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## Article

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# Influence of internet and social media presence on small, local banks' market power

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## ABSTRACT

We study the impact of Internet and social media presence on the market power of small, local banks in Poland. We observe that small banks, which generally embraced new distribution and communication channels considerably later than the large commercial banks, had to forego a portion of their market power to defend market shares or reach new customers. The size of the market power sacrifice was greater when small banks competed against numerous banks within their local markets and particularly substantial when they were outnumbered mostly by large commercial banks.

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Small banks; market power; internet; social media; local banking markets

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## 1. Introduction

Internet and social media presence (I&SMP) is undoubtedly one of the most important factors that is changing the banking industry. The published studies can be roughly categorized into two groups. The first group of studies analyses the determinants of Internet banking adoption (Bauer & Hein, 2006; Courchane, Nickerson, & Sullivan, 2002; Hernández-Murillo, Llobet, & Fuentes, 2010; Santouridis & Kyritsi, 2014), and the second group of studies addresses the consequences of Internet banking introduction (Hitt & Frei, 2002; Hernando & Nieto, 2007; Delgado, Hernando, & Nieto, 2007; DeYoung, Lang, & Nolle, 2007; Ciciretti, Hasan, & Zazzara, 2009; Onay & Ozsoz, 2013). However, the existing evidence concerns mainly developed markets. The number of works regarding Internet and social media use by banks in emerging markets in general and in European post-transition countries is limited (Eriksson & Nilsson, 2007; Frățilă, Zota, & Constantinescu, 2013; Polasik & Wisniewski, 2009). To broaden the knowledge on this consequential subject, we have chosen small, local banks (SLBs) in Poland for two reasons. First, large banking organizations, which adopted Internet banking and social media a long time ago, do not present currently enough heterogeneity to support valid statistical inferences. In contrast, SLBs in Poland differ greatly according to their history of providing online services and current I&SMP. Second, SLBs play an extremely important economic role in providing loans for small- and medium-sized enterprises in emerging economies (Berger, Klapper, Martinez Peria, & Zaidi, 2008; Berger, Klapper, & Udell, 2001; Canales & Nanda, 2012;

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Hasan, Jackowicz, Kowalewski, & Kozłowski, 2017). Therefore, the competitive threats for SLBs and the factors determining their survival and market success constitute key questions from a policy-making point of view.

In our study, we concentrate on the impact of I&SMP on SLBs' market power. We believe that market power measures summarize information about the multi-channel influence of I&SMP on banks' performance and activities. Therefore, they constitute a convenient starting point for more detailed analyses. To test our hypotheses, we amalgamate four datasets. The first dataset contains detailed information on all of the bank branches in Poland, including precise geo-locations. The second, hand-collected and unique dataset is derived from a survey of more than 350 SLBs and illustrates different aspects of their I&SMP. In addition, we employ the financial statements of Polish SLBs and official economic statistics.

The empirical results show that I&SMP affects negatively SLBs' market power. Therefore, it seems that SLBs, which embraced new distribution channels and communication means generally much later than the large commercial banks, had to forego some of their market power to defend market shares or reach new customers. This regularity is shaped mainly by the group of SLBs that operate within local banking markets with a relatively high number of competitors. The size of the necessary market power sacrifice depends on two factors: the type of competing banks and the time of Internet and social media embracement. First, the negative influence of I&SMP on SLBs' market power is particularly acute when large commercial banks outnumber other local competitors. Second, the early adopters of the Internet and social media among SLBs, competing locally against numerous peer organizations, managed to preserve, to a certain degree, their market power. The research outcomes are robust. They are not sensitive to the changes in the econometric procedures, in the sample composition and in the construction of the key variables.

The paper contributes to the literature in three ways. First, as we indicated above, it supplements still incomplete knowledge on the consequences of I&SMP for banks and their market power in emerging economies. Second, it documents that the benefits signalled in the literature for banks that embraced early Internet technologies (Ciciretti et al., 2009; Delgado et al., 2007; DeYoung et al., 2007; Hernando & Nieto, 2007; Onay & Ozsoz, 2013) might be unavailable for banks that adopted Internet banking relatively late, such as, for example, an average SLB in Poland. Third, it also complements the literature on cooperative banks' performance drivers in Poland (Jackowicz & Kozłowski, 2016; Miklaszewska & Kil, 2013; Skała, 2015).

The remainder of the paper is organized as follows. Section 2 provides a literature review and presents our hypotheses. Section 3 describes some institutional features of Poland's cooperative banking sector that are necessary for understanding and interpreting the empirical results; it also presents our empirical strategy, data sources, and variable constructions. Section 4 discusses our results and their limitations. Section 5 contains robustness checks, while Section 6 presents the study's conclusions and managerial implications.

## 2. Literature review and hypotheses

Two strands of the literature are particularly relevant to our investigation. First, we base the methodological approach on studies concerning the market power of banks. Second, we formulate and substantiate our hypotheses using the empirical evidence regarding

Internet banking adoption. In this section, we review in turn the aforementioned strands of literature.

Most of the papers in the first strand conclude that banking markets deviate from the perfect-competition ideal and that the banks do possess some market power. Neven and Roller (1999) analyse margins in the provision of mortgages and commercial loans in seven European countries and find evidence of banks' substantial market power. In the same line, Casu and Girardone (2009) examine the relationship between competition and efficiency in the five largest EU banking markets. They confirm the existence of banks' market power (measured by Lerner' index) and indicate that the analysed markets become progressively more concentrated and less cost efficient. The outcomes of the single-country studies are less conclusive. On the one hand, Canhoto (2004), verifying competitive conditions in the Portuguese deposit markets, establishes that those markets are characterized by market power features and that perfect-competition conditions are obviously lacking. On the other hand, Coccorese (2009), analysing Italian single-branch banks that operated as monopolists in small local areas, find only weak evidence of market power even in markets with only one bank.

The literature on banks' market power investigates not only its sheer existence but also its determinants. The array of factors influencing market power, at least under certain circumstances, is vast and includes bank size, business model, ownership, and efficiency as well as macroeconomic factors. Efthyvoulou and Yildirim (2014) analyse the banking sectors of 17 Central and East European countries and observe that the level of market power and competitive conditions vary significantly across countries with bank ownership characteristics. Turk Ariss (2010) performs a broad analysis of market power using a conventional, an efficiency-adjusted and a funding-adjusted Lerner measure in 60 developing countries. The author finds a significant negative relation between the market power of banks and cost efficiency and a significant positive association of market power with bank-profit efficiency and overall stability. In a single-country framework, Angelini and Cetorelli (2003) establish that Italian banks involved in mergers and acquisitions do not gain market power while Fernández de Guevara and Maudos (2007) provide evidence that in Spain, size, efficiency, and specialization affect banks' market power. Pawłowska (2012) investigates the level of competition and concentration in the Polish banking sector and documents a rise in competition before the recent crisis and a subsequent decrease in competition between 2008 and 2009 caused by the financial turmoil.

Based on the first strand of the relevant literature, we expect that SLBs in Poland possess non-trivial market power. Moreover, to the best of our knowledge, I&SMP has not been studied as a determinant of market power. Therefore, our paper fills a gap in the literature. With regard to the market power measurement issue, the literature applies several different approaches, including different versions of Lerner's indexes.

The second strand of the relevant literature is devoted to the causes and consequences of Internet adoption by banks. The majority of authors agree that Internet adoption as an additional distribution channel was beneficial for banks' profitability. DeYoung et al. (2007) investigate how the Internet affected output and performance at the so-called 'community banks' with assets of less than 1 USD billion. They study the changes in bank financial statements between 1999 and 2001 and find that adding the Internet delivery channel results in substantial increases in bank profitability caused mainly by raises in non-interest income from service charges on deposit accounts. Hernando and Nieto (2007) analyse the

impact of the adoption of a transactional Website on the financial performance of Spanish banks during the period from 1994 to 2002. It turns out that the impact was not immediately apparent; instead, it was significant in terms of profitability measures three years after adoption. The profitability gains were primarily explained by a significant reduction in overhead expenses. Similarly, Ciciretti et al. (2009) report a positive and robust relationship between Internet adoption and bank profitability in Italy. However, a study by Onay and Ozsoz (2013) provides a more nuanced evaluation of Internet services' adoption after-effects. They study Turkish retail banks during the period from 1990 to 2008 and find that Internet adoption had a positive impact on per-branch profitability. However, at the banking sector level, Internet adoption depressed banks' overall profitability and interest incomes, probably because of increased competition.

