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Abhandlungen

The Impact of Regional Economic Conditions on the Efficiency of Savings Banks in the Light of Demographic Change

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Abstract

This paper examines the influence of environmental factors on the technical and revenue efficiency of German savings banks. It employs a two-step approach, using, first, data envelopment analysis to calculate efficiency and, second, multivariate regressions to examine the influence of regional economic conditions on efficiency. Taking into account demographic change with growing regional disparities in economic wealth and population, it differentiates between declining and growing regions and finds that regional factors explain 10–20 % of the variation in efficiency levels. Competitive pressure is the most important environmental factor affecting efficiency, consistent with the quiet life hypothesis. Higher population density and branch penetration enhance efficiency in growing regions while, in declining regions, a greater percentage of older people reduces bank efficiency. Demographic changes through population aging and migration from poor to rich regions impair the efficiency of banks in declining, peripheral regions. Our results show that the public mission of providing financial services to all regions has its costs in terms of efficiency losses. On the other hand, the regional principle of the savings banks sector guarantees competition between banking groups in most regions, which has the largest impact on efficiency.

Der Einfluss regionalökonomischer Faktoren auf die Effizienz von Sparkassen angesichts des demografischen Wandels

Zusammenfassung

Der Beitrag untersucht den Einfluss von Umfeldfaktoren auf die technische Effizienz und Ertragseffizienz deutscher Sparkassen. Mit einem zweistufigen Verfah-

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ren – Data Envelopment Analyse im ersten Schritt und multivariate Regressionsanalysen im zweiten Schritt – wird der Einfluss regionalökonomischer Faktoren auf die Effizienz untersucht. Angesichts des demografischen Wandels mit zunehmenden regionalen Disparitäten in Wohlstand und Bevölkerung wird zwischen schrumpfenden und wachsenden Regionen differenziert. Regionale Faktoren erklären 10–20 % der Effizienzunterschiede. Der wichtigste externe Einflussfaktor auf die Effizienz ist der Wettbewerbsdruck, entsprechend der „quiet life"-Hypothese. Mit zunehmender Bevölkerungs- und Filialdichte steigt die Effizienz in wachsenden Regionen, während sie in schrumpfenden Regionen mit dem Anteil älterer Menschen sinkt. Demografischer Wandel durch Bevölkerungsalterung und Migration von armen zu reicheren Regionen beeinträchtigt die Effizienz von Banken in schrumpfenden, peripheren Regionen. Der öffentliche Auftrag der Sparkassen, eine flächendeckende Versorgung mit Finanzdienstleistungen sicherzustellen, verursacht damit Kosten in Form von Effizienzverlusten. Andererseits wird durch das Regionalprinzip der Wettbewerb zwischen den Bankengruppen in den meisten Regionen sichergestellt, wovon die größte effizienzsteigernde Wirkung ausgeht.

Keywords: revenue efficiency, technical efficiency, Data Envelopment Analysis, savings banks, demographic change

JEL Classification: G21, D24, L2, R1

I. Introduction

In all countries, population and wealth are unevenly distributed across regions. In Germany, there is a gap between rich, agglomerated regions concentrated in the southwest, and underdeveloped, peripheral regions concentrated in the northeast. While population is aging in all regions because of declining fertility rates and increasing longevity, migration of young people from poor, peripheral regions to rich, agglomerated regions increases the disparities in the populations' wealth and age. "Declining regions" lose population and economic wealth and grow old relatively quickly, while "growing regions" gain population and economic wealth and get older more slowly. From 2002 to 2020, 227 out of the 439 districts and independent cities in Germany are expected to face a declining population with relatively high speed of aging (BBR (2006)).

These regional disparities and demographic changes present a huge challenge for regional financial institutions, such as savings banks. As decentralized financial institutions that are bound to the regional principle they cannot diversify regional risks or retreat from declining regions. Changes in the size and structure of the population in their local markets directly affect volume and structure of the demand for retail banking services. Therefore, we expect that regional environmental factors are important determinants of the profitability and efficiency of savings banks. In Germany, the mission of state-owned savings banks is to foster the economic development within their business area, thus contributing to the public goal of equal living standards in all regions. Therefore, understanding regional economic and demographic developments and their consequences is of particular importance for these banks. In Germany's three-pillar commercial banking system – composed of private banks, state-owned savings banks and cooperative banks – the state-owned savings banks are the second largest pillar. In September 2013, private banks accounted for 37 %, savings banks for 29 %, and cooperative banks for 13 % of total banking assets.[1] In the retail banking segment, the savings banks play a larger role. In our sample, the market share of savings banks in their regional deposit markets typically exceeds 50 %.

The performance of banks depends on both internal and external factors. Relevant internal factors affecting the performance of German savings banks are customer orientation, organisation, management, personal, controlling, corporate culture and image. Possible external factors are those that determine the intensity of competition, demand potential and attractiveness of the region (*Riekeberg* (2003), pp. 180, 188). While external economic conditions have been found to be relevant for the business volume, profitability and branch penetration of German savings banks (*Berlemann* et al. (2010)/*Conrad* (2010)/*Conrad* et al. (2009b)/*Gärtner* (2009)), these factors' influence on bank efficiency scores, measured by the deviation of a single bank from a common benchmark remains largely unexplored. Benchmarking the performance of banks is important, for example when monitoring the soundness and stability of financial systems. In the case of public savings banks, knowledge about the effects of regional factors on deviations from a common frontier helps to understand possible costs of the regional principle, which bounds banks also to unattractive regions.

Banks may deviate from the benchmark of optimal performance for three reasons: (1) random noise; (2) heterogeneity of institutions, e.g. with respect to size, business models, and regional conditions; (3) managerial inefficiency, e.g. due to suboptimal input demand at prevailing

[1] Own calculations based on Deutsche Bundesbank (2013). The savings banks pillar is comprised of 423 municipal savings banks and 9 Landesbanken; the private bank pillar is comprised of four big banks (Deutsche Bank AG, Dresdner Bank AG, Hypovereinsbank AG, Commerzbank AG), branches of foreign banks, regional and other banks; and the cooperative bank pillar is comprised of 1104 local cooperative banks and two central institutions. The remaining banks are special commercial banks.

factor prices. To improve our interpretation of the measured inefficiency scores, we should try to disentangle these three factors (*Bos* et al. (2005)). The failure to account for heterogeneity may explain the instability of efficiency results across studies (*Mester* (1997)/*Berger* and *Mester* (1997)). For German cooperative and savings banks for the period 1993–2003, *Bos* et al. (2005) find that sample firm heterogeneity influences the position of the frontier and deviations from it and that estimations improve considerably after accounting for differences across banking groups, size classes and regions. Recent international literature on the efficiency of financial institutions has focused on the role of environmental factors across countries or regions in explaining variations in efficiency as deviations from a common frontier. For German savings banks only the role of one such factor, income per capita, has been examined so far (*Bresler* (2007)).

The present paper contributes to the literature by using a large data set of bank internal and environmental factors to examine the impact of regional economic conditions on the efficiency of savings banks as the largest banking group in Germany. Focusing on German savings banks is interesting for two reasons: First, they serve as a laboratory for variations in regional market conditions under constant legal, regulatory and macro conditions and a common business model. As state-owned regional banks with a public mission they are subject to the regional principle, which bounds each bank to a small district. Operating as decentralized, independent institutions under the umbrella of the German Savings Banks Association, they may differ in soft internal factors such as managerial quality, personal, image, customer orientation, but have a high degree of standardization and harmonization in business model, risk management models, information technology and business processes. Focusing on retail customers in local markets, their common business model is relationship banking based on private information gained through personal contact between loan officer and customer or geographical proximity. Therefore, we assume that their efficiency can best be measured by deviations from a common frontier. Secondly, German savings banks are interesting in their own right because of their public mission. Since their primary goal is not profit maximization, they may not strive for profit or cost efficiency, but for revenues to fulfill their public mandate or for technical efficiency to compete with other banking groups. Therefore, we do not measure profit and cost efficiency, but revenue efficiency (following *Bresler* (2007)) and technical efficiency. Revenue efficiency indicates whether a bank maximizes revenue at given input quantities and output prices, while technical efficiency measures whether a firm maximizes output with a given level of inputs or produces a given output with a minimum of inputs. The conclusions to be drawn from this analysis can be extrapolated to regional, non profit-maximizing banks.

The paper is innovative by connecting efficiency with the regional principle and demographic change. It goes beyond previous bank efficiency studies by including new measures of regional environmental factors, such as population age and declining versus growing regions. Employing a two-step approach with estimation of bank-individual efficiency scores by data envelopment analysis (DEA) in the first step and multivariate regression of the efficiency scores on environmental factors in the second step, we find that regional economic factors explain 10–20 % of the variation in efficiency levels and that the influence of these environmental factors differs between growing and declining regions. Our results show that the public mission of providing financial services to all regions has its costs in terms of efficiency losses. On the other hand, the regional principle of the savings banks sector guarantees competition between banking groups in most regions, which has the largest impact on efficiency.

The paper is organized in five more sections. Section 2 provides an overview of the literature and derives testable hypotheses, and Section 3 describes the methodology. The results are presented and discussed in Section 5, and Section 6 concludes.

II. Literature Review and Hypotheses

1. Influence of Environmental Factors on Bank Efficiency

The importance of the role played by environmental conditions in the performance of European banks was not analyzed before the year 2000. While the first studies compared bank efficiency across countries (*Dietsch/Lozano-Vivas* (2000), *Chaffai* et al. (2001), *Lozano-Vivas* et al. (2001), *Lozano-Vivas* et al. (2002), *Casu/Molyneux* (2003), *Hauner* (2005)), the more recent ones have investigated the determinants of bank efficiency at the regional level within countries (*Chaffai/Dietsch* (2009), *Bresler* (2007), *Bos/Kool* (2006), *Hahn* (2007), *Girardone* et al. (2004), *Wutz* (2002)).[2]

[2] The present paper focuses on industrial countries in Europe. For the first study in the U.S. see *Berger/Mester* (1997).

