maintain market power (Restrepo-Tobón and Kumbhakar, 2014). For one thing, a general classification of such factors onto (in)efficient behavior seems too harsh, as some of them might be outside the banks' control, and other ones may conform to certain business models or "philosophies" (savings banks and credit cooperatives may have a genuine expense preference for practices that foster their missions). On the other hand, the empirical analysis below presumably takes some of these issues into account by adding control variables and seeking to establish a rather homogenous sample of examined banks.

3.3 Boone Indicator

As the adjusted Lerner index, also the Boone indicator is connected to bank efficiency. The idea is the following: If competition increases (either by entry or a more aggressive conduct of rivals), output reallocation takes place with inefficient firms experiencing a relative sharper decrease in profits. In this situation, efficient firms can use their advantage of lower marginal cost to gain profits from the least efficient ones (Liu *et al.*, 2013b). As the measure to be applied in practical research, Boone (2008) proposed the profit elasticity (PE), the percentage decrease in profits if marginal cost increases by 1 %. A more efficient firm shall suffer less from rising costs in terms of profits (Clerides *et al.*, 2015), and thus its PE should be smaller (less negative).

Following this, a simple measure of the Boone indicator could be obtained from regressing profits on marginal cost (both in logarithms). However, there are some complications to consider. First, according to Schiersch and Schmidt-Ehmcke (2011), bank size should be accounted for in the calculation of the Boone measure. The theoretical reasoning behind the Boone indicator would imply that efficient firms become largest over time, but in reality, there are efficient firms that are very small (have low market shares, at least for some time), while big firms may be inefficient, but nevertheless make large profits just because they are large (Schiersch and Schmidt-Ehmcke, 2011, 347). One possible remedy (the one also pursued here) is to divide profits by total assets, and thus use returns on assets as the dependent variable in the regression mentioned above. Schaeck and Cihák (2014) provides a corresponding application, another possibility would be to use the market share in profits as the dependent variable.[9]

[9]For example, van Leuvensteijn *et al.* (2011), van Leuvensteijn *et al.* (2013) or Tabak *et al.* (2012) follow this

A second "problem" is that even with bank-level marginal cost, one cannot obtain Boone measures at the bank-year level using conventional regression. Therefore, also the relation between the ROA and marginal cost is estimated by the PLSC method. For similar applications, see Delis (2012), Brissimis *et al.* (2014) or Clerides *et al.* (2015). Third, the estimation has to consider observations with negative values for ROA as taking logs of these is not possible. Bos and Koetter (2011) provide an approach that dominates the usual "solutions" (removal or rescaling of loss-incurring firms' observations), which is to construct variable π^+ which equals π (profits or, in our case, ROA) with positive values and 1 if the ROA is negative. Additionally, a second variable, NPI (the negative profit indicator), is defined, which is 1 for positive ROA and equal to its absolute value if ROA is negative. In the end, π^+ replaces the dependent variable of the Boone equation, NPI is used as an additional explanatory variable. Actually estimated (by PLSC) then is:

$$\ln \pi_{it}^{+} = \alpha + \beta(z_{it}) \ln mc_{it} + \gamma \ln NPI_{it} + \epsilon_{it} \tag{8}$$

and the Boone indicator is obtained as:

$$BOONE_{it} = \frac{\partial \ln \pi^{+}}{\partial \ln mc} = \beta_{it} \tag{9}$$

For the estimation of mc and the role of z, see Section 3.1. As with the Lerner index above, the interpretation of the Boone indicator might be obscured (β may even become positive) if firms compete in quality (Tabak *et al.*, 2012). Finally, it has to be noticed that, though theoretically appealing, the Boone indicator seems to be outperformed by the Lerner index on empirical grounds. Schiersch and Schmidt-Ehmcke (2011), for example, find the Lerner index to more often indicate the correct change in competition after cartel terminations in German manufacturing.

3.4 Interest Rate Spread

As a fourth competition measure, an interest rate spread is applied, for which some argumentations of Gischer *et al.* (2015, 4476ff.) provide the rationale. First, they argue in favor of measuring competition solely for banks' engagement in the lending business as this mostly takes place in locally segregated markets where competition is attenuated. Measures based on total assets thus may underestimate market power in this core business segment, which presumably is the main concern for researchers and policymakers. Second, average variable cost may replace marginal cost (for they are often found not to differ tremendously and the former are obtained more easily), and there only is one input relevant (not constant) in the short term. As no increase in personnel or property is needed to produce one additional unit of output (loans), Gischer *et al.* (2015) propose a mark-up measure based on (weighted) average interest rates of loans and deposits only.[10] However, the indicator used in this paper can, due to data constraints, only make use of aggregate data on the interest-related business as a whole. An interest rate spread in the form of:

$$IS_{it} = ia_{it} - il_{it} \tag{10}$$

approach, also due to the argument that efficient firms might be able to gain market shares by lowering output prices.

[10]Bolt and Humphrey (2015) calculate a similar mark-up for consumer loans.

is calculated, where *ia* is the average interest revenue per unit of interest-earning assets, and *il* is the average interest expense per unit of interest-bearing liabilities. As a second difference to Gischer *et al.* (2015), the measure is not defined in terms of a mark-up due to the following reason. From our data, it can be observed that both the interest rates used in the above calculation go down after the financial crisis, but in a way (the funding rate decrease is relatively stronger) that a mark-up measure (with the funding rate in the denominator) would indicate declining competition in the lending business. This seems rather unrealistic and, additionally, is opposed to the trend in the other competition measures applied (as well as the net interest margin, too).