The comparison of Internet-only banks and traditional banks yields more ambiguous results with regard to profitability. DeYoung's (2005) seminal work searches for technology-based experience effects and technology-based scale effects using a sample covering the period from 1997 to 2001 and encompassing US Internet-only banking start-ups and newly established branching banks. On average, Internet-only start-ups were less profitable than branching peers. However, the Internet-only banks grew faster and offered more competitive prices on loans and deposits. At the same time, they had problems controlling overhead expenses. In contrast, Delgado et al. (2007), who analyse a sample of European, newly established, primarily Internet banks and newly chartered traditional (clicks and mortar) banks of similar age and size, establish that Internet banks showed strong evidence of scale economies in terms of ROA and ROE. The primary source of technology-based scale effects was the Internet banks' ability to control operational expenses more efficiently than new traditional banks.

The existence of the positive impact of Internet adoption, as an additional distribution channel, on banks' performance along with the evidence of the significant, however unstable in direction, relationship between the adoption of an Internet-only business model and banks' profitability suggest that I&SMP should matter for SLBs. However, we have to consider that the reviewed empirical evidence concerned the groups of banks that adopted online services relatively early, whereas our study concentrates on SLBs that lagged significantly behind large commercial banks in terms of new technologies use. Therefore, we conjecture that positive effects are much more difficult to realize for SLBs in Poland, even within the relatively unsophisticated Polish banking system, which is characterized by a relatively modest degree of Internet banking diffusion (Takeddine & Sun, 2015). This reasoning leads us to H1, foreseeing that reaching new customers or defending market shares through I&SMP in the case of SLBs requires some sacrifice in terms of market power.

H1: The I&SMP is negatively related to SLBs' market power

The literature pertaining to the causes of Internet adoption as a distribution channel or a business model also indicates that competitive considerations may play an important role in banks' decision-making processes. Hernández-Murillo et al. (2010) study the determinants of US banks to adopt a transactional Website from 2003 to 2006. They find that the adoption of online banking occurred faster in markets where rivals had already adopted it. In an earlier paper, Courchane et al. (2002) explain the likelihood of entry into online banking services for a sample of US commercial banks from the Tenth

Federal Reserve District observed at the end of 1999. They report that the probability of bank investment in Internet banking is positively influenced by a bank's market share and demographic market characteristics that increase demand for Internet banking services.

Two pieces of previous empirical evidence for the Polish market suggest also that I&SMP may constitute the SLBs' response to competitive pressure. Miklaszewska and Kil (2013) notice that the recent crisis stimulated changes in business models of Polish SLBs, including their distribution channels. Those modifications were related to new competitive threats from commercial banks and the so-called credit unions. Moreover, Balina, Kowalski, Różyński, and Malesa (2014) conclude that SLBs in Poland perceive the introduction of new software services, the adoption of new distribution networks and the improvement of commercial safety as a chance for market expansion.

The role of competition-related factors, and particularly the role of forced imitation (Hernández-Murillo et al., 2010) in decisions related to I&SMP suggests that the negative impact on market power should be stronger when SLBs operate within already saturated local markets, that is, markets with numerous competitors. H2 expresses this expectation.

H2: The negative relationship between I&SMP and SLBs' market power is stronger when SLBs compete locally with numerous credit institutions

SLBs usually excel at small business lending (Berger & Udell, 1995; Canales & Nanda, 2012; Hasan et al., 2017; Petersen & Rajan, 1994) because their flat organizational structure facilitates both production and transmission of soft information (Boot, 2000; Stein, 2002). However, as Berger, Goulding, and Rice (2014) note, the changes in lending technologies (credit scoring, lending against fixed assets collateral) made it much easier for large banks to serve local, opaque firms. Therefore, when SLBs compete locally mainly with large commercial banks, their decisions regarding I&SMP may be driven by the competitive threats coming from much more powerful credit institutions. In this context, the negative impact of I&SMP on SLBs' market power should be more pronounced. H3 represents this prediction.

H3: The negative relationship between I&SMP and SLBs' market power is more pronounced when SLBs compete locally with numerous large commercial banks

Finally, we expect that early adopters of Internet banking and social media among SLBs have to sacrifice less market power than late adopters for two reasons. First, Onay and Ozsoz (2013) show the Internet banking adoption tends to increase competition. Therefore, late adopters enter the Internet and social media world in a more difficult context than early adopters. Second, Hernando and Nieto (2007) notice that the positive effects of Internet use by banks takes time to appear. As a result, early adopters among SLBs possess more time to realize potential gains from I&SMP. Consequently, H4 takes the following form.

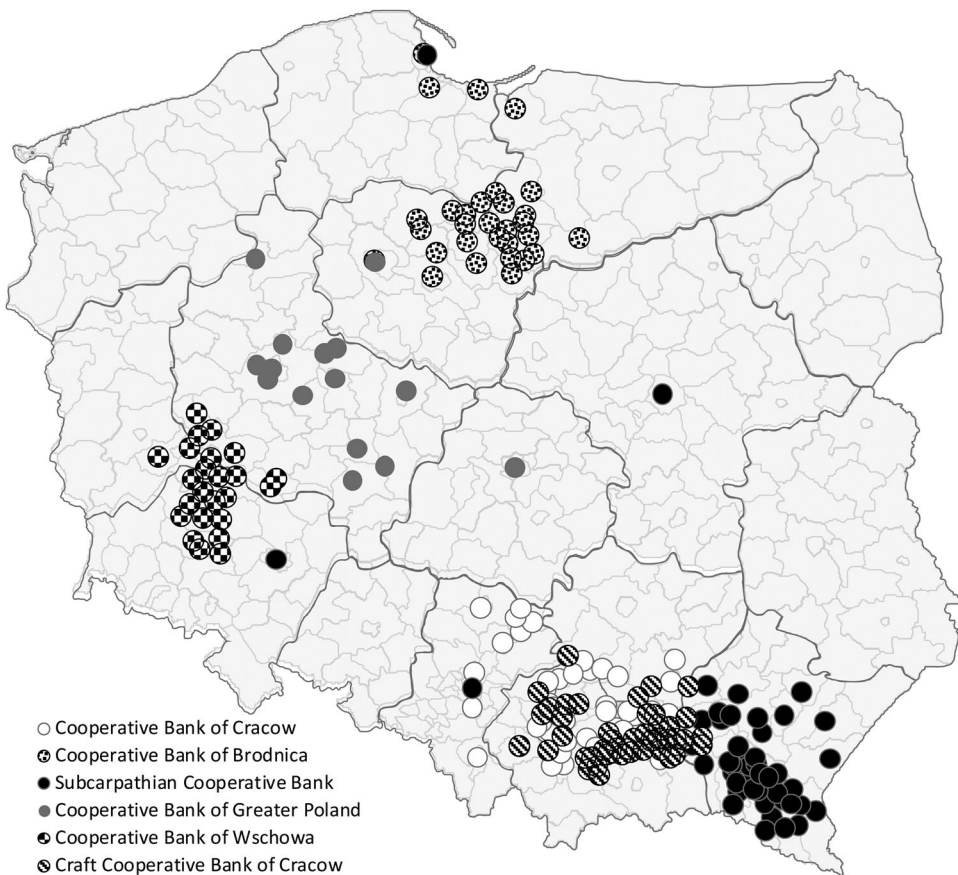
H4: The negative relationship between I&SMP and SLBs' market power is weaker for early adopters among SLBs than for other SLBs

### 3. Institutional framework, data sources and empirical strategy

Before we proceed to the detailed presentation of our empirical strategy, we describe the institutional background of the Polish banking system and the data sources.