Table 1

Extant Evidence on the Impact of Environmental Factors on the Efficiency of European Banks at the Regional Level

Authors	Sample	Environmental factors
Chaffai/Dietsch (2009)	1.618 branches of a large French banking group	cluster analysis: 6 types of environments based on economic wealth, urbanization, commercial potential, unemployment rate, housing market
Bresler (2007)	497–580 German savings banks	income per capita of local market, bank equity capital, bank size
Bos/Kool (2006)	401 local cooperative banks in the Netherlands	bank-specific variables (e.g., number of offices), market-specific variables (e.g., market share, client base), regional macro variables (e.g., inhabitants, added value, investment, urbanization)
Hahn (2007)	More than 800 Austrian universal banks	income per capita; cluster analysis: 9 economic regions based on urbanization and economic activities
Girardone et al. (2004)	panel of nearly 50 % of the Italian banks	four major geographical regions (north-west, north-east, centre, south, islands), bank type, bank equity capital ratio, number of branches, bank size, non-performing loans
Wutz (2002)	533 German cooperative banks	inhabitants of local market, market penetration, customer structure, deposit volume per customer, market share, interest rate spread

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Efficiency measurement	Approach	Main results
profit efficiency	parametric directional distance function; intermediation bank model	Ratio of environmental inefficiency to total inefficiency is > 40 % in most regions; highest efficiency in rural regions; lowest efficiency in centers of large cities
technical efficiency	parametric approach (SFA); production bank model	Negligible (positive) impact of income per capita; positive impact of equity capital ratio; negative impact of bank size on technical efficiency
cost and profit efficiency	parametric approach (SFA), regression analysis; intermediation bank model	Explanatory power of environmental factors is 10 %; negative impact of large rural markets, added value and investment on profit efficiency; negative impact of market size and added value on cost efficiency
technical efficiency	slacks-based DEA, regression analysis; profit and intermediation bank model	Explanatory power of environmental factors is high, but only for private and cooperative banks; negative impact of rural or peripheral regions on technical efficiency; positive impact of income per capita and population density on technical efficiency
cost efficiency	parametric approach (SFA), regression analysis, intermediation bank model	Mean X-inefficiency levels are 13–15 % of total costs; significant regional disparities; bank type matters; negative impact of equity capital and number of branches, no clear impact of bank size, positive impact of non-performing loans on cost efficiency
technical efficiency	DEA, regression analysis; intermediation bank model	Explanatory power of environmental factors is 20 %; positive impact of deposit volume per customer and interest rate spread on technical efficiency

Dietsch and *Lozano-Vivas* (2000), *Chaffai* et al. (2001) and *Casu* and *Molyneux* (2003) showed that the environment played an important role in explaining differences in inter-country banking productivity. Compared to France, Italy and Spain, Germany, characterized by high population density, per capita income and access to finance, has the best environment for bank efficiency (*Chaffai* et al. (2001)). Table 1 provides an overview of previous studies on the impact of environmental factors on the efficiency of European banks at the regional level.

Chaffai and *Dietsch* (2009) examined the influence of the environment on the profit efficiency of branches of a large banking group in France, using a cluster analysis to define regions according to differences in economic wealth and socio-economic factors. Their results showed that bank branches in rural regions had the highest efficiency levels and that those in small cities with high unemployment or in centers of large cities tended to be the most inefficient. In almost all regions, the variation in efficiency could be explained by more than 40 % by environmental factors. *Bos* and *Kool* (2006) investigated the influence of banks' strategic choices, local banking market conditions, and regional macro variables on the cost and profit efficiency of cooperative local banks in the Netherlands and found that the impact of these environmental factors explained 10 % of the variation in efficiency. They found that banks in large rural markets had, on average, low profit efficiency and high cost efficiency and that location in a growth market with high value added or investments had a negative impact on efficiency, which might be explained by high competition in these regions. *Hahn* (2007) found that the environment had a large impact on bank efficiency for Austrian universal banks and that income per capita, population density and urbanization showed significant positive effects on technical efficiency. However, the effects differed between banking groups, as the efficiency of (private) savings banks was unaffected by environmental factors. *Girardone* et al. (2004) showed that the cost efficiency of Italian banks differed significantly among regions and bank type and that it was negatively related to bank equity capital and number of branches, but positively related to non-performing loans. Bank size had no clear impact on efficiency.

Wutz (2002) and *Bresler* (2007) showed that the efficiency of regional banks in Germany depends significantly on the environment. *Wutz* (2002) used a (non-parametric) DEA to measure the technical efficiency of Bavarian cooperative banks and then examined the influence of the size of the business area, market penetration, customer structure, deposit volume per customer, market share and gross interest rate spread on efficiency levels. Only deposit volume per customer and gross interest rate spread showed a significant and positive impact. A higher deposit volume per customer may indicate a better economic environment, which contributes to higher efficiency. A higher interest rate spread may indicate lower competition. Thus, cooperative banks in markets with high competitive pressure (low interest rate spread) seem to be less efficient, which may be due to higher input expenses to compete for market share. The environmental factors explained 20 % of the variation in efficiency.

Bresler (2007) used a one-step (parametric) approach to measure the efficiency of German savings banks, differentiating between location-specific factors (size and economic wealth of business area, intensity of competition, market penetration) and bank-specific external factors (equity capital and size) as possible determinants of efficiency. Since savings banks cannot increase their equity capital and size in the short run, these bank-specific factors are considered exogenous. The equity capital ratio (equity capital per assets) showed a significant positive influence, and bank size a significant negative influence on the efficiency of savings banks. Because of missing data, only one location-specific factor, economic wealth (measured by income per capita), was included in the regressions; its influence on efficiency was positive, but close to zero.

2. *Theory and Hypotheses*

Most of the bank efficiency literature remains unconnected to the modern theory of financial intermediation, which takes an informational approach to banking (*Bhattacharya/Thakor* (1993)). Commercial banks ameliorate informational asymmetries between borrowers and lenders by screening and monitoring borrowers on behalf of lenders. By issuing demandable debt they obtain an informational advantage over other lenders in granting loans to opaque borrowers. The private information gathered through screening, monitoring, checking account transactions and other services helps banks to manage and reduce credit risk and resolve non-performance problems. Banks using a relationship-based lending technology manage credit risk by gathering soft information through multiple interactions with the same customer over time or across products (*Boot* (2000)). Small, regional banks have a comparative advantage in relationship lending over large banks, as they are closer to local market customers to gather and verify soft information (*Agarwal/Hauswald*

(2010)). Soft information is difficult to quantify and transmit through the communication channels of large organizations (*Berger/Udell* (2002)), which tend to specialize on transaction lending and may reap economies of scale through risk diversification and processing of hard information.[3] Therefore, the efficiency with which a bank intermediates between lenders and borrowers depends on its size (*Hughes/Mester* (2013a)), business model and lending technology, beyond external factors such as market conditions and the legal and regulatory environment. To measure the efficiency of large banks taking risks on international capital markets, models accounting for managerial risk preferences and endogenous risk-taking should be applied (*Hughes/Mester* (2013b)). For small, regional banks that specialize on retail banking and relationship lending, it may be more appropriate to use the standard intermediation, production or value-added approach, which defines a cost function by the minimum cost of any given output vector without regard to the return risk (for a review, see *Berger* and *Humphrey* (1992)).

We expect that in the case of regional savings banks in Germany, exogenous economic conditions play a larger role than endogenous risk taking, because these institutions are bound to their own regional market and are highly homogeneous with respect to their risk management model under the umbrella of the German Savings Banks Association. Since they report their performance in great detail according to a uniform format, our sample is especially attractive and we expect to have complete data that will support our expectation that regional environmental factors have a significant influence on efficiency levels. Previous studies have shown that the business volume, profitability and branch penetration of German savings banks depend on regional variables such as economic wealth, intensity of competition, population density, population age, and location in a region with declining or growing population (*Berlemann* et al. (2010), *Conrad* (2010), *Conrad* et al. (2009b), *Gärtner* (2009)). We expect that the same variables influence savings banks' efficiency, measured by the deviation of a bank from a common frontier given by the common business model and lending technology. Regional conditions

[3] There might be no disadvantage for large banks providing credit to opaque SMEs if they use transaction lending technologies well-suited to these enterprises, such as SME credit scoring, asset-based lending, factoring, fixed-asset lending, and leasing (*Berger/Udell* (2006)). But, *Bartoli* et al. (2013) find that relationship banking technologies cannot be entirely substituted by transactional lending technologies in SME lending. In fact, relationship lending technologies produce more soft information which, in turn, lowers the probability of credit rationing.

are likely to influence bank efficiency through three main channels: (1) intensity of competition, (2) demand potential, and (3) attractiveness of the region (*Riekeberg* (2003)).

Therefore, we formulate the following hypotheses:

H1: Competition (lower market concentration or market shares) has a positive influence on bank efficiency ("quiet life" hypothesis).

We expect that higher competition increases efficiency, because competitive pressure increases the incentive to use resources efficiently or maximize profits ("market structure" or "quiet life" hypothesis; *Berger/Hannan* (1998), *Koetter/Vins* (2008)). However, previous studies find an ambiguous influence of competition on efficiency (*Dietsch/Lozano-Vivas* (2000), *Wutz* (2002)). It may be negative because higher competition induces higher expenses to attract customers or because a high market share is the result of a low-cost strategy or production technology ("efficiency-structure" hypothesis; (*Hicks* (1935)).

H2: Population density has a positive influence on bank efficiency.