4 Data, Variables and Empirical Approach

4.1 Base Data and the Structure of Austrian Banking Markets

For all Austrian banks, data from yearly, unconsolidated financial statements were obtained from the Austrian National Bank (Oesterreichische Nationalbank, OeNB). The observation period ranges from 1999 to 2014, and the initial sample is restricted to (794) domestic banks that are primarily engaged in the retail business and offer associated services (payment transactions, deposit collection, granting of credit) to customers in regional markets.[11] Book values from the financial statements are inflation-adjusted to millions of real 2015 euro (deflated by the Harmonized Index of Consumer Prices, obtained from Statistics Austria and Eurostat). The observed banks can be categorized into five types (or sectors, according to the statistical categorization used by the OeNB): commercial banks, savings banks, Raiffeisen credit cooperatives, Volksbank credit cooperatives, and state mortgage banks.

As a second data set, we employ the regional (geographic) distribution of retail banks and their branches over the whole sample period, also provided by the OeNB.[12] Bank office[13] location relates to communities, which, in 2011, had a median (average) size of about 24 (35) square kilometers. For these local markets, several characteristics from census data (plus regional income and municipal tax, described in more detail below) were obtained from Statistics Austria, amended by district-level start-up intensities with the Austrian Economic Chambers (Wirtschaftskammer Österreich, WKO) as the data source. Furthermore, (beeline) distances between municipality centroids are processed in the empirical investigations, which were provided by the GeoMarketing GmbH, along with a shapefile for municipality borders.

Certain general remarks on Austrian banking markets might be expedient at this point. For 2014, the end of the sample period, the number of banks with the characteristics defined above

[11] Institutions with a banking licence not considered here contain bank holdings, investment banks, private banks and asset managers, special purpose banks (including severance funds, investment companies and real estate funds), disbursement societies, online brokers, direct banks, building and loan associations, and European Member State credit institutions.

[12] The fact that with the beginning of 2015, an intensive consolidation process began regarding the Austrian administrative units (districts and municipalities), is the reason our data are confined to end with 2014. To be exact, the delineation of administrative units applied is that of 2011.

[13] Headquarters and branches are equally termed "bank offices" in this paper.

was 601, which maintainted a total of 4321 offices. Although (or because) there are some banks with a very large branch network, however, many decentralized, local markets are served by savings banks and (often rather small) credit cooperatives. As Burgstaller (2017) observes, regional market outreach is strongest for cooperative banks (especially Raiffeisen), which thus also more likely serve the less wealthy and less densely populated regions. Localized market structure is of interest for bank customers and policymakers alike, especially if these are very concentrated. In many municipalities, only few bank branches are present (often only one, 563 out of the 2379 Austrian municipalities even were branchless at the end of 2014), with declining tendency.[14] Some institutional and legal issues[15] are interesting in the context of competition analysis. First, both savings banks and credit cooperatives (which dominate rural markets) are bound by a specific mandate: savings banks should support regional economic development and public welfare, cooperatives have to aim for supporting the business of their members (which are also their owners). By that, profit maximization is obscured, which has to be kept in mind when interpreting results. Second (and connected), market segregation is still widely practiced as both savings banks and credit cooperatives mainly operate in designated regions and rarely invade markets of other within-sector institutions. As the regional focus leads these banks to perceive their peers as partners, not competitors, one has to take that into account when specifying each bank's competitive environment.

4.2 Empirical Approach and Methodology

The following parts of the paper seek to evaluate the competition measures (observed at the bank-year level) and to seek their relation to characteristics of the environment (the market and its structure, features of rivals). A first step is to come up with a (restricted) sample of banks for which this can be done most reasonably, for which both the own scope of action and therefore also market and competitive conditions can be described meaningfully. The final approach pursued is to concentrate on single-market banks (SMB) that face a monopoly or duopoly situation in their home municipality. Banks that only operate in one community are not that uncommon in Austria, as many institutions, predominantly Raiffeisen credit cooperatives, are that small, thus only active locally, but legally independent so that data are available.[16] Coccorese (2009) takes a similar approach (also examines local mono- and duopolists), based on the observation that an analysis of market power in narrow areas is most meaningful when restricting it to cases where the data quite naturally can be seen as market data. An examination of only retail banks with a that confined focus of action also facilitates the identification of rivals (also because SMB by their nature have no multimarket contact with other banks) and the factors that might influence their competitive behavior. Furthermore, it is easier to apply a meaningful measure of physical distance to competitors in the empirical investigation.

[14]The decrease in 873 bank branches from 1999 to 2014 was 16.8% (even more of the 5194 initial branches closed, as 363 were newly established during this period). Several other countries, however, experienced a more drastic branch reduction (Burgstaller, 2017, provides some associated figures).

[15]See Burgstaller (2013) for a more general description of Austrian banking markets.

[16]The fact that bank data are not available at the level of a single branch also is a reason for restricting the sample to such banks. In turn, this choice inhibits the use of spatial econometrics as the observed banks represent only a segment of the whole banking market, are dispersed in space and not necessarily geographical neighbors.

A final advantage of the restricted sample is that the observed banks also are rather homogenous (locally oriented, regionally rooted banks of rather small size, which are mainly engaged in mobilizing deposits and lending them out to households and SMEs at the regional level). The analysis of homogenous units, a prime principle in efficiency and competition studies, is further promoted by considering disparities with respect to certain bank-level control factors. Remaining differences in the calculated measures are then related to rival and market characteristics in a second estimation stage.

Thus, the empirical approach can be summarized as follows. First, the competition measures introduced in Section 3 (by using PLSC and SFA methods) are calculated for all 794 banks considered. In doing that, we follow the intermediation approach of bank production (Sealey and Lindley, 1977) in specifying bank inputs and output. Certain netputs and control variables shall be applied, which are described below. Second, by using data on the distribution of all bank branches, we identify observations of banks (similar to Coccorese, 2009) that only operate in one municipality (are thus termed single-market banks, but may entertain more than one office) with either no or only one rival branch present in that market. For those banks in monopoly or duopoly situations,[17] we then seek to reveal what determines remaining differences in competitive behavior. For that, the characteristics of the nearest rivals (including their physical distance) are considered, as well as variables describing the observed banks' home markets and their neighborhood.