### 3.1. Institutional background

Our analyses concentrate on SLBs organized as cooperatives. Cooperative banks constitute a significant part of the Polish banking system due to their high number. In 2013, there were 571 such institutions compared to a few tens of commercial banks. Taken together, all of the cooperative banks controlled 7% of the banking sector's total assets and held 60% of loan receivables from farmers, 30% deposits from local government authorities, and 11% loan receivables from SMEs (NBP, 2015; PFSA, 2015). Although cooperative banks are domiciled in all areas of Poland, traditionally, they are concentrated and play the most important role in small local markets, often in rural areas, where they take advantage of good knowledge of their customers, local economic and social conditions, and close relationships among members of local communities. It should be noted that an average cooperative bank in Poland operates through eight branches located in 2 or 3 counties, that is, in less than 1% of all of the counties in Poland. The local character of individual cooperative banks is additionally reflected in the small dispersion of their branches, which is visible even in the case of cooperative banks with the highest number of branches (Figure 1). Moreover, in case of half of Polish cooperative banks, the median distance between any pair of its own branches does not exceed 14 km. In comparison, for



**Figure 1.** Branch dispersion for the six cooperative banks (SLBs) with the highest number of branches.

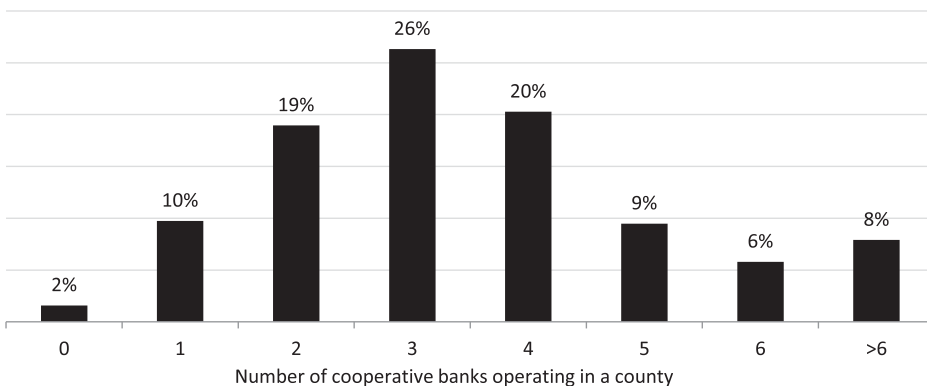


commercial banks and credit unions, this distance is approximately 263 and 70 km, respectively (Kozłowski, 2015). The above-mentioned traits of cooperative banks make them true SLBs. As a consequence, their performance is affected by local economic conditions (Skała, 2015).

There are two cooperative bank associations in Poland (BPS and SGB) and one unassociated bank. In 2013, the larger association, BPS, was composed of 364 banks. Nevertheless, the association's role was quite limited during the sample period. From a theoretical and financial perspective, associated banks are separate business entities because they do not consolidate financial statements, nor are they impaired by the financial difficulties of other institutions from the same association. Associated banks are authorized to issue their own bonds and can be independently pressured by their creditors towards bankruptcy in the event of insolvency. Additionally, individual cooperative banks from the same association compete against each other because their areas of operation often overlap. Three or more of Poland's cooperative banks compete against each other in as many as 70% of Poland's counties (Figure 2). The association's limited role is also reflected in the position of an affiliating commercial bank, which is the association's head. The role of the affiliating commercial bank is generally restricted to clearing activities, and it reports to Polish regulatory authorities in the name of associated banks and supports the associated banks in offering their clients products that are more complex. In summary, the independence of individual cooperative banks – unlike the situation observed in many other European countries – allows us to treat them as separate business entities.

### 3.2. Indexes of I&SMP

To describe the I&SMP of Polish SLBs, we hand-collected data from SLBs' Websites, Facebook profiles and Twitter accounts. The I&SMP survey was conducted in 2013 and the first half of 2014. The static character of our dataset on I&SMP limits, to a certain degree, the inferences that we can responsibly draw. However, we have attempted to add the time dimension to our dataset on I&SMP by checking the length of time that a bank has used the Internet and social media. We completed a questionnaire and verified, inter



**Figure 2.** Distribution of counties with respect to the number of cooperative banks (SLBs) operating within their area.

alia, whether each analysed bank had its own Website, Facebook, and Twitter profile, provided online banking services, and presented financial statements or full product offers on its Website. While gathering the data, we also attempted to describe an SLB's experience with regard to I&SMP. Therefore, we measured the length of time during which a Facebook profile was used and attempted to verify how much time had passed since the first piece of information was entered onto the bank's Website. We found that only a few SLBs had used Twitter. Therefore, we omitted Twitter activity from our analysis of I&SMP consequences for market power. Appendix A provides details about the scope of the information collected during the survey. It should be noted that we restricted the survey to 364 banks for which we have financial statements (see Section 3.3) because from our perspective, it would be useless to study I&SMP information without financial data.

Based on our survey, we calculated seven I&SMP indexes. All of those indexes are constructed in such a manner that their higher values correspond to the greater I&SMP of SLBs. The first index, *IDX.PRES*, summarizes information about the existence of a bank's Website and Facebook profile and the availability of Internet banking through the Website. The second index, *IDX.EXPER*, approximates the number of years that a bank possessed a Website and Facebook profile. The third index, *IDX.FIN*, describes the extent to which a bank's Website information on the bank's fundamentals is comprehensive. The fourth index, *IDX.PROD*, reflects the availability of information about a bank's products and branches through its Website. The fifth index, *IDX.ALL.INF*, is designed to capture the extent of all types of information available through a bank's Website. This index is calculated based on the *IDX.FIN* and *IDX.PROD* indexes. Additionally, it accounts for whether the Website reveals information about bank managers. The sixth index, *IDX.FCBK*, presents the activity and potential significance of a bank's Facebook profile. It should be noted that Facebook presence in terms of incurred costs is by far less consequential than adopting Internet distribution channels. However, it may serve as an effective means of communication. The seventh index, *IDX.GEN*, combines the information contained in the previous six indexes and portrays SLBs' overall presence on the Internet and in social media. Panel A of [Table 1](#) presents definitions of all of the indexes, and Panel A of [Table 2](#) provides details about their distribution in our sample. For example, the index *IDX.EXPER* measuring the banks' experience in employing Internet and social media in years varies between zero and 11 years. The most comprehensive index – *IDX.GEN* has its mean and median values close to 2.5 with relatively high standard deviation equal to 1.15. Therefore, our sample of SLBs is heterogeneous according to their historical and current I&SMP.

### **3.3. Other data sources**

We used three data sources in addition to the I&SMP dataset. First, we gathered the financial statements of cooperative banks from the BPS association, which is by far the larger of Poland's two associations.<sup>1</sup> The dataset covers the 2007–2013 period and 364 banks, which constitute approximately two-thirds of all cooperative banks in Poland. Second, we obtained a unique dataset of detailed addresses for all of the bank branches (commercial and cooperative banks, including both associations) and credit unions in Poland from Inteliace Research, an independent consulting company. We geo-coded all of the locations using information from Google Maps. This allowed us to calculate distances between any pair of branches. To reflect local market structures experienced by each branch, we