We expect that banks in more densely populated regions face higher demand, which positively influences both technical and revenue efficiency by affecting capacity utilization, production cost and profit opportunities (*Dietsch/Lozano-Vivas* (2000), *Chaffai* et al. (2001), *Lozano-Vivas* et al. (2002)). With a larger number of inhabitants per bank, a bank can reap economies of scale and specialization. The costs of distributing financial services are lower in more densely populated regions than in peripheral ones because more inhabitants are reached per branch and transportation costs per customer are lower. This is particularly relevant for relationship lending provided by the savings banks, where distance matters. Higher demand is likely to increase revenues, even in highly competitive markets. On the other hand, regions with low population density may be characterized by lower competition ("quiet life"), because profit maximizing banks do not serve these regions. By controlling for both market structure/competition and population density, we are able to disentangle both effects.

H3: Economic wealth has a positive influence on bank efficiency.

In regions with higher purchasing power per capita, demand for financial services is higher, which is likely to increase both revenue and technical efficiency through larger sales volumes and a better utilization of production factors (*Chaffai* et al. (2001), *Bresler* (2007)). Higher economic wealth tends to raise profit opportunities and may help to compensate for inefficiencies caused by internal factors (*Wutz* (2002)). On the other hand, it could reduce the incentive for managers to use resources efficiently or maximize profits, exerting a negative influence on bank efficiency. Moreover, banks in rich regions may face higher demand for differentiated financial services and therefore provide less standardized services with higher inputs than banks in poorer regions.

H4: The region's percentage of older people has a negative influence on bank efficiency.

Older people tend to have less demand for standardized financial services than do younger people but more demand for costly personal advice in bank branches because they are less inclined to use cost-saving distribution channels such as online or mobile banking. Therefore, banks need a higher level of inputs to produce a given output in regions with a larger percentage of older people, which reduces technical and revenue efficiency. On the other hand, older customers are likely to be less price sensitive than younger ones, which might increase revenue efficiency.

H5: Bank efficiency is lower in declining regions than in growing regions.

Population growth influences the attractiveness of the region. Growing regions attract wealth and scarce production factors. We expect that even after controlling for the share of the elderly, demographic change measured by the growth rate of the population matters. While the share of older people measures age-specific demand conditions, the variable declining versus growing region measures the growth potential of a bank's customers. Although declining regions often experience high aging, the change of population size may not highly correlate with the share of elderly. For example, a region which attracts older people might experience growth and aging at the same time. We expect that both technical and revenue efficiency are lower for saving banks in declining regions, because these banks have to make more efforts to keep or gain customers, or loose revenues at a given level of inputs.

H6: Bank size has a positive influence on bank efficiency.

Because of the regional principle, savings banks cannot grow through geographic expansion but only by gaining market share in their local markets. As bank size is limited by the size of the business area, it may be a further relevant exogenous variable. We expect that larger banks have higher technical and revenue efficiency, because they can reap economies of scale and scope or larger revenues through a larger customer base or demand. Bank size may be also a proxy for scare production factors and demand for centralized services provided by larger or central institutions of the savings banks sector. For example, small savings banks with few employees may be less efficient because they cannot reap economies of labor specialization, but they may compensate this disadvantage by specializing on more standardized products or getting services from larger or central institutions within the savings banks network. *Bresler* (2007) found that small savings banks are more efficient than larger ones, which she explains by lower incentives of large banks to use resources efficiently because of lower risk of insolvency or takeover. Another possible explanation is that larger savings banks need more inputs to provide centralized services (e.g. R&D, representation in bodies) that are used by the whole network.

Other relevant factors discussed in the literature are equity capital, market penetration, access to financing, and the rate of financial intermediation. Equity capital might limit a bank's asset growth and is therefore correlated with size, but it is more likely to be endogenous because savings banks can strengthen their capital base by retaining a large part of net income. Bank efficiency is likely to rise with deposit penetration (*Dietsch/Lozano-Vivas* (2000), *Lozano-Vivas* et al. (2002)) and a higher financial intermediation rate, which relates to the ability of banks to transform deposits into loans (*Dietsch/Lozano-Vivas* (2000)). Less access to financing, measured by lower branch density, may have a positive influence on bank efficiency because costs of the branch network are saved (*Dietsch/Lozano-Vivas* (2000), *Lozano-Vivas* et al. (2002)). These factors will be controlled for in the following analysis as long as they are not correlated too highly with the key factors and inputs.[4]

Finally, we postulate

H7: The expected influence of environmental factors on bank efficiency applies in particular to declining regions.

The expected influence of economic variables may be more relevant for bank efficiency in declining regions because banks in these regions have to make larger efforts to keep customers and face larger pressure to fulfill the public mandate of fostering the regional economy, which reduces

[4] *Banker* and *Natarajan* (2008) showed that a high correlation between input and environmental factors causes special problems.

their technical and revenue efficiency. They may face lower competitive pressure because they have fewer competitors than banks in growing regions, but larger pressure to cope with the unattractive economic conditions of their region from which they cannot retreat.

III. Methodology

1. Efficiency Measures

Most previous studies on bank efficiency have focused on cost or technical efficiency, neglecting the fact that profit efficiency is a better measure of bank performance (*Chaffai/Dietsch* (2009)).[5] For our purposes, profit and cost efficiency may not be suitable because profit maximization and cost minimization are not the primary goals of state-owned savings banks in Germany. Instead, they strive for revenues to fulfill their public mandate.[6] Therefore, we measure revenue efficiency, which indicates whether a savings bank maximizes revenue at given input quantities and output prices (following *Bresler* (2007)). The revenue efficiency score reveals the revenue achieved relative to the maximum achievable revenue, which lies on the production frontier.

Moreover, we measure technical efficiency, which reveals whether a firm maximizes output with a given level of inputs or produces a given output with a minimum of inputs. We assume that this measure is consistent with the behavior of state-owned savings banks because they compete with private and cooperative banks for market share in their regions and, therefore, strive to maximize output with a given input.[7] A technically efficient bank is located on the production frontier (efficient frontier).

[5] For an explanation of the different efficiency measures, see *Coelli* et al. (2005).

[6] For theoretical models of the competition between profit maximizing private banks and non-profit maximizing state-owned banks, see *Hakenes* and *Schnabel* (2010) and *Neumann* et al. (2008). For empirical evidence on activities of German savings banks to fulfill their public mission, see *Conrad* et al. (2009b), *Conrad* (2010) and *Gärtner* (2009).

[7] *Bos* and *Kool* (2006) also questioned the relevance of the cost minimization and profit maximization assumption for cooperative banks in the Netherlands and investigated cost and profit efficiency because of competitive pressure and the aim of cooperative banks to provide low-cost services to their customers in practice. We also estimated cost efficiency for the savings banks in our sample, but we do not present the results because the influence of environmental factors on cost efficiency does not differ meaningfully from the influence on revenue and technical efficiency.

Scale efficiency, which may also be relevant to savings banks, is defined as the amount by which a firm's efficiency could be improved by moving to its optimal scale (e.g., *Ray* (2004), *Coelli* et al. (2005)) and is calculated by dividing technical efficiency under constant returns to scale (CRS) by technical efficiency under variable returns to scale (VRS). Previous evidence shows that German savings banks exhibit high scale efficiency, so they have minimal potential to become more efficient by changing their size (*Radomski* (2008)). Measuring scale efficiency for our sample confirms this result. Since scale efficiency varies little between regions, we do not present these results.

To examine the influence of environmental factors on technical and revenue efficiency, we proceed in two steps.

2. *First Step: Data Envelopment Analysis*

In the first step, we apply modern frontier efficiency analysis to estimate the technical and revenue efficiency of each bank. The methodology allows for the analysis of multiple input-output technologies. The performance of each firm is measured by comparing it to the efficient frontier of the industry, which is composed of the efficient firms in the reference set (e.g., all savings banks). The frontier analysis is suitable for examining scale economies and the influence of environmental factors on efficiency scores.

We estimate firm-specific efficiency using non-parametric DEA. When DEA is used, an a priori specification of the underlying production function is not needed because the efficient best practice frontier is estimated by solving linear programming models to envelope the observed data as tightly as possible (*Charnes* et al. (1978)). DEA requires only convexity of the production possibility set and disposability of the inputs and outputs, which makes DEA especially useful when dealing with service industries since knowledge about the sector's production technology is usually limited.

Radomski (2008) used the DEA approach to examine the efficiency of German savings banks and the effects of mergers between them in the period 1994–2003. By contrast, *Bresler* (2007) used a parametric approach to estimate individual bank efficiency scores and the success of mergers in the period 1996–2002, including for the first time external factors into an efficiency analysis of German savings banks. We use the non-parametric DEA approach because it seems to be more advantageous (*Radomski* (2008)), at least for the present purpose.

3. Second Step: Regression Analysis

In a second step, we estimate the influence of environmental factors on bank efficiency scores, following *Banker* and *Natarajan* (2008) and *Wutz* (2002). The DEA efficiency scores obtained in the first step are used as dependent variables in linear regression models. We include regional economic variables as independent variables.

The methodology, explained in detail by *Banker* and *Natarajan* (2008), can be shortly described as follows. We assume a production equation $y_i(x) = y^{eff}(x)\, e^{Ei}$, with $E_i = -u_i$. $y_i(x)$ describing observable output and $y^{eff}(x)$ efficient output at an input use of x. e^{Ei}, $E_i = -u_i$, describes the influence of inefficiency ($u_i > 0$, e.g. wasting) on production. If there is no wasting, i.e., $u_i = 0$, the observed output $y_i(x)$ coincides with the efficient output $y^{eff}(x)$; otherwise, $y_i(x) < y^{eff}(x)$ so that $\phi_i < 1$ with $\phi_i = y_i(x)/y^{eff}(x) = e^{Ei} = e^{-ui}$.