In this second estimation stage, we apply dynamic panel data regression (one-step Difference GMM, see Arellano and Bond, 1991). Thereby, the lagged dependent variable, which is correlated with the error term, is instrumented by its first and second lag as well as by the first differences of the other explanatory variables with the instrument set being collapsed (see Roodman, 2009). Tests on serial correlation of orders one and two (Arellano and Bond, 1991) are used to ensure that the model is not misspecified. Instrument validity (exogeneity) is evaluated by use of the Hansen (1982) J-test from the two-step model, which is robust to heteroscedasticity but may be weakened with many instruments (Roodman, 2009). Potential endogeneity of environmental variables is addressed by lagging all proposed determinants by one period.

4.3 Variable Definition and Construction

Several of the variables used to construct the competition measures were already mentioned in Section 3: bank output is proxied by total assets, output price (with the Lerner index) measured by income per unit of assets. The calculation of the ALI requires a profit variable, which is profits before tax, and is divided by total assets to obtain the return on assets (ROA) used to calculate the Boone indicator. Three rather common inputs are assumed, their prices are defined as follows: a) personnel expenditures divided by total assets (as the number of employees is not available) as the price of labor, b) non-personnel costs (other administrative and operating expenses, depreciation and amortization) as a share of fixed assets depicting the price of capital (property), and c) the ratio of interest expenses to total interest-bearing funds (average cost of one unit of interest-bearing liabilities) repesenting the cost of financial funding.

Other variables are presumed to affect the production process, but enter as so-called netputs.

[17] Sometimes, these shall be termed "monopolists" and "duopolists" for simplicity.

Netputs are quasi-fixed (cannot be varied in the short run) quantities of either inputs or outputs that affect costs or profits (Rime and Stiroh, 2003), and are measured as quantities or ratios (in "levels" according to Mester, 2008). This means that no price is calculated, which is deemed rather difficult for some factors generally seen as being inputs to bank production (e.g. equity, see Gischer and Stiele, 2009). Two such netputs are applied in this paper, which are also advocated by Mester (2008) and Hughes and Mester (2015). The first is equity capital (measured as the book equity share in total assets), which shifts the cost function and shall reflect the risk attitude or preferences of the bank. Conversely, financial capital disposable to absorb losses directly influences a bank's insolvency risk (Mester, 2008). The ratio of value adjustments from the credit business relative to total claims against non-financial customers represents the second netput.[18] Higher relative net charges from loan revaluations (our measure increases with more write-downs) are indicating higher portfolio risk, or a low quality of credit claims, or depict that less effort and costs are engaged to keep loans performing (Mester, 2008). Data on another measure of output or product quality, non-performing loans (Hughes and Mester, 2015), unfortunately were not available. The use of both variables (risk preference and output quality) may thus level out the associated cost differences which could mistakely be interpreted as market power differences (especially with the efficiency-adjusted Lerner index).

Further variables act as control factors for other disparities in banks' risks and activities, which may affect the production process. Rather commonly appearing in literature connected to the current subject (e.g. Bikker *et al.*, 2012) are measures of asset, funding and income composition. This paper applies the loans ratio (claims against non-bank customers to total assets), the deposits ratio (savings deposits in total interest-bearing liabilities) and the interest income share (in total revenues). Both the loans ratio and the interest income share account for differing degrees of involvement in traditional versus non-traditional bank activities and the associated profits and costs. Measures like the deposits ratio are presumed to depict preferences for stable and inexpensive funding (by less use of wholesale funding and securitized debt), or differences in liquidity risk.

Next, the determinants and environmental variables applied in the second estimation stage are introduced. At the level of the observed banks, one final variable coming into play is bank size. Several further indicators used are based on the competitive environment. Conduct of mono- and duopolists is proposed to differ with respect to isolation which is inferred from the physical distance to branches of potential rivals. For banks in a monopoly situation, the distance (in kilometers) to the next branch of a rival is used, for duopolists, we apply the average distance of the next three branches of distinct rivals (since the distance to the first one is zero throughout by definition).[19]

In both samples (mono- and duopolistic banks), additional characteristics of the first rival applied are: its size, its own competitive stance, and all the characteristics defined also for the banks of interest (from the equity ratio to bank size).[20] Further, we add the functional distance

[18]Gischer and Stiele (2009) apply a similar measure, but they divide by total assets and count write-downs negatively, thus their measure is mostly negative.

[19]For monopolists, distances to the second and third rival branch, and thus also an average distance, turned out insignificant for all competition measures, thus only the first one remained. In rival determination, it is assumed that neither savings banks nor cooperatives and state mortgage banks compete within their peer group, while commercial banks do.

[20]As there is no data available at the branch level for rival banks as well, it is assumed that the competitor's

of this (first) rival branch (the kilometer distance between between the branch and the rival bank's headquarter) and the geographical diversification of the first rival's branching network. The larger the former distance is, the farther the rival's branch is away from its decisional center, which may affect its local behavior and thus the conduct of the observed banks. Both measures can additionally be seen as depicting the relative(ly low) interest the rival may have in the local market examined, with branches that are either located far away or a embedded in a large network of branches possibly concentrated elsewhere.[21] Branch dispersion may also represent a geographic indictor of what Hughes and Mester (2015) discuss in terms of bank risk due to credit and funding concentration.