**Table 1.** Definitions of variables.

Variable	Definition
<b>A. I&amp;SMP variables</b>	
IDX.PRES	An index summarizing information about the existence of a bank's Website and Facebook profile and the availability of Internet banking through the Website. This variable equals $A+B+C$ , where $A$ , $B$ , and $C$ denote banks that (a) have a Website, (b) adopted an Internet banking system, and (c) have a Facebook profile.
IDX.EXPER	An index approximating the number of years during which a bank possessed its Website and Facebook profile. It is calculated as $A+B$ , where $A$ is the number of years from the first entry on the bank's Website ( $A=0$ for banks without a Website), and $B$ is the number of years since the bank's Facebook profile was created ( $B=0$ for banks without a Facebook profile).
IDX.FIN	An index describing the extent to which a bank's Website information regarding its fundamentals is comprehensive. This index equals $A+B+C$ , where $A$ identifies banks with financial statements on their Websites, $B$ denotes banks with up-to-date financial statements on their Websites (i.e. information for the preceding year), and $C$ equals 0 for banks without financial statements on their Websites, 0.5 for banks with information for 1 year only and 1 for banks with information for at least two years.
IDX.PROD	An index reflecting the availability of information about a bank's products and branches through its Website. This index equals $A+B+C$ , where $A$ denotes banks with information on credit offers, $B$ denotes banks with information on deposit offers, and $C$ denotes banks that list the addresses of all of their branches on the Website.
IDX.ALL.INFO	An index capturing the extent of all types of information available through the Website. This index equals $IDX.FIN+IDX.PROD+C$ , where $C$ denotes banks that present any information about their managers on their Websites.
IDX.FCBK	An index presenting the activity and potential significance of a bank's Facebook profile. It equals $A+B+C+D+E$ , where $A$ denotes banks with their own Facebook profiles; $B$ equals the number of a bank's Facebook 'likes' divided by the maximum number of 'likes' observed for any bank in the sample; $C$ equals the number of years that a bank has been present on Facebook divided by the maximum number of years that any bank in the sample has been present on Facebook; $D$ equals the number of photo albums on the bank's Facebook profile divided by the maximum number of photo albums on any Facebook profile of a bank from the sample; and $E$ equals 2 for banks that updated their Facebook profile at least once every few days, 1 for banks that updated their Facebook profile at least once every few weeks, and 0 for other banks.
IDX.GEN	An index describing a bank's overall I&SMP. This index equals the sum of all previously mentioned indexes, whereas each index is normalized before entering $IDX.GEN$ . The normalization is performed by dividing each index value by a maximum value of a given index observed in the sample.
<b>B. Bank-level variables</b>	
NON.INT	Ratio of non-interest income to interest and non-interest income
EQUITY	Ratio of equity to total assets
INEFF	Ratio of overhead to interest and non-interest income
LNA	Natural logarithm assets (in constant prices)
RISK.COST	Ratio of yearly net loan loss provisions and average loans
<b>C. Local environment</b>	
NUMB.BRANCH <sup>a</sup>	Number of other credit institutions' branches within a radius of 2.5 km
NUMB.BRANCH.COOP <sup>a</sup>	Number of other cooperative banks' branches within a radius of 2.5 km
NUMB.BRANCH.OTH <sup>a</sup>	Number of commercial banks and credit unions' branches within a radius of 2.5 km
OUTLET.DENS <sup>b</sup>	Number of branches of credit institutions in a county divided by county's population in thousands
SALARY <sup>b</sup>	Ratio of average salary in a county to the Poland's average
UNEMPL <sup>b</sup>	Unemployment rate in a county
HIGH.NUMB.BRANCH	A binary variable that equals 1 for bank-year observations for which NUMB.BRANCH is above its median, and 0 otherwise
HIGH.NUMB.BRANCH.COOP	A binary variable that equals 1 for bank-year observations for which NUMB.BRANCH.COOP is above its median, and 0 otherwise
HIGH.NUMB.BRANCH.OTH	A binary variable that equals 1 for bank-year observations for which NUMB.BRANCH.OTH is above its median, and 0 otherwise

<sup>a</sup>Medians of values calculated for a bank's branches.

<sup>b</sup>Values were averaged over counties in which a bank operates with a number of a bank's branches in individual counties used as weights.

**Table 2.** Descriptive statistics of the sample.

Variable	Observations	Mean	Std. dev.	1st quartile	Median	3rd quartile	Min	Max
<i>A. I&amp;SMP variables</i>								
IDX.PRES	2548	1.8984	0.6979	2.0000	2.0000	2.0000	0.0000	3.0000
IDX.EXPER	2548	3.1703	2.4066	1.0000	3.0000	5.0000	0.0000	11.0000
IDX.FIN	2548	0.4904	0.9053	0.0000	0.0000	1.0000	0.0000	3.0000
IDX.PROD	2548	2.2912	1.1061	1.0000	3.0000	3.0000	0.0000	3.0000
IDX.ALL.INF	2548	3.5728	1.8685	2.0000	4.0000	4.0000	0.0000	7.0000
IDX.FCBK	2548	0.3993	1.1881	0.0000	0.0000	0.0000	0.0000	6.2000
IDX.GEN	2548	2.4230	1.1452	1.8528	2.5108	3.0494	0.0000	5.5462
<i>B. Bank-level variables</i>								
NON.INT	2502	0.2154	0.0630	0.1718	0.2066	0.2504	-0.0001	0.5615
EQUITY	2502	0.1347	0.0504	0.0981	0.1243	0.1574	0.0085	0.4147
INEFF	2502	0.4784	0.0892	0.4172	0.4783	0.5380	0.2070	0.9869
LNA	2502	18.0101	0.8430	17.3978	17.9374	18.5043	15.9024	21.6232
RISK.COST	2062	0.0022	0.0058	-0.0001	0.0006	0.0028	-0.0098	0.0829
<i>C. Local environment</i>								
NUMB.BRANCH	2547	5.4118	10.3188	0.0000	1.0000	6.0000	0.0000	118.0000
NUMB.BRANCH.COOP	2547	0.4151	1.0387	0.0000	0.0000	0.5000	0.0000	12.0000
NUMB.BRANCH.OTH	2547	4.8967	9.5460	0.0000	1.0000	5.5000	0.0000	109.0000
OUTLET.DENS	2547	18.5973	21.5233	7.0000	12.5000	22.3333	0.3750	231.8000
SALARY	2183	0.8350	0.0877	0.7780	0.8160	0.8705	0.6570	1.2441
UNEMPL	2183	0.1427	0.0459	0.1075	0.1385	0.1730	0.0450	0.3240

counted competitors' branches within a circle around each branch. Following Kozłowski (2015), we decided to look for competitors within a 2.5 km radius because this area equals 19.6 km<sup>2</sup> and corresponds to an area of a small city with a population of approximately 30,000–40,000. To reflect a bank-level instead of a branch-level market structure, we calculated each bank's median based on the number of its individual branches' competitors. Additionally, we differentiated between branches of competing cooperative banks and other credit institutions (commercial banks and credit unions). Third, we retrieved county-specific economic information from the records of the Polish Central Statistical Office. We used that dataset to characterize a cooperative bank's area of operation. More precisely, for each bank, we calculated the weighted average values of the county-specific measures with weights constituted by the number of the bank's branches in individual counties. Panels B and C of Table 1 present definitions of all of the variables constructed using all of the three datasets described in this sub-section, whereas Table 2 provides the descriptive statistics for those variables. The correlation matrix of the regressors is available upon request from the authors. It should be noted that, in contrast to static indexes presented in Section 3.2, all bank-specific and county-specific variables form a panel.

### 3.4. Estimation of the Lerner index

The Lerner index is a traditional, widely recognized measure of a company's market power.<sup>2</sup> The index captures the disparity between price and marginal costs expressed as a percentage of price (Berger, Klapper, & Turk-Ariss, 2009), and we calculate it for each bank  $i$  in year  $t$  as follows:

$$\text{Lerner}_{it} = \frac{(P_{it} - MC_{it})}{P_{it}}, \quad (1)$$

where  $P$  is the price of bank output, for which the ratio of total revenue (interest and non-interest income) to total assets serves as a proxy, and  $MC$  is the marginal cost. Following the literature, total assets account for the bank's aggregate product (e.g. Angelini & Cetorelli, 2003; Efthyvoulou & Yildirim, 2014; Hryckiewicz & Kozłowski, 2015; Turk Ariss, 2010).  $MC$  is derived from a translog cost function:

$$\begin{aligned} \ln \frac{TC_{it}}{W_{3,it}} &= \alpha_0 + \sum_{j=1}^2 \alpha_j \ln \frac{W_{j,it}}{W_{3,it}} \\ &+ \frac{1}{2} \sum_{j=1}^2 \sum_{k=1}^2 \alpha_{jk} \ln \frac{W_{j,it}}{W_{3,it}} \ln \frac{W_{k,it}}{W_{3,it}} \\ &+ \alpha_q \ln Q_{it} + \frac{1}{2} \alpha_{qq} (\ln Q_{it})^2 \\ &+ \sum_{j=1}^2 \alpha_{jq} \ln \frac{W_{j,it}}{W_{3,it}} \ln Q_{it} + \alpha_z Z + \frac{1}{2} \alpha_{zz} Z^2 \\ &+ \sum_{j=1}^2 \alpha_{jz} \ln \frac{W_{j,it}}{W_{3,it}} Z + \alpha_{qz} \ln Q_{it} Z + \varepsilon_{it}, \end{aligned} \quad (2)$$

where TC is a bank's total cost; Q proxies bank output through total assets;  $W_1$ ,  $W_2$  and  $W_3$  represent the input prices of funds, capital, and labour, respectively, calculated as the ratios of interest expenses to total deposits, other operating and administrative expenses to total assets, and personnel expenses to total assets, respectively. Z describes the level of technology and is introduced as an annual index of time. Finally,  $\varepsilon$  is an error term. Following Poghosyan and Poghosyan (2010), Efthyvoulou and Yildirim (2014) and Hryckiewicz and Kozłowski (2015), total costs and all terms involving the input prices are deflated by  $W_3$  to automatically satisfy the restriction of linear homogeneity for input prices.