If firm 1 is more efficient than firm 2, $\phi_1 = y_1/y^{eff} > \phi_2 = y_2/y^{eff}$, with $E_1 > E_2$ because $u_1 < u_2$. This result may be due to higher managerial waste in firm 2. However, if the firms operate in different environments, the efficiency differential may be caused by environmental factors. To take this into account, the inefficiency term E_i has to be extended by βz_i to $E_i = -u_i + \beta z_i$, where u_i denotes managerial inefficiencies, z_i is an environmental variable and β indicates the sign and size of the influence of z_i on y_i. If, for example, purchasing power is higher in the business area of firm 1 than in that of firm 2, $z_1 > z_2$, and if at the same time $\beta > 0$ and $u_1 = u_2 = u$, we obtain $\phi_1 > \phi_2$ and $E_1 > E_2$. In this case, the efficiency gap between the firms is caused completely by the influence of the environmental variable. Thus, $\beta > 0$ indicates that regional purchasing power has a positive impact on bank efficiency, while the reverse holds if $\beta < 0$.

These relationships can be transformed into an OLS equation of the form $In(\phi_i) = \beta_0 + \sum_{i=1} \beta_i z_i + \varepsilon$, where ϕ indicates the individual efficiency scores obtained from the DEA analysis and z_i are the environmental variables.

Banker und *Natarajan* (2008) compared the performance of this two-stage approach with one-stage and two-stage parametric approaches. Using Monte Carlo simulations, they showed that the use of DEA in the first step, followed by OLS in the second step, is appropriate in evaluating the impact of contextual variables on productivity. The performance of this approach is better in the estimation of individual productivity in the first step, and the approach is the best of the parametric models in the estimation of the impact of environmental factors on productivity. OLS in the second step yields consistent estimators even if the contextual variables are correlated.

4. Data and Variables

We use bank-specific and regional data provided by the DSGV (Deutscher Sparkassen- und Giroverband) for all savings banks in the period 2001–2005. In 2005, there were 435 legally and economically independent banks, with each bank operating independently in its own region.[8] The regional (the business area of each savings bank) data are comprised of population density, number of competitors, purchasing power and employment in each year. Information about the age structure and predicted development of the population is not available for the years before 2007; however, since large changes in the age and size of the population are unlikely within two years, we include 2007 data about age structure.

Using DEA requires identifying the relevant inputs and outputs of a bank. The existing literature usually employs the intermediation, production or value-added approach (for a review, see *Berger* and *Humphrey* (1992)). According to the intermediation approach, banks are intermediaries that use labor, physical capital and deposits as inputs to produce outputs such as loans and revenues. The production approach defines deposits, loans and other financial services as outputs, which are produced by employing labor and capital as classical inputs. The value-added approach considers assets with substantial value-added – labor, capital and interest expenses – as inputs and liabilities that have substantial value-added – loans, deposits, and revenues – as outputs (*Radomski*, 2008). Although bank branch efficiency studies typically use the production approach (*Bos* and *Kool* (2006), p. 6), we employ the intermediation approach, which has been widely used in the literature and is appropriate when the banks in the sample operate as independent entities. To test the robustness of our results, we also calculate technical efficiency using the production and value added approach, although this is not possible when calculating revenue efficiency because of missing data. We do not account for return risk that may affect efficiency through mana-

[8] Mergers were accounted for by looking back. For example, if two banks merged in 2004, we aggregated the data for the two merged institutions for the years 2001, 2002 and 2003 and assigned them to the new institution in 2004.

gerial risk preferences and endogenous risk-taking (*Hughes/Mester* (2013b)) because of missing data and because these aspects are likely to be less relevant for small regional banks than environmental conditions.

Table 2

Inputs, Outputs und Prices – Technical Efficiency

	Outputs	Inputs	Prices
IA	customer loans commission earnings other ordinary earnings	customer deposits employees plant and equipment	average deposit rate personnel expenses/employees operating expenses/employees
VA	customer loans customer deposits commission earnings other ordinary earnings interest earnings	employees interest expense* plant and equipment	personnel expenses/employees price of interest expense = 1 operating expenses/employees

Notes: (IA) intermediation approach, (VA) value added approach, *interest expense = customer deposits × average deposit rate; for CRS and VRS model.

Source: based on *Radomski* (2008), p. 82.

Tables 2 and 3 provide an overview of the variables used as inputs and outputs in the first step of our analysis. Table 4 presents the measurement and descriptive statistics of the independent variables used in the second step.

Table 3

Inputs and Outputs – Revenue Efficiency

earnings *= Outputs × Output prices	commission earnings interest earnings other ordinary earnings
Inputs	employees plant and equipment customer deposits

Notes: *If information on output prices is missing, an alternative approach with price-based output information can be used (see Section 4.1.4 and *Cooper* et al. (2006), p. 255); for CRS and VRS model.

To measure population age we chose the threshold 75+ because we assume that this age group is more homogeneous in demand for financial services than more broader groups of 65+ or 60+. After reducing the threshold to 65+ and 60+, the sign of the influence did not change, but the significance levels declined. Competition is measured by the number of competitor branches per savings banks branches (following *Conrad* et al. (2009b)) to account for different strategic orientations of different banking groups regarding outreach. Following previous studies (*Wengler* (2006), *Conrad* (2010)), we measure bank size by bank assets per inhabitant. Since we assume that bank size is constrained by the regional principle, we relate it to the region's population size, which is the constraining factor. Likewise, we relate equity capital to the number of inhabitants. Since deposit density, measured by a bank's customer deposits per inhabitant, is correlated with the presence of competitors and population density, we include it in M2 without controlling for competition and population density.

We estimate the following OLS equation:

$$\phi_i^{EC} = \beta_0 + \beta_1 dens_i + \beta_2 purch_i + \beta_3 old_i + \beta_4 comp_i + \beta_5 size_i + \varepsilon_i , \tag{1}$$

(where ϕ_i^{EC} is the efficiency score of bank i for efficiency concept EC.

To investigate whether the influence of environmental factors on bank efficiency differs between declining and growing regions, we use structural break models of the form

$$\phi_i^{EC} = \beta_0 + \beta_1 dens_i + \beta_2 (dens_i \times decline) + \ldots + \varepsilon_i \tag{2}$$

The variable decline is a dummy variable that takes the value 1 if bank i is located in a declining region (a region where population is expected to decline in the period 2001–2025) and 0 otherwise. Thus, β_1 indicates the influence of population density on the efficiency of banks in growing regions, and $\beta_1 + \beta_2$ indicates the influence of population density on the efficiency of banks in declining regions.

Table 4: **Measurement and Descriptive Statistics of Independent Variables**

		Mean		Standard deviation		Minimum value		Maximum value		Number of observations	
	Measurement	*2001*	*2005*	*2001*	*2005*	*2001*	*2005*	*2001*	*2005*	*2001*	*2005*
Key variables:											
– population density (*dens*)	number of inhabitants per km^2 in the business area	420	422	548	554	40	36	3.782	4.330	426	427
– purchasing power (*purch*)	purchasing power in thousand Euro per inhabitant in the business area	16.26	17.14	2.12	2.77	11.72	12.48	26.24	51.85	434	435
– population age (*old*)*	percent of inhabitants aged 75 or older in the business area	–	0.08	–	0.01	–	0.02	–	0.30	–	427
– competition (*comp*)	number of competitor branches per savings bank branches in the business area	2.38	1.37	0.93	0.64	0.40	0.50	7.8	7.90	434	434
– bank size (*size*)	average volume of savings bank assets in thousand Euro per inhabitant of the business area	12.06	12.68	4.35	4.72	3.42	3.48	52.18	56.79	434	435
Control variables (control):											
– equity capital (*equity*)	equity capital of savings bank in thousand Euro per inhabitant of the business area	0.51	0.61	0.21	0.24	0.05	0.17	1.66	2.32	433	434
– branch penetration (*branch*)	number of savings bank branches per km^2 of the business area	0.09	0.11	0.04	0.05	0	0.02	0.27	0.28	434	435
– unemployment (*unemp*)	unemployment rate in the business area	0.07	0.06	0.06	0.05	0.004	0.004	0.42	0.35	426	427
– deposit density (*ddens*)	bank's customer deposits in thousand Euro per inhabitant of the business area	2.01	2.07	0.28	0.27	0.78	0.97	3.00	3.24	435	435

* Information about the population age in the business areas of the savings banks is missing for both years. For 2005, we use 2007 data.

IV. Results

1. First Step Results

a) Technical Efficiency

ϕ_j^{TC} is the (input-oriented) technical efficiency score of bank j, which takes a value of 1 if the bank is on the production frontier and a value between 0 and 1 if it uses too much input to produce the same output. Each bank uses K input factors with quantities x_{ki} ($k = 1, \ldots, K$) to produce M outputs with quantities y_{mi} ($m = 1, \ldots, M$). Technical efficiency is calculated by solving the following optimization problem for each individual savings bank i ($i = 1, \ldots, j, \ldots, N$):[9]

(3)
$$\underset{\lambda,\theta}{Min}\,\theta_j^{TE}$$

$$\text{s.t.} \quad \theta_j^{TE} x_{kj} \geq \sum_{i=1}^{N} \lambda_i x_{ki}$$

$$y_{mj} \leq \sum_{i=1}^{N} \lambda_i y_{mi}$$

$$\lambda_i \geq 0$$

This holds under the assumption that there is a production process with constant returns to scale (CRS). In the case of variable returns to scale (VRS), the constraint $\Sigma_{i=1}^{N} \lambda_i = 1$ has to be added.

The solutions for this problem are presented in Table 5 (see also Tables A.1–A.2 in the appendix).

In 2001, technical efficiency (VRS model) of savings banks reached an average of 77 % for the intermediation approach (IA), which declined to 74 % in 2005. Over the years 2002–2005, the efficiency scores remain stable around 74 %. The efficient frontier (VRS) given by the best practice institutes is composed of 34 banks in 2001, but only 26 banks in 2005. The results are very similar when using the value added approach (VA, see Table 5), while the efficiency scores are lower when using the production approach (PA). In 2005 (2001), technical efficiency (VRS model) reached an average of 74 % (77 %) for the IA, 75 % (78 %) for the VA and

[9] See *Coelli* et al. (2005), p. 162.