The final set of variables depicts socio-economic characteristics of the municipality and its surroundings which are possibly affecting competitive performance: population structure (the share of elder people, aged 60 or older, in %), the average income of the employed resident population (without transfers, in 1000 euros per inhabitant per year, in real 2015 euro), the percentage share of outgoing commuters (inhabitants having their workplace outside the municipality) in the working population, and the employment share (out of people having their place of work in this municipality) in the primary production sector (agriculture, forestry, fishery), also measured in %. These factors were selected[22] to depict both the demand for banking services and products (and thus market attractivity) and the economic development of the municipality. While intended, a clear separation of what (better) measures the one or the other is not really possible. For example, demand for banking services might be lower in communities with an ageing population, but the latter indicates structural weakness as well.[23]

As the catchment area of a rural bank may exceed the home municipality (the relevant market is larger), spatial lags of the above characteristics are applied. Therefore, we apply a binary spatial weights matrix (containing ones for neighboring municipalities and zeros for non-neighbors). The number of neighbors considered is based on the Euclidean distance between municipality centroids with a cut-off (point) obtained in a way that every community has at least one neighbor. The matrix then is row-normalized so that the elements of each row sum up to unity, and thus spatial lags calculated are to be interpreted as averages of the respective variables in surrounding areas.

The final indicator to be mentioned shall depict the dynamics of market development: business registration intensity (newly founded firms per 1000 capita), observed at the district level.

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branch conveys the characteristics of the entire rival bank.

[21] Alessandrini *et al.* (2010), for example, discuss functional (organizational) distance, though they define it at the regional level. Meslier *et al.* (2016) may serve as a reference for geographic diversification being applied, which they calculate as one minus the concentration of market shares in deposits (for which we do not have data, thus our measure is based solely on office distribution).

[22] Data on further characteristics (e.g. municipal tax revenues or the population share with tertiary educational attainment) would have been available, but were set aside as they measure similar municipality qualities (are highly correlated with one or more of the applied measures). Not all the variables are available throughout the sample period, values for some years were interpolated by assuming a constant growth rate. Nevertheless, this somewhat reduces the number of usable observations.

[23] Even more ambivalent are measures of unemployment (not applied here). The unemployment rate probably has merits as a demand indicator, but flaws with respect to measuring structural development: out-migration and commuting from the community may keep unemployment low despite of economic weakness.

Table 1: Descriptive Statistics of Competition Measures

	N	Mean	SD	MIN	MAX
SMB in a monopoly situation					
Lerner index (LI)	1145	0.199	0.078	0.0004	0.642
Efficiency-adjusted Lerner index (ALI)	1177	0.425	0.126	0.087	0.901
Boone indicator (BOONE)	1106	-0.041	0.048	-0.473	-0.004
Interest spread (IS)	1177	2.630	0.667	1.043	5.893
SMB in a duopoly situation					
Lerner index (LI)	1023	0.213	0.071	0.005	0.712
Efficiency-adjusted Lerner index (ALI)	1038	0.464	0.110	0.087	0.823
Boone indicator (BOONE)	1004	-0.034	0.036	-0.206	-0.003
Interest spread (IS)	1038	2.573	0.693	1.061	5.662
Remaining SMB and MMB					
Lerner index (LI)	8588	0.217	0.078	0.0002	0.994
Efficiency-adjusted Lerner index (ALI)	8721	0.426	0.117	0.018	0.857
Boone indicator (BOONE)	8239	-0.037	0.043	-0.748	-0.004
Interest spread (IS)	8733	2.594	0.807	0.119	7.653

SMB = single-market banks, MMB = multi-market banks, N = number of bank-year observations.
SD = standard deviation, MIN = minimum, MAX = maximum.

5 Results

Descriptive statistics on the competition indicators calculated can be found in Table 1.[24] Initially, the groups of mono- and duopolistic SMB contain 110 and, respectively, 94 institutions (exhibiting the respective status at least for some time), and are rather homogenous as almost all of them are Raiffeisen credit cooperatives from rural areas. The third group featured contains remaining observations (834) for SMB in a market situation with two or more competing branches, as well as all "kinds" of multi-market banks (MMB).

For monopolists, the mean Lerner index on average is about 20%, the ALI, as expected, are higher, but also have more variation (which is true for all considered bank groups). These simple statistics at least show that banks without a rival within the community do not exhibit more monopoly power than duopolists or even the remaining Austrian banks. Interestingly, both mark-ups (LI and ALI) are on average higher for duopolistic banks, with the gap also being significantly different from zero (based on a two-sample t-test). Without controlling for market characteristics, however, this need not mean collusive behavior, a simple, also suitable explanation might be that local markets that are still "large enough" for two active bank offices have features that "allow for" higher price-cost margins.

Figure 1 presents the development of monopolists' competition measures over time by use of box plots (the corresponding graphs look similar for duopolists), Kernel density estimates for LI and ALI are depicted for monopolistic and duopolistic banks in Figure 2.

[24] A few observations with negative values for the Lerner index or positive Boone indicators were removed from the sample.