We estimate the coefficients of the translog function from Equation (2) using a random-effects GLS procedure. We use robust standard errors clustered by bank to capture the specificities of each institution in the sample. Finally, the marginal cost for bank  $i$  in year  $t$  is computed as follows:

$$MC_{it} = \frac{TC_{it}}{Q_{it}} \left( \alpha_q + \alpha_{qq} \ln Q_{it} + \sum_{j=1}^2 \alpha_{jq} \ln \frac{W_{j,it}}{W_{3,it}} + \alpha_{qz} Z \right). \tag{3}$$

It is noteworthy that the Lerner index obtained should generally vary between zero (a perfectly competitive bank) and one (a purely monopolistic bank); thus, a higher value of the Lerner index denotes greater market power. Nevertheless, it is also noteworthy that values below zero are theoretically possible. This suggests that the bank's marginal cost exceeds price and as a result, the bank is experiencing losses (Efthyvoulou & Yildirim, 2014; Hryckiewicz & Kozłowski, 2015). Panel A of Table 3 presents the distribution of the estimated Lerner indexes in individual years and in the entire sample. The mean value over the entire sample period of SLBs' Lerner index amounts to 0.21 with a standard deviation 0.08. Panel B in Table 3 tests for differences in market power between SLBs that relatively early and lately embraced online banking and new communications means. As we see, simple univariate tests fail to reject the null hypothesis about the equal means or medians.

**Table 3.** Lerner index for SLBs.

Year	Observations	Mean	Std. dev.	1st quartile	Median	3rd quartile	Min	Max
Panel A. Lerner index over years								
2007	332	0.2340	0.0764	0.1856	0.2276	0.2738	0.0624	0.5829
2008	351	0.2479	0.0753	0.2003	0.2479	0.2914	0.0546	0.4693
2009	361	0.1977	0.0748	0.1502	0.1874	0.2410	0.0063	0.4539
2010	364	0.2073	0.0746	0.1547	0.1988	0.2512	-0.1269	0.4652
2011	364	0.2170	0.0676	0.1721	0.2162	0.2606	0.0093	0.4273
2012	364	0.2118	0.0706	0.1656	0.2091	0.2556	-0.0373	0.4317
2013	364	0.1795	0.0764	0.1320	0.1817	0.2278	-0.2501	0.4885
Total	2500	0.2132	0.0765	0.1621	0.2098	0.2591	-0.2501	0.5829
Panel B. Lerner index for early vs. late adopters of I&SM. Parametric test for difference in means, and non-parametric Mann-Whitney U-test.								
	Observations	Means	t-statistic	p	Medians	Z-statistic	p	
Late adopters	1550	0.2135	0.3112	0.7556	0.2094	0.4218	0.6732	
Early adopters	950	0.2126			0.2104			

Note: We define early adopters as banks with IDX.EXPER above its median, and late adopters as banks with IDX.EXPER below or equal to its median.

### 3.5. Econometric approach

To verify our hypotheses, we estimated static panel regression models. We regressed the cooperative banks' Lerner indexes against different sets of explanatory variables and their interaction terms. A general construction of the models explaining a bank's  $i$  Lerner index in year  $t$  is given by Equation (4):

$$\text{LERNER}_{it} = f \left( \begin{array}{l} \text{BANK\_CTRL}_{it-1}; \text{BRANCHES}_{it}; \text{ENV\_CTRL}_{it-1}; \text{ISMP}_{it}; \\ \text{BRANCHES}_{it} \times \text{ISMP}_{it}; \text{YEAR}_t \end{array} \right), \quad (4)$$

where BANK\_CTRL is a set of control variables describing a bank's financial profile, BRANCHES – a set of variables providing information about competitors branches in the vicinity of a given SLB, ENV\_CTRL – a set of variables that provides insight into other characteristics of a bank's operation area, ISMP – a set of indexes describing different aspects of a bank's I&SMP, and YEAR is composed of a set of year dummies. We estimate Equation (4) with a GLS random-effects procedure. A fixed-effect technique is inapplicable because of the inclusion of constant-over-time ISMP variables.

As in the literature on Internet banking adoption (DeYoung, 2005; DeYoung et al., 2007; Hernández-Murillo et al., 2010), we use two groups of control variables. The first group – BANK\_CTRL – encompasses bank-specific factors while the second group – ENV\_CTRL contains variables related to the economic environment in which banks operate (ENV\_CTRL).

In our choice of bank-level control variables (BANK\_CTRL), we follow the standard set by two strands of literature. We employ variables that have been previously used, on the one hand, by the authors analysing different aspects of banking activity, including the issue of market power, particularly in Central and Eastern Europe and, on the other hand, by the authors investigating the Internet banking phenomenon. More specifically, we include in our regressions five variables reflecting a bank's financial profile. First, the variable EQUITY illustrates the capital base of sample banks (Allen, Jackowicz, Kowalewski, & Kozłowski, 2017; de Haas & van Lelyveld, 2006; DeYoung, 2007; Fang, Hasan, & Marton, 2014; Hasan, Jackowicz, Kowalewski, & Kozłowski, 2013). Second, the variable RISK.COST shows the costs of the credit risk materialization (DeYoung, 2005; Fang et al., 2014; Hernández-Murillo et al., 2010). Third, the variable LNA controls for differences in banks' sizes (Allen et al., 2017; de Haas & van Lelyveld, 2006; DeYoung, 2007; Fang et al., 2014; Fernández de Guevara & Maudos, 2007; Hasan et al., 2013; Hernández-Murillo et al., 2010). Fourth, the variable NON.INT reflects the role of non-interest income in income creation and the dominant component of a bank activity (DeYoung, 2005; Hasan et al., 2013). Fifth, the variable INEFF depicts the percentage of operating income used to cover overhead costs (Fries & Taci, 2005; Hasan et al., 2013; Hernando & Nieto, 2007; Turk Ariss, 2010).

The group ENV\_CTRL comprises four variables. SALARY and UNEMPL control for the level of wages and for the situation on the labour market, respectively, in the counties in which a bank operates, whereas OUTLET.DENS and BRANCHES describe local banking market traits. Therefore, our approach is similar to those applied in the seminal works on online banking by DeYoung (2005) and DeYoung et al. (2007) but also in the papers regarding local banking markets and small business finance (Berger, Bouwman, & Kim, 2017; Hasan et al., 2017) and works on entry into online banking (Courchane et al., 2002). Moreover, previous studies document that local economic situation plays an important role in shaping cooperative

bank performance (Skala, 2015) and that traits of local markets co-determine the customers' propensity to accept online banking in Poland (Polasik & Wisniewski, 2009).

The group of variables ISMP includes seven indexes introduced in the Section 3.2. The variables form the ISMP group and the interaction terms between variables from the groups ISMP and BRANCHES are used to test our hypotheses. Because we use numerous variants of those interaction terms, we postpone their detailed presentation to Section 4. Year dummies present in Equation (4) control for common, mainly macroeconomic factors that affect all cooperative banks.