Table 5

Technical Efficiency of Savings Banks – Overview of Results

		2001 $n = 433$	2002 $n = 435$	2003 $n = 435$	2004 $n = 435$	2005 $n = 435$
IA	Ø	0.77	0.74	0.72	0.74	0.74
	σ	0.11	0.12	0.12	0.12	0.12
	Min	0.49	0.50	0.49	0.47	0.47
	1st quartile	0.68	0.65	0.62	0.64	0.64
	2nd quartile	0.76	0.73	0.70	0.72	0.72
	3rd quartile	0.84	0.83	0.80	0.82	0.81
	Eff	34	29	20	28	26
VA	Ø	0.78	0.76	0.74	0.76	0.75
	σ	0.11	0.11	0.11	0.11	0.11
	Min	0.50	0.51	0.51	0.56	0.54
	1st quartile	0.69	0.67	0.66	0.66	0.66
	2nd quartile	0.76	0.75	0.72	0.74	0.74
	3rd quartile	0.85	0.84	0.82	0.83	0.83
	Eff	36	31	24	29	27

Notes: results of VRS (variable returns to scale) model; (IA) intermediation approach, (VA) value added approach; 1st quartile = 25 % of the banks reach no higher than this efficiency score; 2nd quartile (median) = 50 % of the banks reach no higher than this efficiency score; 3rd quartile = 75 % of the banks reach no higher than this efficiency score; Ø = mean, σ = standard deviation; Min = minimum value, Eff = number of efficient ('best practice') banks.

70 % (74 %) for the PA approach.[10] This indicates that the banks could have reduced their inputs by about 25 % (IA and VA) or even 30 % (PA), on average, without reducing their outputs. State-owned savings banks in Germany appear to face difficulties in utilizing resources productively, which have increased over time. The declining trend of savings banks' technical efficiency found by *Radomski* (2008) for the period 1994–2003 thus seems to continue. Possible explanations are that these banks are increasingly engaged in activities to fulfill their public mission or that they need more inputs to produce outputs under less favorable economic conditions.[11] Some banks may employ too many inputs to produce public services, which are not accounted for as outputs in the efficiency calculations.

[10] The results of all models are presented in *Conrad* et al. (2009a).

[11] For example, the volume of sponsorship (to e.g. research, sports, social and cultural projects) increased from 285 million Euro in 2002 to 465 million Euro in 2007. Especially savings banks in rural and peripheral regions are engaged in activities to fulfil their public mission (*Schrumpf/Müller* (2001)).

We find that the number of best practice institutes is both absolutely and relatively higher in West Germany than in East Germany, but that the average efficiency scores do not differ remarkably between the regions (see Table A.3 in the appendix).[12] Banks in regions with high (above the median) population density reach higher efficiency levels than do those in regions with low population density (77 % vs. 71 % in 2005; see Table A.4 in the appendix), and banks in rich regions (with purchasing power per inhabitant above the median) reach higher technical efficiency levels than those in poorer regions (76 % vs. 73 % in 2005; see Table A.5 in the appendix). Also the number of best practice institutes is higher in agglomerated than in peripheral regions (16 vs. 9 in 2005) and higher in rich than in poor regions (17 vs. 9 in 2005). Both results are consistent with H2 and H3 and the findings of *Hahn* (2007) for Austria. In declining ($n = 235$) and growing ($n = 192$) regions, the shares of technically efficient banks and the average efficiency levels are about the same (see Table A.6 in the appendix), possibly because of high heterogeneity of both types of regions. Population declines in both agglomerated and peripheral regions and in both rich and poor regions. Thus, we do not find support for H5.

b) Revenue Efficiency

Revenue efficiency is calculated by taking output prices into account. If data about output prices are not available, price-based output measures can be used instead (Cooper *et al.*, 2006, p. 255). In this case, total revenue of bank j is given by:

$$R_j = \Sigma_{m=1}^{M} \bar{y}_{mj} = p_{mj} y_{mj},$$

where $\bar{y}_{mj}$ is price-based output, p_{mj} is the price of output m and y_{mj} is the quantity of output m produced by bank j. The optimal price-based output that maximizes revenues for a given input is determined by solving the following system of equations:

$$(4) \qquad R_j = \underset{\lambda, \bar{y}^*_m}{Max} \sum_{m=1}^{M} \bar{y}^*_{mj}$$

$$\text{s.t.} \qquad x_{kj} \geq \sum_{i=1}^{N} \lambda_i x_{ki}$$

[12] We present only the IA results, which do not differ significantly from the VA results. For all results see *Conrad* et al. (2009a).

$$\bar{y}^{*}_{mj} \leq \sum_{i=1}^{N} \lambda_i \bar{y}_{mi}$$

$$\lambda_i \geq 0$$

By dividing the output level actually used, $\bar{y}_{mj}$, by the optimal price-based output, $\bar{y}^{*}_{mj}$, we obtain the revenue efficiency score of bank *j*:

$$\theta_j^{RE} = \frac{\sum_{m=1}^{M} \bar{y}_{mj}}{\sum_{m=1}^{M} \bar{y}^{*}_{mj}} \tag{5}$$

Table 6 presents the results for 2001–2005 under the assumption of VRS and CRS for the intermediation approach (see also Table A.1 in the appendix). The average revenue efficiency (VRS) declined only slightly from 78 % in 2001 to 76 % in 2002, where it remains until 2005. The lowest revenue efficiency was 53 % in both 2001 and 2005. Thus, savings banks may increase their revenues by about 24 % on average by produc-

Table 6

Revenue Efficiency of Savings Banks – Overview of Results

		2001 n = 433	2002 n = 435	2003 n = 435	2004 n = 435	2005 n = 435
VRS	Ø	0.78	0.76	0.75	0.76	0.76
	σ	0.11	0.11	0.11	0.11	0.11
	Min	0.53	0.52	0.53	0.53	0.53
	1st quartile	0.69	0.67	0.66	0.67	0.67
	2nd quartile	0.76	0.74	0.73	0.74	0.74
	3rd quartile	0.85	0.84	0.82	0.83	0.83
	Eff	36	31	24	29	27
CRS	Ø	0.75	0.74	0.72	0.73	0.73
	σ	0.11	0.11	0.10	0.10	0.11
	Min	0.49	0.50	0.53	0.52	0.52
	1st quartile	0.67	0.66	0.64	0.65	0.65
	2nd quartile	0.74	0.72	0.70	0.71	0.71
	3rd quartile	0.82	0.81	0.79	0.80	0.79
	Eff	17	17	15	17	18

Notes: results of VRS/CRS (variable returns to scale/constant returns to scale) model; 1st quartile = 25 % of the banks reach no higher than this efficiency score ; 2nd quartile (median) = 50 % of the banks reach no higher than this efficiency score; 3rd quartile = 75 % of the banks reach no higher than this efficiency score; Ø = mean, σ = standard deviation; Min = minimum value, Eff = number of efficient ('best practice') banks.

ing higher output at given input and output prices, and the 25 % least efficient banks may increase their revenues by as much as a third. Savings banks in regions with low population density or low economic wealth show, on average, lower revenue efficiency and a larger decline in efficiency levels than those in densely populated or rich regions (see Tables A.4–A.5 in the appendix), possibly because savings banks in peripheral and poor regions may be (increasingly) focused on fulfilling their public mandate. This is consistent with H2 and H3. In contrast, revenue efficiency levels do not seem to differ between declining and growing regions (see Table A.6 in the appendix).

2. *Second Step Results*

To examine the influence of environmental factors on the efficiency scores, we employ multivariate regressions on the means for the period 2001–2005. Using average values of efficiency and environmental factors over five years helps to compensate for the influence of stochastic variations and gaps in the data set. To test the robustness of the results, we estimated first-difference equations for the years 2001 and 2005[13], as well as truncated regression models that take into account that the dependent variable is restricted to values between 0 and 1 (e.g., *Simar/Wilson* (2007)). Since the results do not differ significantly, we do not present them.

Some of the key variables and control variables described in Table 4 are highly correlated, so we estimated two models separately: M1 includes only the key variables, and M2 includes only the control variables as independent variables. In addition, the results concerning the influence of the dummy variable decline are presented only if its influence is significant. Thus, coefficients that are not related to a dummy variable indicate the influence of the respective independent variable on bank efficiency for the whole of Germany.

Tables 7 and 8 present the results concerning the influence of regional economic factors on the technical and revenue efficiency of savings banks using the intermediation approach. Since the results using the value-added approach are essentially the same, we do not report them.

[13] The first-difference estimation model wipes out time-invariant omitted variables by regressing the change in the dependent variable on the changes in the independent variables between 2001 and 2005: $(y_{2005} - y_{2001}) = (x_{2005} - x_{2001})\beta + (u_{2005} - u_{2001})$.

Table 7

Impact of Environmental Factors on Technical and Revenue Efficiency (Intermediation Approach) – Results (M1)

Independent Variable	Technical efficiency VRS $n = 2061$	Technical efficiency CRS $n = 2061$	Revenue efficiency VRS $n = 2061$	Revenue efficiency CRS $n = 2061$
Comp	***1.79	***1.81	***2.09	***1.89
dens × *decline*	***–0.0058	**–0.0046	*–0.0035	**–0.0034
Purch	*–0.56	***–0.76	**–0.64	***–0.86
purch × *decline*	***0.86	***0.59	***0.81	***0.76
Old	51.26	45.16	39.42	38.96
old × *decline*	***–135.06	**–96.07	***–141.45	***–133.92
Size	***0.75	***0.77	***0.97	***0.97
Const	***63.77	***64.87	***65.17	***66.71
R^2	0.128	0.132	0.212	0.214
F-test	***7.67	***7.98	***14.06	***14.28

Notes: coefficients are multiplied by 100; results are for the means of years 2001–2005, except for variables *old* and *old x decline* with 2005 values; regressions use group means, group number = 427 (= number of savings banks); significance levels: *** $p \leq 1\,\%$, ** $p \leq 5\,\%$, * $p \leq 10\,\%$; VRS/CRS = variable/constant returns to scale.