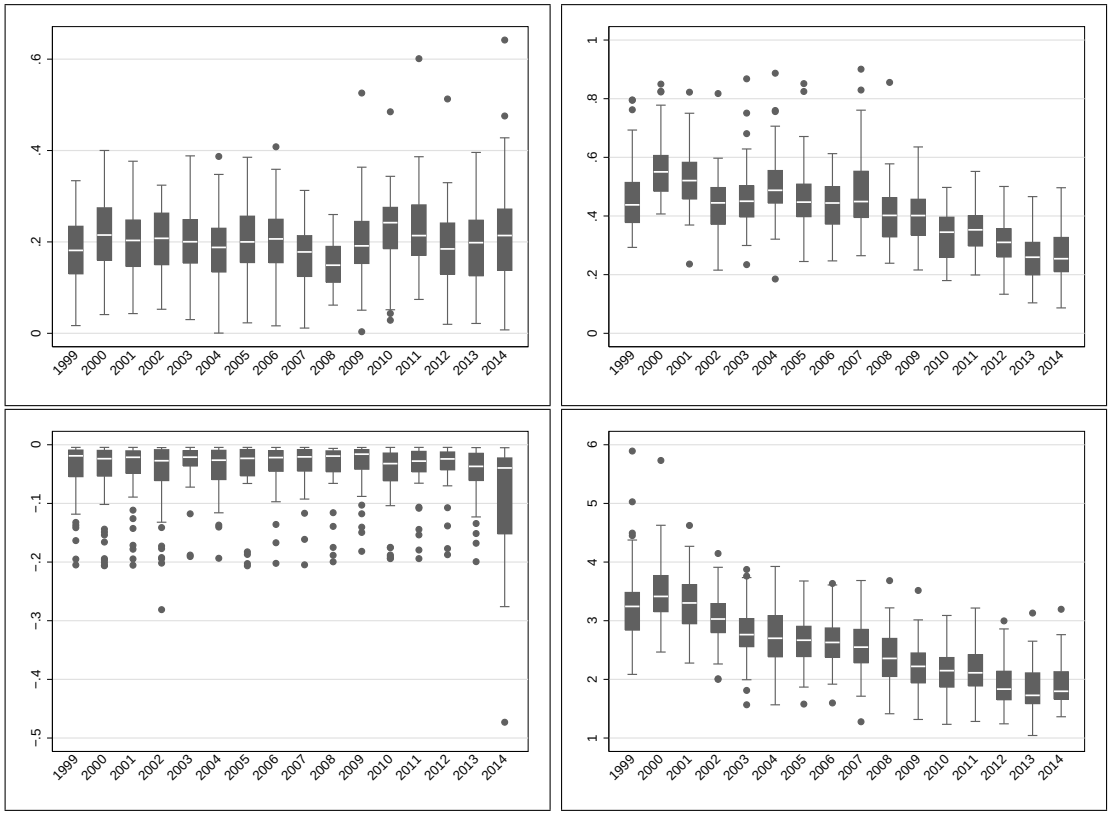

Figure 1: LI (Upper Left), ALI, IS, BOONE (Clockwise); Sample: Monopolists

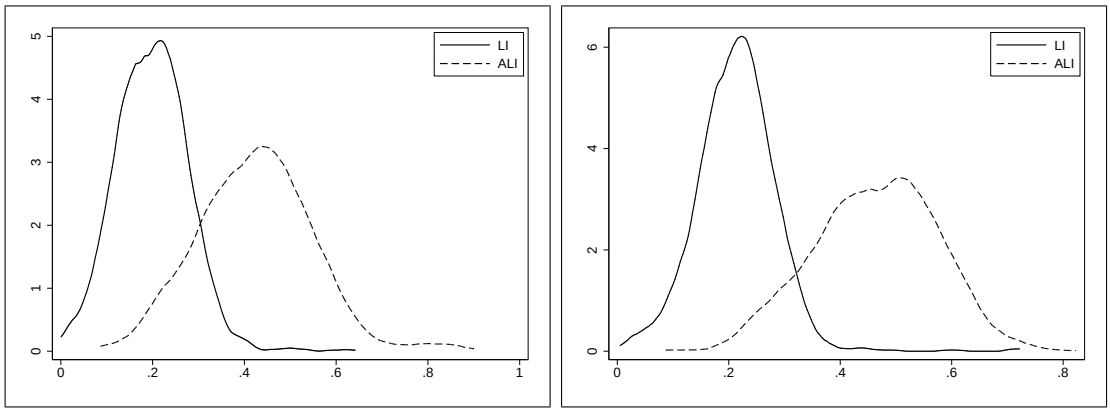

Figure 2: Kernel Density Estimates of LI and ALI (Left: Monopolists, Right: Duopolists)

From the time course of the indicators it can be derived that all of them, apart from Lerner indices, go down, indicating more competition in the banking sector. For the Boone indicator, this development comes relatively late in the period, the decrease in the interest rate spread of course is determined by the long-time decrease in the general interest rate level. The upper-right graph in Figure 1 shows that with the financial crisis, the average ALI goes down (almost to levels which are typical for "ordinary" LI). This is compatible with an intensifying competition, but the fact that the LI does not reflect these developments may be an indication of

Table 2: Pairwise Correlations Between the Competition Measures

	LI	ALI	BOONE
Lerner index (LI)			
Efficiency-adjusted Lerner index (ALI)	0.138		
Boone indicator (BOONE)	-0.001	0.130	
Interest spread (IS)	0.113	0.369	-0.014

Sample: "monopolistic" single-market banks.

intensified (and necessary) advances in achieving more (cost) efficiency. Figure 2 indicates that the relatively higher average values for duopolists' ALI mentioned above might stem from some outlying values in the upper end of the distribution.

Correlations between the competition measures (for the monopolists subsample; the pattern is similar for duopolists) are reported in Table 2. Our measures are, at best, only slightly associated, the by far largest correlation emerges between ALI and the interest spread (0.37). A similar lack of linkage is observed by Carbó *et al.* (2009) and Bolt and Humphrey (2015), which can in part be explained by these indicators measuring different aspects of competition.

Results from the second estimation stage, which seeks to examine the determinants of competitive behavior, can be found in Tables 3 (for monopolistic banks) and 4 (SMB in a duopolistic situation). Both sets of results also highlight that competition measures are differently affected by their postulated influence factors. In interpretations, it has to be kept in mind that certain bank-level differences (in equity and asset quality) were already considered with calculating competitive behavior – most thorough with the ALI, where those factors are "allowed" to affect both profits and costs.