## 4. Results

First, we will test our baseline hypothesis – H1 – stating that I&SMP is negatively related to the market power of SLBs. Table 4 presents the results of H1 verification. Unsurprisingly for the sample of SLBs, which, as a sector, embraced Internet banking and new communications means late in comparison to large, commercial banks, the empirical evidence supports H1. The more pronounced I&SMP of SLBs is accompanied by lower Lerner index values. In Table 4, the coefficients estimated for the indexes describing I&SMP are all negative and statistically significant in four of seven specifications. Therefore, the research outcomes suggest that sample banks in general had to accept the reduction in their market power in order to reach new customers or defend market shares through I&SMP.<sup>3</sup> The identified relationships are also moderately significant in economic terms. One standard deviation increase in the IND.GEN value engenders, according to the specification (8) in Table 4, the diminution in Lerner index equivalent to 3.2% of its mean value in the sample.

The findings for local market-level (ENV\_CTRL) and bank-level (BANK\_CTRL) control variables should be qualified as expected. The number of competing banks' branches within a 2.5 km radius (the variable NUMB.BRANCH) has a negative and statistically significant impact on SLBs' market power. Similarly, the density of bank branches (the variable OUTLET.DENS) in counties in which a given cooperative bank operates is negatively and significantly correlated with the dependent variable. The increasing income of clients and, consequently, their financial sophistication (the variable SALARY) also decreases SLBs' market power. The difficulties in controlling overheads (the variable INEFF) and the weak capital base (the variable EQUITY) negatively influence the Lerner index for an SLB. The evidence regarding the role of a bank size is less conclusive. The coefficients for the variable LNA are positive and significant in four specifications; however, with the exception of the specification (8), they are significant only at the 10% level. Therefore, we obtain weak evidence that larger cooperative banks possess higher market power. The results for the variables from the groups: ENV\_CTRL and BANK\_CTRL are highly stable. For this reason, in the subsequent tables, for the sake of brevity, we present only variables important from a hypothesis testing point of view. The full estimation results are available from the authors on request. Moreover, all models are characterized by very similar determination coefficients close to 50%.

In Table 5, we check whether the number of other banks' branches in the vicinity of a cooperative bank has an impact on the relationship between I&SMP and SLBs' market power. To test H2, we interact I&SMP indexes and the binary variable HIGH.NUMB.BRANCH, which takes the value of one for the local banking markets with the above the median



**Table 4.** The impact of I&SMP on SLBs' market power.

Dependent variable: I&SMP index as a regressor:	(1) LERNER –	(2) LERNER IDX.PRES	(3) LERNER IDX.EXPER	(4) LERNER IDX.FIN	(5) LERNER IDX.PROD	(6) LERNER IDX.ALL.INF	(7) LERNER IDX.FCBK	(8) LERNER IDX.GEN
INEFF	–0.393*** (0.0353)	–0.393*** (0.0353)	–0.396*** (0.0353)	–0.394*** (0.0353)	–0.391*** (0.0352)	–0.393*** (0.0352)	–0.393*** (0.0353)	–0.394*** (0.0352)
NON.INT	–0.0915 (0.0559)	–0.0840 (0.0563)	–0.0864 (0.0563)	–0.0888 (0.0564)	–0.0845 (0.0558)	–0.0817 (0.0561)	–0.0912 (0.0560)	–0.0795 (0.0565)
RISK.COST	–0.476 (0.296)	–0.470 (0.297)	–0.484* (0.294)	–0.481 (0.296)	–0.478 (0.299)	–0.486 (0.297)	–0.472 (0.296)	–0.483 (0.296)
EQUITY	0.418*** (0.0734)	0.404*** (0.0730)	0.417*** (0.0730)	0.419*** (0.0735)	0.404*** (0.0736)	0.408*** (0.0730)	0.419*** (0.0737)	0.409*** (0.0728)
LNA	0.00613 (0.00464)	0.00810* (0.00469)	0.00732 (0.00475)	0.00699 (0.00484)	0.00868* (0.00469)	0.00930* (0.00483)	0.00650 (0.00476)	0.00998** (0.00491)
OUTLET.DENS	–0.000199** (0.000100)	–0.000199** (9.99e–05)	–0.000195** (9.92e–05)	–0.000198* (0.000101)	–0.000211** (9.92e–05)	–0.000207** (0.000101)	–0.000196* (0.000101)	–0.000200** (9.95e–05)
SALARY	–0.0819*** (0.0290)	–0.0808*** (0.0289)	–0.0816*** (0.0288)	–0.0799*** (0.0291)	–0.0819*** (0.0293)	–0.0785*** (0.0293)	–0.0824*** (0.0290)	–0.0795*** (0.0290)
UNEMPL	0.0206 (0.0535)	0.0124 (0.0526)	0.0143 (0.0534)	0.0218 (0.0533)	0.0167 (0.0520)	0.0199 (0.0523)	0.0190 (0.0539)	0.0137 (0.0523)
NUMB.BRANCH	–0.000323** (0.000159)	–0.000327** (0.000160)	–0.000331** (0.000160)	–0.000319** (0.000159)	–0.000326** (0.000159)	–0.000318** (0.000159)	–0.000324** (0.000159)	–0.000325** (0.000160)
I&SMP index		–0.00789* (0.00409)	–0.00144 (0.00101)	–0.00227 (0.00275)	–0.00566** (0.00242)	–0.00342** (0.00148)	–0.000805 (0.00190)	–0.00599** (0.00253)
Constant	0.305*** (0.0986)	0.285*** (0.0989)	0.289*** (0.0998)	0.289*** (0.103)	0.273*** (0.0989)	0.257** (0.101)	0.299*** (0.100)	0.249** (0.102)
Observations	1699	1699	1699	1699	1699	1699	1699	1699
Banks	363	363	363	363	363	363	363	363
R-squared	0.474	0.478	0.476	0.474	0.479	0.479	0.474	0.480

Note: This table presents random-effects estimates. For brevity we do not report coefficients for year dummies. All of the explanatory variables except for NUMB.BRANCH and I&SMP indexes are lagged by one year. Robust standard errors are shown in parentheses. \*, \*\*, \*\*\* signify statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 5.** Impact of I&SMP on SLBs' market power conditional on number of competing bank branches.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	LERNER	LERNER	LERNER	LERNER	LERNER	LERNER	LERNER
I&SMP index as a regressor:	IDX.PRES	IDX.EXPER	IDX.FIN	IDX.PROD	IDX.ALL.INF	IDX.FCBK	IDX.GEN
NUMB.BRANCH	−0.000210 (0.000162)	−0.000254 (0.000163)	−0.000305* (0.000160)	−0.000231 (0.000160)	−0.000237 (0.000162)	−0.000327** (0.000160)	−0.000236 (0.000162)
I&SMP index	−0.00584 (0.00412)	−0.000159 (0.00119)	−0.00103 (0.00321)	−0.00426* (0.00256)	−0.00254 (0.00157)	−0.00138 (0.00188)	−0.00444* (0.00261)
I&SMP index×HIGH.NUMB.BRANCH	−0.00471** (0.00194)	−0.00202* (0.00111)	−0.00205 (0.00310)	−0.00332** (0.00153)	−0.00176* (0.000927)	0.000824 (0.00228)	−0.00288** (0.00142)
Observations	1699	1699	1699	1699	1699	1699	1699
Banks	363	363	363	363	363	363	363
R-squared	0.486	0.480	0.475	0.487	0.485	0.474	0.486

Note: This table presents random-effects estimates. For brevity we do not report coefficients for year dummies, the constant term, and all control variables except for NUMB.BRANCH (i.e. INEFF, NON.INT, RISK.COST, EQUITY, LNA, OUTLET.DENS, SALARY, and UNEMPL). All of the explanatory variables except for NUMB.BRANCH, HIGH.NUMB.BRANCH, and I&SMP indexes are lagged by one year. Robust standard errors are shown in parentheses. \*, \*\*, \*\*\* signify statistical significance at the 10%, 5%, and 1% levels, respectively.

number of competing bank branches. The results speak in favour of H2, as the negative impact of I&SMP on market power is in five of seven cases stronger when SLBs compete locally with numerous credit institutions. We are inclined to explain this regularity by the fact that the decisions of SLBs operating in saturated markets regarding their I&SMP may contain an element of forced, perhaps also late imitation.