Table 8

Impact of Environmental Factors on Technical and Revenue Efficiency (Intermediation Approach) – Results (M2)

Independent variable	Technical efficiency VRS $n = 2121$	Technical efficiency CRS $n = 2121$	Revenue efficiency VRS $n = 2121$	Revenue efficiency CRS $n = 2121$
branch	***0.50	***0.49	***0.50	***0.44
branch × *decline*	***–0.55	***–0.53	**–0.42	**–0.41
ddens	***–0.016	***–0.016	–0.0077	*–0.0085
ddens × *decline*	*–0.012	–0.009	**–0.014	*–0.011
unemp	***0.58	***0.68	***0.44	***0.50
equity	***0.20	***0.22	**0.14	***0.16
equity × *decline*	**0.21	*0.15	***0.21	**0.17
const	***0.68	***0.63	***0.68	***0.64
R^2	0.138	0.158	0.138	0.146
F-test	***9.65	***11.27	***9.61	***10.27

Notes: results are for the means of years 2001–2005; regressions are performed with group means, group number = 427 (= number of savings banks); significance levels: *** $p \leq 1\,\%$, ** $p \leq 5\,\%$, * $p \leq 10\,\%$; VRS/CRS = variable/constant returns to scale.

A higher intensity of competition, measured by a higher number of competitor branches (M1) goes along with higher efficiency in the whole country, consistent with the "quiet life" hypothesis H1 but in contrast to the findings of *Wutz* (2002). Quantitatively, competition plays the largest role of all environmental factors influencing technical and revenue efficiency.

Population density (M1) has a highly significant positive influence on technical and revenue efficiency in growing regions, and this result is consistent with the first step result that most of the best practice banks are located in central, agglomerated regions. In addition, in declining regions, efficiency increases with population density, although to a much smaller degree – near zero. Thus, we find evidence consistent with H2 and confirm the positive influence of population density on technical efficiency found by *Hahn* (2007) for Austrian banks. However, this influence is small, which indicates that demand or proximity to customers play a smaller role than competition.

The control variable branch density (M2), which measures access to finance and is closely related to population density, has a highly significant positive effect on efficiency in growing regions. Thus, banks in growing regions can improve their technical and revenue efficiency by increasing branch penetration. In contrast, for banks in declining regions, the influence of branch density on technical (revenue) efficiency is negative (positive) and near zero, inconsistent with H7.

The influence of purchasing power (M1) on efficiency is large and negative in growing regions (VRS and CRS), but small and positive (VRS) or negative (CRS) in declining regions. The results for the control variables deposit density and unemployment (M2) point in the same direction: deposit density (unemployment) has a negative (positive) influence on efficiency in all regions. Since unemployment rate (deposit density) is negatively (positively) correlated with economic wealth, both are alternative measures for economic wealth. In summary, then, we find a negative influence of economic wealth on the technical and revenue efficiency of savings banks, contrary to H3. The results are consistent with the results of *Bos* and *Kool* (2006) on the cost and profit efficiency of local cooperative banks in the Netherlands, but contrary to the findings of *Hahn* (2007) and *Bresler* (2007) on the technical efficiency of German cooperative and savings banks. A possible explanation for our result is that banks in regions with low purchasing power or high unemployment rates face lower demand for individual services and therefore provide more standardized financial services with lower inputs than banks in more wealthy regions, which provide more differentiated services such as private banking, competence centers, mobile selling, etc. This effect seems to be relevant only in in growing regions. Another possible explanation is that banks in richer regions are under less pressure to produce a given output with a minimum of inputs, enjoying a "quiet life." In contrast, purchasing power seems to have a positive effect on efficiency in declining regions because it improves profit opportunities and the utilization of production factors, as expected (H3). Our findings support H7 that the expected influence of environmental factors applies in particular to declining regions.

Population age (M1) shows a significant and negative influence on efficiency only in declining regions, which is larger for revenue efficiency than for technical efficiency. This is consistent with H4 and H7. It indicates that a larger share of older people reduces the ability of banks in declining regions to maximize their revenues at given input quantities and output prices or to produce a given output with a minimum of inputs. Customers aged 75+ tend to demand more costly personal advice and less standardized financial products than younger customers. Banks in declining regions seem to face larger pressure to fulfill these needs of the elderly, while banks in growing regions may specialize on more standardized services to the younger.

Bank size (M1) has a positive influence on efficiency overall, supporting H7, but the higher efficiency of larger banks is contrary to the findings of *Bresler* (2007).[14] Larger banks seem to be able to achieve a larger output with a given level of inputs or a larger revenue at given input quantities and output prices by realizing economies of scale and scope, although they provide central services to smaller banks within the savings banks network. Following *Bresler* (2007), we also control for equity capital, even if it may be endogenous. Larger equity capital (M2), which is highly correlated with size, also increases efficiency. The effect is larger in declining regions, where equity capital is likely to be scarcer than in growing regions.

The R^2 values indicate that environmental factors have quite a large explanatory power; they explain 13 % of the variation of banks' individual technical efficiency scores (M1) when the intermediation approach is

[14] The different results may also be due to different measurements of bank size. In contrast to *Bresler* (2007), we do not consider the absolute size, but the relative size (per inhabitant). The relationship between absolute size and efficiency is not linear, but has a quadratic shape.

applied and as much as 20 % when the value added approach is applied. In the case of revenue efficiency, the explanatory power of the estimations reaches 21 % in model M1 and 14 % in model M2. Therefore, up to a fifth of the variation of revenue efficiency of savings banks can be explained by regional economic factors. This result confirms our expectation that environmental factors have a large impact on the efficiency of German savings banks and corresponds to that of *Wutz* (2002) for German cooperative banks.

V. Conclusions

This paper examines the influence of regional environmental factors on the efficiency of state-owned savings banks in Germany for the period 2001–2005. In a first step, banks' individual efficiency scores are estimated using a data envelopment analysis and, in a second step, the efficiency scores are regressed on various regional economic factors.

The paper contributes to the empirical literature on the influence of environmental factors on bank efficiency mainly in three respects: First, beyond technical efficiency, it examines revenue efficiency, which has been neglected in the literature but is consistent with the behavior of state-owned savings banks. Second, it examines a wider range of environmental factors at the regional level than previous studies have done, including, for the first time, population age. Third, it connects efficiency with the regional principle and demographic change. It differentiates between declining and growing regions, taking into account regional disparities in population size, which tend to increase with demographic change.

The analysis in the first step shows that most of the savings banks are quite efficient, with average technical and revenue efficiency levels of about 75 % (2005). Only part of the observed inefficiencies seems to result from managerial behavior, with the other part determined by the environment. Regional comparisons show that the relative number of best-practice banks is larger in West Germany than in the East, but that on average bank efficiency does not differ between both regions. Also the location in a declining versus growing region does not seem to matter. Banks in densely populated and rich regions reach higher efficiency levels than do those in peripheral and poor regions.

The results of the second step show that environmental factors are clearly relevant to the explanation of the technical and revenue efficiency of savings banks. Competitive pressure by a larger number of competitors is the most important environmental factor, having a much larger effect on efficiency than all other factors. Efficiency levels are higher in more competitive environments, contrary to the findings of *Wutz* (2002). Therefore, savings banks in peripheral regions which are not attractive for profit-maximizing banks enjoy a “quiet life”. Regional population density has a positive impact on efficiency, which is near zero in declining regions. Branch penetration in the business area also increases efficiency in growing regions, but has a negative (positive) effect near zero on technical (revenue) efficiency in declining regions. Thus, savings banks in declining and peripheral regions with low and declining population density and branch penetration have no scope for improving efficiency by changing their branch density. The larger inputs required to attract more customers do not seem to be compensated by higher output. Contrary to the findings of *Hahn* (2007) and *Bresler* (2007), but consistent with those of *Bos* and *Kool* (2006), regional economic wealth has a negative influence on technical and revenue efficiency. One possible explanation is that banks in regions with high purchasing power face higher demand for individual services and therefore provide less standardized financial services than banks in poorer regions. This effect seems to be relevant only in growing regions. Another possible explanation is that banks in richer regions are under less pressure to produce a given output with a minimum of inputs. Population age is relevant for only savings banks in declining regions, where a larger percentage of older people has a negative influence on technical and revenue efficiency. Older people tend to have less demand for standardized financial services and prefer products distributed by cost-intensive traditional means. By serving these customers in declining regions, savings banks fulfill their public mission. Their ability to do so efficiently depends on their size.

All in all, savings banks that operate under unfavorable economic conditions show relatively high levels of technical and revenue efficiency. However, demographic changes through population aging and migration from poor to rich regions impair the efficiency of banks in declining, peripheral regions. Our results show that the public mission of providing financial services to all regions has its costs in terms of efficiency losses. On the other hand, the regional principle of the savings banks sector guarantees competition between banking groups in most regions, which has the largest impact on efficiency. Research related to strategies for coping with the challenges of demographic change while continuing to fulfill the public goal of providing services to customers in all regions will be important to German savings banks in the future.

References

Agarwal, S./*Hauswald,* R. (2010): Distance and private information in lending, Review of Financial Studies, Vol. 23, pp. 2757–2788.

Banker, R. D./*Natarajan,* R. (2008): Evaluating contextual variables affecting productivity using Data Envelopment Analysis, Operations Research, Vol. 56, pp. 48–58.