For efficiency-adjusted Lerner indices (ALI), only a few factors turn out significant. Both the negative effect of an ageing population (which is present from both the own market and its surroundings) and the positive one from the start-up intensity depict that potential mark-ups are lower in structurally weak areas.[25] However, actual market power (measured by LI) is lower for monopolists if their home municipality is situated in a district where business registrations surge. Observed banks may have to incur costs to obtain market shares in such surroundings, or they are not, on average, the banks that profit from these economic dynamics.[26] The last significant determinant of the adjusted Lerner index is the ALI of the nearest competitor. A possible interpretation of (or one that is compatible with) this negative effect might be that skimming rents is a zero-sum game in very narrow regions. However, the rival's own competitive behavior is significant with no other indicator. Rather surprisingly, the headquarter distance of the rival branch is also negatively connected to the interest spread and the Lerner index. Probably branches (of larger institutions) far away are granted ample autonomy to compete with incumbent banks.

[25]For example, Conrad *et al.* (2009) also argue that a higher share of elder people is indicative of local areas with less economic and societal activity. A more direct interpretation of the former effect might entail that elder people demand services and products that are less profitable for the bank.

[26]Some of them, of course, do, which then are those efficient banks with high revenues that all other banks, i.e. monopolists, are compared with in calculating the LI adjustment (ALI).

Visible with the Boone indicator, monopolists behave more competitively if the rival is relatively better equipped with (loss-absorbing) capital and exhibits superior asset quality. Such a competitor probably increasingly introduces (aggressive) actions of rivalry forcing the monopolist to follow (with profits being allocated away). The more income the rival generates out of the interest-related business, however, the lower its competitive pressure.

Outgoing commuting in the vicinity is significant for the Boone indicator as well as with interest rate spreads. With its positive effect on the former, it follows the interpretation of commuting as an indicator of structural weakness. However, lower interest spreads need not necessarily indicate more competition in this case, it may simply be a characteristic of an unattractive market.

Several features of the nearest rival are significantly impacting Lerner indices of banks in monopolistic situations. The larger, the more geographically diversified and the more stable (and safely, as measured by the deposits ratio) it is financed, the lower is the competitive pressure of its presence (and the higher LI of monopolists). All these features of the nearby contestant might represent a rather low importance of the respective market, also with respect to the deposits that "need" to be raised.

The main effect of interest, however, is the distance between the monopolistic bank and the nearest branch of a competitor. It has a significant effect, but as with the functional distance of the latter branch, only for LI and IS: the greater the relative isolation of the monopolist's home market, the higher the mark-up, for the whole business but also measured by the interest spread. Concerning this isolation premium, several observations can and should be made. First, as it amounts to 1 percentage point (in LI) per kilometer, it surely is not negligible economically. Secondly, it doesn't seem plausible that the higher price-cost margin of banks residing in such circumstances of remoteness comes from profitable non-interest income sources. This is supported by the fact that also loan spreads increase with relative isolation from rivalry. Thirdly, there is no such premium with the ALI or Boone indicator, which indicates a role of efficiency or of behavior with similar consequences in bank figures. From the efficiency adjustment implied in going from LI to ALI it could be derived that monopolists with more distant competitors are more efficient.[27] Fourth, a plausible explanation therefore might be that geographical seclusion enables banks in such markets to decrease funding costs (and thus appearing more efficient) by paying rather low deposit rates. In this case, banks impose remoteness-induced market power via the rates on banks' main funding source. It may be surmised that a rather inert local deposit base is a prerequisite, which is conceivable if customers accept lower rates on their deposits due to being loyal or locked-in, having high switching costs or no willingness or appeal to use alternatives such as direct banks. Similar observations are made and arguments given by Maurer and Thießen (2016), who examine differences in the price-setting and profitabilty of rural and urban banks in Germany.[28]

[27]For the Italian case, Aiello and Bonanno (2016) find that small cooperative banks are more efficient if market concentration is higher and branch density is lower. In the sense of this paper, monopolistic markets are the most concentrated ones possible. However, results are not fully comparable because Aiello and Bonanno (2016) use bank concentration on the provincial level to explain individual bank efficiency, with the latter being calculated by frontier methods.

[28]Maurer and Thießen (2016) also observe that rural banks in general do not charge higher lending rates than their urban and suburban counterparts, but nevertheless have higher profit margins due to a higher share of loans in the balance sheet.

Table 3: Results on Competition (Monopolists)