To assess the economic significance of the results in [Table 5](#), we use Specification (7), which applies the most comprehensive index of I&SMP. An increase in the IDX.GEN by one standard deviation for the banks operating in saturated local markets leads to a decrease in the Lerner's measure equivalent roughly to almost 4% of the dependent variable average value. Again, the identified relationship should be qualified as moderately relevant in economic terms.

SLBs within their local markets are confronted with competition stemming from other cooperative banks or large commercial banks. The latter are particularly formidable opponents for two reasons. First, the large organization, thanks to technological changes, as suggested by Berger et al. (2014), acquired tools necessary to challenge the role of SLB in financing small business. Second, large credit institutions possess resources required for fast, early and successful implementation of new distribution channels while SLBs, due to limited financial means, are frequently constrained to follow more cautious strategies with regard to I&SMP. Both factors lead to the prediction expressed in H3, which is tested in [Table 6](#). In this table, we differentiate between branches of competing cooperative banks (the variable NUMB.BRANCH.COOP) and of other credit institutions (the variable NUMB.BRANCH.OTH). To verify H3, we use the interaction terms between I&SMP indexes and two binary variables (HIGH.NUMB.BRANCH.COOP and HIGH.NUMB.BRANCH.OTH), which identify SLBs outnumbered in their local markets by cooperative banks and other credit institutions, respectively.

The results contained in [Table 6](#) reveal an interesting empirical pattern. The negative relationship between I&SMP and the market power of SLBs turns out to be shaped mainly by the cooperative banks that operate in local markets populated by numerous branches of large, commercial banks. The coefficients estimated for the interaction terms between I&SMP indexes and the variable HIGH.NUMB.BRANCH.OTH are all negative and statistically significant in six of seven cases. The impact of I&SMP on the market power for such banks is also relevant in economic terms. Specification (7) in [Table 6](#) indicates that for an SLB facing strong competition from commercial banks, a one standard deviation increase in the IDX.GEN causes a reduction in the Lerner index by 5.05% of its mean in the entire sample. This effect is bigger than the analogous effects identified in [Tables 4](#) and [5](#).

Interestingly, the coefficients estimated for the interaction terms between the variable HIGH.NUMB.BRANCH.COOP and the indexes: IDX.FIN, IDX.FCBK, and IDX.GEN are positive and statistically significant. Those research outcomes suggest that the negative impact of I&SMP on SLBs' market power is attenuated (or even reversed) when cooperative banks compete locally mainly with their peers. We believe that two factors may explain this phenomenon. First, firms operating and households living in the areas dominated by SLBs are more familiar with this type of banking organizations and probably have more confidence in the viability of the cooperative banking model. As a consequence, SLBs in such areas find it easier to implement new business solutions without, for example, narrowing their intermediation margins. Second, SLBs with high values of

**Table 6.** Impact of I&SMP on banks' market power and the distinction between competition from cooperative banks and competition from other credit institutions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	LERNER	LERNER	LERNER	LERNER	LERNER	LERNER	LERNER
I&SMP index as a regressor:	IDX.PRES	IDX.EXPER	IDX.FIN	IDX.PROD	IDX.ALL.INF	IDX.FCBK	IDX.GEN
NUMB.BRANCH.COOP	0.00171 (0.00226)	0.00209 (0.00214)	0.00205 (0.00207)	0.00118 (0.00231)	0.00114 (0.00228)	0.00209 (0.00199)	0.00101 (0.00229)
NUMB.BRANCH.OTH	-0.000298 (0.000248)	-0.000383 (0.000246)	-0.000520** (0.000252)	-0.000309 (0.000250)	-0.000320 (0.000251)	-0.000493** (0.000244)	-0.000300 (0.000249)
I&SMP index	-0.00619 (0.00410)	0.000179 (0.00113)	-0.00134 (0.00309)	-0.00407 (0.00255)	-0.00232 (0.00155)	-0.00102 (0.00188)	-0.00429* (0.00257)
I&SMP index × HIGH.NUMB.BRANCH.COOP	0.00235 (0.00201)	0.000770 (0.000940)	0.00741** (0.00337)	0.00237 (0.00155)	0.00156 (0.000959)	0.00529** (0.00206)	0.00255* (0.00145)
I&SMP index × HIGH.NUMB.BRANCH.OTH	-0.00748*** (0.00211)	-0.00327*** (0.00111)	-0.00542 (0.00377)	-0.00536*** (0.00166)	-0.00310*** (0.00104)	-0.00411* (0.00236)	-0.00512*** (0.00155)
Observations	1699	1699	1699	1699	1699	1699	1699
Banks	363	363	363	363	363	363	363
R-squared	0.477	0.494	0.485	0.482	0.495	0.492	0.478

Note: This table presents random-effects estimates. For brevity we do not report coefficients for year dummies, the constant term, and all control variables except for NUMB.BRANCH.COOP and NUMB.BRANCH.OTH (i.e. INEFF, NON.INT, RISK.COST, EQUITY, LNA, OUTLET.DENS, SALARY, and UNEMPL). All of the explanatory variables except for NUMB.BRANCH.COOP, NUMB.BRANCH.OTH, HIGH.NUMB.BRANCH.COOP, HIGH.NUMB.BRANCH.OTH, and I&SMP indexes are lagged by one year. Robust standard errors are shown in parentheses. \*, \*\*, \*\*\* signify statistical significance at the 10%, 5%, and 1% levels, respectively.

IDX.FCBK and IDX.GEN, originating from local markets with a relatively strong position of cooperative banks, were in reality in their respective areas of operation early adopters of Internet banking and social media because cooperative banks as a sector lagged behind other banks in this respect. Therefore, they may have realized the benefits of pioneers entering new, uncrowded markets, as identified in the literature reviewed in Section 2. The verification of H4 will help to differentiate between those two explanations.

In Table 7, we re-estimate our regressions for the two sub-samples. We divide the sample of SLBs into late adopters (Panel A) and early adopters (Panel B) using the median value of the index IDX.EXPER. For the late adopters, operating in the local markets with numerous competitors from the outside of the cooperative sector, market power is strongly negatively related to I&SMP. All coefficients for the interaction term including I&SMP indexes and the variable HIGH.NUMB.BRANCH.OTH are negative and significant at the 1% or 5% levels. Notably, in contrast to Table 6, for late adopters, there is no proof of a positive impact of I&SMP on market power in any circumstances. The results in Panel B resemble very closely those obtained for the entire sample and are presented in Table 6. When early adopters compete locally mainly with commercial banks, the impact of I&SMP on market power is negative. However, the situation changes when an SLB is surrounded by numerous peers. Therefore, our research outcomes conditionally (upon traits of the local banking market) support H4. Moreover, the positive signs of the coefficients for the interaction terms between I&SMP and HIGH.NUMB.BRANCH.COOP in the sub-sample of early adopters privilege the second explanation of the results in Table 6 based on the benefits realized by the local pioneers with respect to online banking and new, electronic means of communication.

## 5. Robustness checks

To verify the stability of our results, we undertook several robustness checks. Those checks include the changes in the sample composition, the construction of key variables and the estimation procedures. In general, the research outcomes remain unchanged. For the sake of brevity, we refrain from presenting the detailed estimation results; however, they are available on request from the authors.

First, we exclude from the sample, banks with zero values of the most comprehensive IDX.GEN, that is, banks without any I&SMP. This modification limits the number of SLBs in the sample from 363 to 329. The results turn out to be almost identical to those discussed in Section 4. The negative impact of I&SMP is the strongest for SLBs competing with numerous other credit institutions and is somewhat attenuated for cooperative banks competing mainly against their peers.

Second, we change the definition of the variables HIGH.NUMB.BRANCH.COOP and HIGH.NUMB.BRANCH.OTH. In Section 4, those variables take the value of one for local markets with above the median number of competing cooperative and other credit institutions' branches, respectively. Alternatively, we treat local markets as saturated when the number of competing bank branches is from the upper quartile. The conclusions are not altered. The only exception to this rule constitutes the fact that the I&SMP indexes more frequently preserve their stand-alone statistical significance after the inclusion of the interaction terms used for testing H2, H3, and H4.