Bartoli, F./*Ferri,* G./*Murro,* P./*Rotondi,* Z. (2013): SME financing and the choice of lending technology in Italy: Complementarity or substitutability?, Journal of Banking and Finance, Vol. 37, pp. 5476–5485.

BBR (2006): Kurzfassung Raumordnungsprognose 2020/2050. Bundesamt für Bauwesen und Raumordnung, Bonn.

Berger, A. N./*Hannan,* T. H. (1998): The efficiency cost of market power in the banking industry: a test of the 'quiet life' and related hypotheses, Review of Economics and Statistics, Vol. 80, pp. 454–465.

Berger, A. N./*Humphrey,* D. B. (1992): Measurement and efficiency issues in commercial banking, in Output Measurement in the Services Sectors. (Ed) Z Griliches Z, National Bureau of Economic Research, Studies in Income and Wealth, Vol. 56, University of Chicago Press, Chicago, pp. 245–279.

Berger, A. N./*Mester,* L. J. (1997): Inside the black box: what explains differences in the efficiencies of financial institutions?, Journal of Banking and Finance, Vol. 21, pp. 895–947.

Berger, A. N./*Udell,* G. F. (2002): Small business credit availability and relationship lending: The importance of bank organisational structure, Economic Journal, Vol. 112, pp. F32–F53.

– (2006): A more complete conceptual framework for SME finance, Journal of Banking and Finance, Vol. 30, pp. 2945–2968.

Berlemann, M./*Oestmann,* M./*Thum,* M. (2010): Demographic change and bank profitability. Empirical evidence from German savings banks, CESifo working paper No. 2911.

Bhattacharya, S./*Thakor,* A. (1993): Contemporary banking theory, Journal of Financial Intermediation, Vol. 3, pp. 2–50.

Boot, A. W. A. (2000): Relationship banking: what do we know? Journal of Financial Intermediation, Vol. 9, pp. 7–25.

Bos, J. W. B./*Heid,* F./*Koetter,* M./*Kolari,* J. W./*Kool,* C. J. M. (2005): Inefficient or just different? Effects of heterogeneity on bank efficiency scores, Discussion Paper, Deutsche Bundesbank.

Bos, J. W. B./*Kool,* C. J. M. (2006): Bank efficiency: The role of bank strategy and local market conditions, Journal of Banking and Finance, Vol. 30, pp. 1953–1974.

Bresler, N. (2007): Effizienz von Sparkassen und Sparkassenfusionen – Eine empirische Untersuchung, Dr. Kovač, Hamburg.

Casu, B./*Molyneux,* P. (2003): A comparative study of efficiency in European banking, Applied Economics, Vol. 35, pp. 1865–1876.

Chaffai, M. E./*Dietsch,* M. (2009): The effect of the environment on profit efficiency of bank branches, in Productivity in the financial services sector, (Eds.) M. Balling et al., Larcier, Vienna, SUERF Studies, pp. 259–273.

Chaffai, M. E./*Dietsch,* M./*Lozano-Vivas,* A. (2001): Technological and environmental differences in the European banking industries, Journal of Financial Services Research, Vol. 19, pp. 147–162.

Charnes, A./*Cooper,* W. W./*Rhodes,* E. (1978): Measuring the efficiency of decision making units, European Journal of Operational Research, Vol. 2, pp. 429–444.

Coelli, T. J./*Rao,* D. S. P./*O'Donnell,* C. J./*Battese,* G. E. (2005): An Introduction to Efficiency and Productivity Analysis, 2nd edn, Springer, New York.

Conrad, A. (2010): Banking in schrumpfenden Regionen, Dr. Kovač, Hamburg.

Conrad, A./*Neuberger,* D./*Schneider-Reißig,* M. (2009b): Geographic and demographic bank outreach: Evidence from Germany's three-pillar banking system, Credit and Capital Markets (Kredit und Kapital), Vol. 42, pp. 377–411.

Conrad, A./*Neuberger,* D./*Trigo Gamarra,* L. (2009a): Der Einfluss regionaler und demographischer Umfeldfaktoren auf die Kosten- und Ertragssituation von Sparkassen – Eine Effizienzanalyse, Thünen-Series of Applied Economic Theory, No. 107, University of Rostock.

Cooper, W. W./*Seiford,* L. M./*Tone,* K. (2006): Introduction to Data Envelopment Analysis and its Uses – with DEA-solver Software and References, Springer, New York.

Deutsche Bundesbank (2013): Bankenstatistik, May 2013, Frankfurt/Main

Dietsch, M./*Lozano-Vivas,* A. (2000): How the environment determines banking efficiency: a comparison between French and Spanish industries, Journal of Banking and Finance, Vol. 24, pp. 985–1004.

Gärtner, S. (2009): Balanced structural policy: German savings banks from a regional economic perspective, World Saving Banks Institute, Perspectives 58, Brussels

Girardone, C./*Molyneux,* P./*Gardener,* E. P. M. (2004): Analysing the determinants of bank efficiency: the case of Italian banks, Applied Economics, Vol. 36, pp. 215–227.

Hahn, F. R. (2007): Environmental determinants of banking efficiency in Austria. Empirica, Vol. 34, pp. 231–245.

Hakenes, H./*Schnabel,* I. (2010): The Threat of Capital Drain: A Rationale for Public Banks?, Journal of Institutional and Theoretical Economics, Vol. 166, pp. 662–689.

Hauner, D. (2005): Explaining efficiency differences among large German and Austrian commercial banks, Applied Economics, Vol. 37, pp. 969–980.

Hicks, J. (1935): Annual survey of economic theory: The theory of monopoly, Econometrica, Vol. 3, pp. 1–20.

Hughes, J. P./*Mester,* L. J. (2013a): Measuring the performance of banks: Theory, practice, evidence, and some policy implications, Working Paper Federal Reserve Bank of Philadelphia.

– (2013b): Who said large banks don't experience scale economies? Evidence from a risk-return-driven cost function, Journal of Financial Intermediation, Vol. 22, pp. 559–585.

Koetter, M./*Vins,* O. (2008): The quiet life hypothesis in banking – evidence from German savings banks, Working Paper Series: Finance and Accounting 190, Dept. of Finance, Goethe University, Frankfurt am Main.

Lozano-Vivas, A./*Pastor,* J. T./*Hasan,* I. (2001): European bank performance beyond country borders: what really matters? European Finance Review, Vol. 5, pp. 141–165.

Lozano-Vivas, A./*Pastor,* J. T./*Pastor,* J. M. (2002): An efficiency comparison of European banking systems operating under different environmental conditions, Journal of Productivity Analysis, Vol. 18, pp. 59–77.

Mester, L. J. (1997): Measuring efficiency at U.S. banks: accounting for heterogeneity is important, European Journal of Operational Research, Vol. 98, pp. 230–242.

Neumann, M./*Reichel,* R./*Weigand,* J. (2008): Competition between profit seekers and non-profit firms: the case of German banking, in The economics of corporate governance and mergers, (eds) K. Gugler and B. B. Yurtoglu, Cheltenham, UK, Northampton, MA, USA, Edward Elgar, pp. 146–164.

Radomski, B. (2008): Fusionen deutscher Sparkassen – Eine Anwendung der Data Envelopment Analysis (DEA), Finanzmanagement, Vol. 53, Dr. Kovač, Hamburg.

Ray, S. C. (2004): Data Envelopment Analysis – Theory and Techniques for Economics and Operational Research, Cambridge, University Press.

Riekeberg, M. (2003): Erfolgsfaktoren bei Sparkassen – Kausalanalytische Untersuchung mittels linearer Strukturgleichungsmodelle, Deutscher Universitäts-Verlag, Wiesbaden.

Schrumpf, H./*Müller,* B. (2001): Sparkassen und Regionalentwicklung – Eine empirische Studie für die Bundesrepublik Deutschland, Deutscher Sparkassen Verlag, Stuttgart.

Simar, L./*Wilson*, P. W. (2007): Estimation and inference in two-stage, semiparametric models of production processes, Journal of Econometrics, Vol. 136, pp. 31–64.

Wengler, M. O. (2006): Wechselwirkungen zwischen der finanzintermediatorischen Tätigkeit kommunaler Kreditinstitute und dem kommunalen Raum – Eine institutionenökonomische und empirische Untersuchung am Beispiel der Sparkassen in den neuen Bundesländern, Institut für Wirtschaftsforschung Halle (Hrsg.), Sonderhefte 06/2006, Halle.

Wutz, A. (2002): Wie beeinflusst das Umfeld einer Bank die Effizienz?, Volkswirtschaftliche Diskussionsreihe, Universität Augsburg, Beitrag 215.

Appendix

Table A.1

Results for Intermediation Approach – All Savings Banks

	2001 $n = 433$	2002 $n = 435$	2003 $n = 435$	2004 $n = 435$	2005 $n = 435$
Ø TE_{VRS}	0.77	0.74	0.72	0.74	0.74
σ	0.11	0.12	0.12	0.12	0.12
Min	0.49	0.50	0.49	0.47	0.47
Eff	34	29	20	28	26
Ø TE_{CRS}	0.75	0.72	0.69	0.71	0.71
σ	0.11	0.12	0.11	0.11	0.12
Min	0.46	0.38	0.37	0.40	0.41
Eff	17	17	10	15	18
Ø RE_{VRS}	0.78	0.76	0.75	0.76	0.76
σ	0.11	0.11	0.11	0.11	0.11
Min	0.53	0.52	0.53	0.53	0.53
Eff	36	31	24	29	27
Ø RE_{CRS}	0.75	0.74	0.72	0.73	0.73
σ	0.11	0.11	0.10	0.10	0.11
Min	0.49	0.50	0.53	0.52	0.52
Eff	17	17	15	17	18

Notes: TE = technical efficiency, RE = revenue efficiency; CRS/VRS = constant/variable returns to scale; Ø = mean, σ = standard deviation, Min = minimum value; Eff = number of efficient (best practice) banks.