Dependent variable	LI	ALI	BOONE	IS
Lagged dependent variable	0.739 **	-0.162	-0.067	1.505 **
	(0.00)	(0.12)	(0.48)	(0.00)
Size	-0.088	-0.017	0.059	2.949 **
	(0.33)	(0.78)	(0.15)	(0.00)
Distance to first rival branch	0.010 *	-0.001	-0.004	0.062 *
	(0.07)	(0.96)	(0.26)	(0.07)
GEODIV of nearest rival	0.258 *	0.250	-0.146	1.354
	(0.10)	(0.28)	(0.12)	(0.12)
FDIST of first rival branch	-0.003 **	-0.002	0.001	-0.018 *
	(0.03)	(0.38)	(0.22)	(0.05)
Loans ratio (nearest rival)	0.0003	-0.001	-0.0001	-0.006
	(0.76)	(0.41)	(0.82)	(0.40)
Deposits ratio (nearest rival)	0.002 *	0.001	0.0001	-0.006
	(0.06)	(0.49)	(0.84)	(0.27)
Interest income ratio (nearest rival)	0.001	-0.0004	0.001 *	-0.016 **
	(0.49)	(0.46)	(0.07)	(0.00)
Equity ratio (nearest rival)	-0.004	0.001	-0.008 *	0.019
	(0.26)	(0.91)	(0.06)	(0.48)
Net write-downs (nearest rival)	0.002	-0.003	0.007 *	-0.041
	(0.84)	(0.73)	(0.10)	(0.61)
Size (nearest rival)	0.033 **	0.018	-0.013	-0.007
	(0.01)	(0.34)	(0.22)	(0.93)
Competitive stance (nearest rival)	-0.022	-0.096 **	-0.001	-0.123
	(0.75)	(0.02)	(0.99)	(0.18)
Elderly inhabitants	0.003	-0.014 **	-0.006	-0.002
	(0.70)	(0.03)	(0.31)	(0.97)
Average income	0.002	0.001	0.003	0.027
	(0.80)	(0.75)	(0.36)	(0.22)
Primary sector employment	-0.0002	-0.0001	-0.001	-0.005
	(0.94)	(0.92)	(0.40)	(0.47)
Outgoing commuters	-0.003	-0.0005	0.001	0.003
	(0.42)	(0.81)	(0.41)	(0.82)
SL of elderly inhabitants	0.020	-0.063 **	-0.014	0.015
	(0.11)	(0.00)	(0.11)	(0.87)
SL of average income	0.023	-0.011	-0.003	0.003
	(0.13)	(0.40)	(0.81)	(0.97)
SL of primary sector employment	0.003	0.0001	-0.003	-0.025
	(0.53)	(0.98)	(0.17)	(0.10)
SL of outgoing commuters	-0.012	-0.004	0.008 **	-0.093 **
	(0.30)	(0.47)	(0.05)	(0.00)
Business registration intensity (district)	-0.017 **	0.020 **	0.005	0.012
	(0.03)	(0.00)	(0.15)	(0.70)
Number of banks	80	84	76	84
Number of observations	656	706	548	706
AR(1) test (p-value)	0.00	0.00	0.00	0.00
AR(2) test (p-value)	0.52	0.85	0.75	0.60
Hansen test (p-value)	0.10	0.69	0.54	0.11

Estimation method: one-step difference GMM (DGMM).
Though only made explicit with the dependent variable, all explanatory variables are lagged one period.
LI = Lerner index. ALI = efficiency-adjusted Lerner index. BOONE = Boone indicator. IS = interest spread.
GEODIV = index of geographical diversification. FDIST = branch-headquarter distance. SL = spatial lag.
Dimensions of the variables are as in Table xx.
P-values for the t-test on non-significance are given in parentheses.
* Significant at the 10% level. ** Significant at the 5% level.

Turning to the results for banks in duopolistic situations in their home municipality (Table 4), the most striking difference is the effect of rival proximity (measured as the average distance to the nearest three branches of distinct competitors). As the first rival (which is located in the same municipality) enters calculation with zero distance, it is determined by the nearness of the second and third contestant and therefore measures the relative isolation of the duopolists pair.

The effect is negatively significant in Lerner index and interest spread equations, which suggests a more intense contest between geographically remote duopolists (derived from the behavior of sampled SMB in such a situation). However, it has to be kept in mind that duopolistic banks' mark-up levels are nevertheless slightly above those for monopolist SMB. Therefore, and by comparing results from both samples, it can be reasoned that, in terms of bank mark-ups faced, customers suffer most if situated in a municipality changing from a very isolated duopolistic to a secluded monopolistic market (i.e. if one of the two banks or branches is closed).

Other characteristics of the next-door contestant (interest income share, deposits share and its own spread) mainly affect incuments' interest rate spread. All three effects might depict rivalry with a certain type of institutions, banks from "outside" being interested in raising local deposits. These probably have a higher dependence in deposit funding per se, offer higher saving rates, and thus their own interest spread is lower, as is the interest income share. Observed duopolist SMB in this case (with such rivals), however, seem able to maintain higher interest spreads. With respect to structural weakness (in terms of demand or economic structure), at least one measure is significant for all competition indicators apart from the LI. Finally, it can be observed that both Lerner indices and Boone indicators show rather little heterogeneity with respect to the proposed determinants.

6 Discussion, Implications and Policy Conclusions

Competition represents a cornerstone in the relationships between bank behavior and (SME) lending, financial sector stability and economic growth. Nevertheless, it is seldom analyzed where it mostly takes place, in locally restricted areas. This paper aims to fill that gap and examines several competition indicators obtained for banks with no or only one contestant branch or bank within the municipality. By controlling for characteristics of these limited markets, a better understanding of competitive behavior in such narrow environments shall be obtained.

The evaluated bank-level indicators of competitive behavior do not exhibit tremendous differences across groups of institutions, monopolists (as also duopolists) are not found less competitive than other banks. In that respect, our results differ from those of Coccorese (2009), who observed Italian single-market banks without direct rivals to exploit relatively more market power. Duopolists cannot be assessed as acting fully competitively either, based on the levels of the calculated measures, though it can be said that their average conduct does not differ from that observed for the rest of Austrian banks, including the big ones and those in more complicatedly structured markets. However, although potential mark-ups (efficiency-adjusted Lerner indices) generally go down over time, the institutions in our samples are able to keep their realized (conventional) price-cost margins.