Third, to verify the sensitivity of findings to the choice of estimation procedure and to indirectly address the issue of potential unexplained bank-fixed effects, we calculate bank-

**Table 7.** Impact of I&SMP on banks' market power.

Dependent variable: I&SMP index as a regressor:	(1) LERNER IDX.PRES	(2) LERNER IDX.EXPER	(3) LERNER IDX.FIN	(4) LERNER IDX.PROD	(5) LERNER IDX.ALL.INF	(6) LERNER IDX.GEN
Panel A.Late adopters (IDX.EXPER below or equal to its median)						
NUMB.BRANCH.COOP	0.00208 (0.00251)	0.00211 (0.00248)	0.00177 (0.00232)	0.00158 (0.00257)	0.00148 (0.00253)	0.00154 (0.00253)
NUMB.BRANCH.OTH	-0.000515 (0.000336)	-0.000559 (0.000363)	-0.000722** (0.000325)	-0.000567* (0.000336)	-0.000567* (0.000337)	-0.000542 (0.000337)
I&SMP index	-0.00537 (0.00539)	-0.00517 (0.00332)	0.00258 (0.00394)	-0.00287 (0.00314)	-0.00136 (0.00192)	-0.00327 (0.00357)
I&SMP index × HIGH.NUMB.BRANCH.COOP	0.000150 (0.00304)	0.000927 (0.00300)	0.00529 (0.00343)	0.000677 (0.00207)	0.000650 (0.00121)	0.000907 (0.00214)
I&SMP index × HIGH.NUMB.BRANCH.OTH	-0.00828** (0.00330)	-0.00777** (0.00342)	-0.00936*** (0.00353)	-0.00554** (0.00233)	-0.00341** (0.00138)	-0.00616*** (0.00239)
Observations	1057	1057	1057	1057	1057	1057
Banks	224	224	224	224	224	224
R-squared	0.522	0.526	0.507	0.523	0.519	0.522
Panel B.Early adopters (IDX.EXPER above its median)						
Dependent variable: I&SMP index as a regressor:	(7) LERNER IDX.PRES	(8) LERNER IDX.EXPER	(9) LERNER IDX.FIN	(10) LERNER IDX.PROD	(11) LERNER IDX.ALL.INF	(12) LERNER IDX.GEN
NUMB.BRANCH.COOP	0.00161 (0.00518)	0.00464 (0.00510)	0.00341 (0.00463)	0.000106 (0.00510)	0.000294 (0.00503)	0.000261 (0.00504)
NUMB.BRANCH.OTH	8.86e-05 (0.000418)	1.51e-05 (0.000446)	-0.000241 (0.000434)	0.000139 (0.000407)	0.000106 (0.000414)	0.000159 (0.000402)
I&SMP index	-0.00823 (0.00731)	-0.000378 (0.00249)	-0.00799* (0.00468)	-0.00657 (0.00495)	-0.00454 (0.00291)	-0.00867* (0.00448)
I&SMP index × HIGH.NUMB.BRANCH.COOP	0.00410 (0.00289)	0.000155 (0.00115)	0.00934 (0.00610)	0.00448* (0.00253)	0.00278* (0.00158)	0.00385* (0.00211)
I&SMP index × HIGH.NUMB.BRANCH.OTH	-0.00712*** (0.00274)	-0.00335*** (0.00121)	-0.000134 (0.00600)	-0.00512** (0.00237)	-0.00276* (0.00156)	-0.00465** (0.00201)
Observations	642	642	642	642	642	642
Banks	139	139	139	139	139	139
R-squared	0.449	0.462	0.470	0.457	0.461	0.463

Note: Late adopters vs. early adopters among SLBs. This table presents random-effects estimates. For brevity we do not report coefficients for year dummies, the constant term, and all control variables except for NUMB.BRANCH.COOP and NUMB.BRANCH.OTH (i.e. INEFF, NON.INT, RISK.COST, EQUITY, LNA, OUTLET.DENS, SALARY, and UNEMPL). All of the explanatory variables except for NUMB.BRANCH.COOP, NUMB.BRANCH.OTH, HIGH.NUMB.BRANCH.COOP, HIGH.NUMB.BRANCH.OTH, and I&SMP indexes are lagged by one year. Robust standard errors are shown in parentheses. \*, \*\*, \*\*\* signify statistical significance at the 10%, 5% and 1% levels, respectively. We do not estimate regressions with IDX.FCBK as a regressor due to limited Facebook presence within the group of early adopters.

level averages in the analysed period for all variables and then estimate models with a standard OLS estimator applied to cross-sectional data instead of random-effects static panel models. The research outcomes prove to be robust.

## 6. Concluding remarks

In this paper, we have assessed four hypotheses regarding relationships between the I&SMP of SLBs and their market power. To verify the hypotheses, we gathered and combined four data sources: the financial statements of SLBs in Poland; hand-collected information on SLBs' I&SMP; official local economic statistics; and a unique dataset on local banking markets, including geo-locations of all of the bank branches in Poland. The research outcomes provided, at least partial, support for all the hypotheses. First, as stipulated by H1, we find that SLBs that applied, as a sector, new distribution channels and communications tools relatively late, had to forego some of their market power to open the possibilities of reaching new or retaining existing customers. Second, the scale of the necessary reduction in market power was bigger when SLBs operated within local markets with a high number of competing bank branches, as indicated in H2, and when SLBs' branches were outnumbered by commercial bank branches, as predicted in H3. Finally, SLBs that decided to embrace faster Internet banking and social media than their peers and additionally operated in areas with numerous cooperative banks were able to protect, to a certain degree, their market power. The last piece of empirical evidence thus corroborates H4.

We believe that our study conveys some managerial implications. On the one hand, it seems that with regard to new banking technologies, entities that choose the safer option of 'wait and see', which guards against reputational or operational risk, find themselves eventually in the position of late adopters and are forced to forego some of their market power in order to catch up with market leaders or defend market shares. On the other hand, from the SLBs' perspective, competition from commercial banks seems to be more dangerous than from their peers. Commercial banks, thanks to the changes in banking technologies and large resources, are able to contest traditional SLBs' fields of excellence such as small business financing. As a consequence, the growth and long-term survival of SLBs may be threatened primarily in local markets already populated by numerous commercial bank branches.

## Notes

1. Unfortunately, the second association, SGB, was unwilling to provide us with its members' financial statements.
2. Recent empirical applications of the index to the banking industry include Angelini and Cetorelli (2003), Fernández de Guevara, Maudos, and Pérez (2005), Fernández de Guevara and Maudos (2007), Jimenez, Lopez, and Saurina (2007), Fernández de Guevara and Maudos (2007), Koetter, Kolari, and Spierdijk (2008), Berger et al. (2009), Carbó, Humphrey, Maudos, and Molyneux (2009), Turk Ariss (2010), Agoraki, Delis, and Pasiouras (2011), Fang, Hasan, and Marton (2011), Maudos and Solis (2011), Lozano-Vivas and Weill (2012), Liu and Wilson (2013), Weill (2013), Efthyvoulou and Yildirim (2014), and Hryckiewicz and Kozłowski (2015) among others.
3. The additional, non-tabulated and preliminary results show that the increased I&SMP is associated with higher interest costs. Therefore, competing for new markets and clients through augmented I&SMP requires, as one may expect, favorable deposit rates.

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## Appendix A. Scope of information collected during the I&SMP survey

1. Does the bank have a Website?
2. What is the year of the earliest piece of information entered on the bank's Website?
3. Does the bank present its financial statements on its Website?
4. How many years do the bank's financial statements cover if they are presented on its Website?
5. What are the earliest and the latest year covered by the bank's financial statements if they are presented on its Website?
6. Does the bank present its credit offers on its Website?
7. Does the bank present its deposit offers on its Website?
8. Does the bank provide all of its branches' addresses on its Website?
9. Does the bank present information about its managers on its Website?
10. Does the bank provide online banking services to its clients?
11. Does the bank have a Twitter account?
12. Does the bank have a Facebook profile?
13. When did the bank create its Facebook profile?
14. How many Facebook 'likes' does the bank have?
15. How often does the bank enter new information on its Facebook profile? Does it do so at least every few days, every few weeks or less often?
16. How many Facebook photo albums does the bank have?