Table A.2

Results for Value Added Approach – All Savings Banks

	2001 $n = 433$	2002 $n = 435$	2003 $n = 435$	2004 $n = 435$	2005 $n = 435$
Ø TE_{VRS}	0.78	0.76	0.74	0.76	0.75
σ	0.11	0.11	0.11	0.11	0.11
Min	0.50	0.51	0.51	0.56	0.54
Eff	36	31	24	29	27
Ø TE_{CRS}	0.75	0.73	0.72	0.73	0.73
σ	0.11	0.11	0.10	0.10	0.11
Min	0.49	0.50	0.53	0.52	0.52
Eff	17	17	15	17	18

Notes: TE = technical efficiency; CRS/V RS = constant/variable returns to scale; Ø = mean, σ = standard deviation, Min = minimum value; Eff = number of efficient ('best practice') banks.

Table A.3

Results for Intermediation Approach – East vs. West Germany

	2001		2002		2003		2004		2005	
	East $n = 54$	West $n = 379$	East $n = 54$	West $n = 381$	East $n = 54$	West $n = 381$	East $n = 54$	West $n = 381$	East $n = 54$	West $n = 381$
Ø TE_{VRS}	0.76	0.78	0.76	0.75	0.74	0.72	0.74	0.74	0.75	0.74
σ	0.13	0.12	0.13	0.13	0.11	0.13	0.10	0.13	0.10	0.13
Min	0.50	0.54	0.51	0.52	0.54	0.49	0.56	0.47	0.57	0.48
Eff	4	30	3	26	1	19	2	26	2	24
Ø TE_{CRS}	0.75	0.76	0.74	0.72	0.72	0.69	0.73	0.71	0.74	0.71
σ	0.12	0.12	0.13	0.12	0.11	0.12	0.09	0.12	0.10	0.12
Min	0.49	0.47	0.51	0.38	0.54	0.37	0.55	0.41	0.56	0.42
Eff	2	15	2	15	1	9	1	14	2	16
Ø RE_{VRS}	0.77	0.79	0.76	0.77	0.74	0.75	0.74	0.77	0.76	0.76
σ	0.12	0.12	0.13	0.12	0.11	0.11	0.09	0.11	0.10	0.12
Min	0.54	0.54	0.53	0.53	0.54	0.54	0.59	0.53	0.59	0.54
Eff	4	32	3	28	1	23	2	27	2	25
Ø RE_{CRS}	0.75	0.76	0.74	0.74	0.72	0.72	0.73	0.74	0.74	0.73
σ	0.12	0.11	0.13	0.11	0.11	0.10	0.09	0.11	0.10	0.11
Min	0.53	0.49	0.51	0.50	0.54	0.53	0.59	0.53	0.58	0.53
Eff	2	15	2	15	1	14	1	16	2	16

Notes: TE = technical efficiency, RE = revenue efficiency; CRS/V RS = constant/variable returns to scale; Ø = mean, σ = standard deviation, Min = minimum value; Eff = number of efficient ('best practice') banks.

Table A.4

**Results for Intermediation Approach –
Regions with Low vs. High Population Density**

	2001		2002		2003		2004		2005	
	Low $n = 212$	High $n = 213$	Low $n = 214$	High $n = 213$	Low $n = 214$	High $n = 213$	Low $n = 214$	High $n = 213$	Low $n = 214$	High $n = 213$
Ø TE_{VRS}	0.75	0.80	0.72	0.77	0.70	0.75	0.71	0.77	0.71	0.77
σ	0.12	0.12	0.13	0.13	0.12	0.13	0.12	0.13	0.12	0.13
Min	0.54	0.50	0.52	0.51	0.49	0.50	0.47	0.49	0.48	0.48
Eff	14	18	12	16	7	12	8	19	9	16
Ø TE_{CRS}	0.73	0.77	0.69	0.74	0.67	0.71	0.68	0.74	0.69	0.74
σ	0.11	0.12	0.12	0.12	0.12	0.12	0.11	0.12	0.11	0.12
Min	0.50	0.47	0.47	0.38	0.46	0.37	0.46	0.41	0.48	0.42
Eff	6	9	7	9	3	6	4	10	6	11
Ø RE_{VRS}	0.76	0.81	0.74	0.80	0.72	0.78	0.73	0.80	0.73	0.79
σ	0.11	0.11	0.12	0.11	0.11	0.11	0.10	0.11	0.11	0.11
Min	0.54	0.55	0.54	0.53	0.54	0.54	0.57	0.53	0.54	0.54
Eff	14	20	14	16	9	0.14	9	19	9	17
Ø RE_{CRS}	0.73	0.78	0.72	0.77	0.70	0.74	0.71	0.76	0.71	0.76
σ	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.11	0.10	0.11
Min	0.53	0.49	0.54	0.50	0.54	0.53	0.56	0.53	0.54	0.53
Eff	6	9	7	9	7	7	7	9	7	10

Notes: Low = regions with population density ≤ median (2001), High = regions with population density > median (2001); TE = technical efficiency, RE = revenue efficiency; CRS/VRS = constant/variable returns to scale; Ø = mean, σ = standard deviation, Min = minimum value; Eff = number of efficient (best practice) banks.

Table A.5

Results for Intermediation Approach – Poor vs. Rich Regions

	2001		2002		2003		2004		2005	
	Poor $n = 216$	Rich $n = 217$	Poor $n = 218$	Rich $n = 217$	Poor $n = 218$	Rich $n = 217$	Poor $n = 218$	Rich $n = 217$	Poor $n = 218$	Rich $n = 217$
Ø TE_{VRS}	0.76	0.80	0.73	0.77	0.71	0.74	0.72	0.76	0.73	0.76
σ	0.12	0.12	0.12	0.13	0.12	0.13	0.12	0.13	0.12	0.13
Min	0.50	0.57	0.51	0.53	0.50	0.49	0.47	0.51	0.48	0.52
Eff	14	20	11	18	7	13	10	18	9	17
Ø TE_{CRS}	0.74	0.77	0.70	0.74	0.68	0.71	0.70	0.73	0.70	0.73
σ	0.11	0.12	0.12	0.13	0.11	0.13	0.11	0.12	0.11	0.13
Min	0.49	0.47	0.47	0.38	0.46	0.37	0.46	0.41	0.48	0.42
Eff	6	11	6	11	3	7	5	10	6	12
Ø RE_{VRS}	0.77	0.80	0.75	0.79	0.73	0.77	0.75	0.79	0.74	0.78
σ	0.12	0.11	0.12	0.12	0.11	0.12	0.11	0.11	0.11	0.12
Min	0.54	0.55	0.53	0.53	0.54	0.54	0.57	0.53	0.56	0.54
Eff	16	20	13	18	9	15	11	18	10	17
Ø RE_{CRS}	0.74	0.77	0.73	0.76	0.71	0.74	0.72	0.75	0.72	0.75
σ	0.11	0.11	0.11	0.11	0.10	0.11	0.10	0.11	0.11	0.12
Min	0.53	0.49	0.51	0.50	0.54	0.53	0.56	0.53	0.55	0.53
Eff	7	10	7	10	6	9	7	10	6	12

Notes: Poor = regions with purchasing power per inhabitant ≤ median (2001), Rich = regions with purchasing power per inhabitant > median (2001); TE = technical efficiency, RE = revenue efficiency; CRS/VRS = constant/variable returns to scale; Ø = mean, σ = standard deviation, Min = minimum value; Eff = number of efficient (best practice) banks.

Table A.6

Results for Intermediation Approach – Declining vs. Growing Regions

	2001		2002		2003		2004		2005	
	Decline $n = 234$	Grow $n = 191$	Decline $n = 235$	Grow $n = 192$	Decline $n = 235$	Grow $n = 192$	Decline $n = 235$	Grow $n = 192$	Decline $n = 235$	Grow $n = 192$
Ø TE_{VRS}	0.77	0.78	0.74	0.75	0.72	0.72	0.74	0.74	0.74	0.74
σ	0.12	0.12	0.12	0.14	0.12	0.13	0.12	0.13	0.12	0.13
Min	0.50	0.55	0.51	0.52	0.50	0.49	0.47	0.51	0.48	0.51
Eff	17	15	13	15	8	11	13	14	12	13
Ø TE_{CRS}	0.75	0.76	0.71	0.72	0.69	0.69	0.71	0.71	0.71	0.72
σ	0.11	0.12	0.11	0.13	0.11	0.12	0.12	0.12	0.12	0.13
Min	0.49	0.47	0.47	0.38	0.46	0.37	0.46	0.41	0.48	0.42
Eff	8	7	8	8	4	5	8	6	8	9
Ø RE_{VRS}	0.77	0.79	0.76	0.78	0.74	0.76	0.76	0.77	0.76	0.77
σ	0.11	0.12	0.11	0.12	0.11	0.12	0.11	0.12	0.11	0.12
Min	0.54	0.55	0.53	0.53	0.54	0.54	0.57	0.53	0.56	0.54
Eff	17	17	13	17	9	14	13	15	12	14
Ø RE_{CRS}	0.75	0.76	0.73	0.75	0.72	0.73	0.73	0.74	0.73	0.74
σ	0.11	0.11	0.11	0.11	0.10	0.11	0.10	0.11	0.11	0.12
Min	0.53	0.49	0.51	0.50	0.54	0.53	0.56	0.53	0.55	0.53
Eff	6	9	6	10	4	10	8	8	9	8

Notes: Decline = regions with declining population in 2001–2025, Grow = regions with growing popu-lation in 2001–2025; TE = technical efficiency, RE = revenue efficiency; CRS/VRS = constant/variable returns to scale; Ø = mean, σ = standard deviation, Min = minimum value; Eff = number of efficient (best practice) banks.

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