Heterogeneity of competitive behavior within both groups of monopolists and duopolists is then related to differences in market environments (proxies for demand and development) as well as to characteristics of the nearest rival. The distance to the latter, however, is the main factor of interest (or the average distance to the first three branches of distinct rivals for banks in a duopolistic setting). More remote monopolists (with the first competitor being located farther away) are found to exhibit a non-trivial isolation premium both in Lerner indices and interest

Table 4: Results on Competition (Duopolists)

Dependent variable	LI	ALI	BOONE	IS
Lagged dependent variable	0.747 **	-0.111	0.384 **	1.193 **
	(0.00)	(0.42)	(0.01)	(0.00)
Size	0.132	0.073	0.010	2.928 **
	(0.15)	(0.14)	(0.84)	(0.00)
Average distance of first three rival branches	-0.027 **	0.0003	0.001	-0.182 **
	(0.01)	(0.98)	(0.86)	(0.01)
GEODIV of nearest rival	0.070	0.333	0.276	-2.043
	(0.88)	(0.28)	(0.37)	(0.25)
FDIST of first rival branch	0.0002	-0.003 *	-0.002	0.007
	(0.94)	(0.07)	(0.16)	(0.43)
Loans ratio (nearest rival)	-0.001	-0.001	-0.0004	0.0002
	(0.41)	(0.40)	(0.60)	(0.98)
Deposits ratio (nearest rival)	0.001	0.001	0.001	0.015 *
	(0.36)	(0.59)	(0.64)	(0.08)
Interest income ratio (nearest rival)	-0.001	0.0002	-0.0004	-0.019 **
	(0.60)	(0.81)	(0.55)	(0.01)
Equity ratio (nearest rival)	0.0004	0.004	-0.003	0.031
	(0.93)	(0.40)	(0.44)	(0.25)
Net write-downs (nearest rival)	-0.00002	-0.003	-0.0002	0.019
	(0.99)	(0.39)	(0.98)	(0.29)
Size (nearest rival)	0.007	0.020	0.031	0.087
	(0.69)	(0.25)	(0.15)	(0.50)
Competitive stance (nearest rival)	-0.068	-0.054	0.012	-0.175 *
	(0.41)	(0.40)	(0.88)	(0.09)
Elderly inhabitants	-0.005	0.0002	-0.004	-0.068
	(0.65)	(0.98)	(0.46)	(0.15)
Average income	-0.002	-0.002	0.001	-0.001
	(0.38)	(0.27)	(0.58)	(0.97)
Primary sector employment	-0.003	-0.003	-0.007 **	-0.036 **
	(0.34)	(0.30)	(0.05)	(0.02)
Outgoing commuters	0.004	-0.001	0.002	0.006
	(0.15)	(0.52)	(0.44)	(0.70)
SL of elderly inhabitants	0.008	-0.061 **	0.003	-0.038
	(0.47)	(0.00)	(0.74)	(0.54)
SL of average income	-0.009	-0.011 *	-0.004	-0.085
	(0.29)	(0.06)	(0.65)	(0.11)
SL of primary sector employment	0.003	0.002	0.002	-0.007
	(0.71)	(0.65)	(0.58)	(0.72)
SL of outgoing commuters	-0.015	-0.014 *	-0.010	-0.120 **
	(0.14)	(0.07)	(0.13)	(0.00)
Business registration intensity (district)	-0.004	0.029 **	0.002	-0.018
	(0.66)	(0.00)	(0.66)	(0.55)
Number of banks	75	75	73	75
Number of observations	591	614	520	614
AR(1) test (p-value)	0.00	0.00	0.00	0.00
AR(2) test (p-value)	0.53	0.99	0.17	0.72
Hansen test (p-value)	0.37	0.53	0.25	0.60

Estimation method: one-step difference GMM (DGMM).
Though only made explicit with the dependent variable, all explanatory variables are lagged one period.
LI = Lerner index. ALI = efficiency-adjusted Lerner index. BOONE = Boone indicator. IS = interest spread.
GEODIV = index of geographical diversification. FDIST = branch-headquarter distance. SL = spatial lag.
Dimensions of the variables are as in Table xx.
P-values for the t-test on non-significance are given in parentheses.
* Significant at the 10% level. ** Significant at the 5% level.

rate spreads, presumably due to market power exercised in deposit funding. For SMB with one rival branch within the municipality, more seclusion from further contestants is found to intensify competition (derived from lower mark-ups and interest spread observed for sampled duopolists).

Several aspects of these results seem policy-relevant. First, while higher mark-ups of banks which are rather isolated from rivals are certainly harming customers, one can also speculate on their necessity to keep those institutions profitable and "afloat". The concerned, remote markets would almost certainly be worse off if bankless. Although the differences in competition measures between banks in all observed situations are not enormous, regression results seem to indicate that the largest difference in mark-ups exists between monopolies and duopolies if both are a long way off (further) contestants. Thus, branch closures in duopolistic markets also lead to non-negligible reductions in customer welfare. Secondly, and rather trivial, our findings also hint on bank profitability being diminished in surroundings with economic and structural weaknesses. If it can be presumed that financial institutions are still a necessary component of well-functioning local infrastructures, policies to prevent branch closures and "deserts" especially in already declining areas should accompany other aspects of regional policy. Thirdly, by recognizing that often-used competition measures have different interpretations and determinants (and are also driven by factors not representing anticompetitive behavior), it appears difficult to tell which one is most informative for regulators and other interested authorities. One possible advice, of course, is to consult more than one indicator before implementing competition policy actions.

Of course, there are some limitations to and critical issues regarding the analysis and results which introduce avenues for further research. A clear limitation is that most competition indicators calculated in this paper assume banks to be one-product businesses. However, improved specifications including multiple outputs (which of course already exist) should also reflect other features of a more realistic production process (e.g. desirable inputs and undesirable outputs). While discussed with respect to bank efficiency (see, for example, Koetter and Meesters, 2013, or Ahn and Le, 2014), these issues have not yet been considered in measuring competition. Further advances are also possible by progress in accounting for bank risk (Hughes and Mester, 2015) and technological heterogeneity (Bos *et al.*, 2009). Future research might also lift the restriction to monopolistic and duopolistic banks and study also more complicated issues in detail at the disaggregated level, such as competition effects of mergers, branch closures and other consequences of structural change, as well as of multi-market contact (Coccorese and Pellecchia, 2013). Finally, attempts to uncover the role of local rivalry in explaining regional differences in economic development appear fruitful. Alongside efficiency, also bank competition portrays financial sector and intermediation quality and thus may affect regional growth.

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