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# Regional Bank Efficiency and its Effect on Regional Growth in “Normal” and “Bad” Times

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## Abstract

The financial crisis affected regions in Europe in a different magnitude. We examine whether regions which incorporate banks with a higher intermediation quality grow faster using a sample which includes the aftermath of the financial crisis. We measure the intermediation quality of a bank by estimating a its profit and cost efficiency. Next, we aggregate the efficiencies of all banks within a NUTS 2 region to obtain a regional proxy for financial quality in twelve European countries. Our results show that relatively more profit efficient banks foster the economic growth in their region. The link between financial quality and growth is valid in “normal” times as well as in “bad” ones.

**G21 · O16 · O47 · O52 /// Bank efficiency · Regional growth · Financial Development · Europe**

## 1 Introduction

Growth in European regions is very diverse (Quah, 1996; Cuaresma et al., 2014). One of the reasons for this finding could be that banks perform differently in their financial intermediation function across regions. For example, easier access to credit increases resources that could be channeled into investment. There are many studies which analyzed the relationship between the financial volume and economic growth in cross-country studies (Levine, 2005). However, Hasan et al. (2009) criticize, firstly, that cross-country studies suffer from sample heterogeneity as they cover very different economies. Therefore, a solution is to concentrate on regions to use within-country variation (Higgins et al., 2006).<sup>1</sup>

Secondly, Hasan et al. (2009) argue that financial development cannot be only measured by the credit to GDP ratio - a financial *volume* measure. In fact, Rousseau and Wachtel (2011) showed there has been only a weak link between financial volume and economic growth in developed countries over recent times. Therefore, Hasan et al. (2009) provide another channel of the influence of banks on regional

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<sup>1</sup>Further examples of studies examining the effect of financial development on regional growth are Guiso et al. (2004) and Moretti (2014) using Italian firm data, Pascali (2014) for long-term effects in Italy, Koetter and Wedow (2010) taking Bundesbank data about German banks, and Kendall (2012) examining Indian district data.

growth. Specifically, they showed for eleven European countries over the period 1996-2004 that the intermediation ability of a bank should not be assessed alone by the volume of funds which are shifted from savers to borrowers, but by its *quality*, i.e. by its ability to channel funds to its most productive uses at a reasonable interest rate. A bank's intermediation quality can be measured by its efficiency in converting inputs into outputs while either minimizing costs or maximizing profits. A more efficient bank is assumed to foster growth as it is able to select the optimal projects to fund while calculating the optimal cost of lending given the projects' risks.

We test whether Hasan et al. (2009)'s finding of a positive link between the average efficiency of banks in a region and economic growth holds for an updated and extended data set for twelve European countries. As our sample includes the financial crisis and its aftermath, we thereby contribute to the literature by examining whether the results of Hasan et al. (2009) are valid in "normal" as well as in "bad" times. Furthermore, we demonstrate that the strength of the relationship between financial quality and growth is dependent on the level of economic development of a region. This result bears interesting policy implications on how to increase the speed of convergence of European regions.

Our results are corroborated by several robustness tests. Firstly, we confirm our findings for an estimation which excluded financial centers to account for the fact that we assigned a bank to a region by its headquarter - a procedure which could be considered heuristic for large commercial banks which usually are operating nationwide and are based in financial centers. Additionally, we exclude either large banks or all banks but savings banks from the sample as the latter is forced by law to operate only regionally. Another approach to dealing with across-region spillovers is to specifically model them. We use a spatial-lag model to account for spillovers of financial development from neighboring regions. All estimations confirm our findings. As policy makers are not only interested in economic growth, but also in reducing unemployment, we also check whether fostering bank efficiency is a potential tool to do so. While we found evidence for that using our complete sample, it cannot be said that a region with more efficient banks is more resilient against growing unemployment during a turmoil period as the financial crisis.

The outline of this work is as follows: Firstly, the methodology of the analysis will be presented. After an explanation of the regional growth equation and the estimation of banks' efficiency, a description of the data follows. Secondly, empirical evidence will be presented with an additional chapter on robustness. Lastly, we conclude our results.

## 2 Methodology

### 2.1 Regional Growth Equation

The regions in Europe display different long-term growth patterns. Furthermore, the banks of a region are different. Although financial regulation in Europe is being harmonized, regions still incorporate different banks in terms of credit supply to GDP and efficiency of channeling funds (Bos and Kool, 2006). To test whether these differences in financial volume and quality affect growth, we follow Levine et al. (2000)

and estimate a dynamic panel growth model of the following form:

$$\Delta Y_{r,t} = \alpha + \beta_1 \Delta Y_{r,t-1} + \beta_2 \ln FQ_{r,t} + \beta_3 \ln FV_{r,t} + \beta_4 \ln X_{r,t} + \mu_r + \epsilon_{r,t} \quad (1)$$

where  $\Delta Y$  is the growth rate of GDP per worker. We take GDP per worker as the variable of interest as this measure is determining the productivity of an economy. Still, we also present results for GDP per capita and unemployment. FQ and FV denote financial quality and financial volume, respectively. Financial quality is represented by the weighted average estimated bank efficiency of a region. The weighting was done according to a bank's market share of a region's loans. Financial volume is measured by the regionally aggregated value of loans relative to GDP. Details on the calculation of the financial development variables follow later in Section 2.3.2. The additional variables contained in  $X$  control for further regional and country-specific variables<sup>2</sup> and  $\mu_r$  represents an unobserved region-specific effect. The subscript  $r$  indicates the European NUTS 2 region and  $t$  the year.

Equation (1) cannot be estimated with basic panel techniques as the lagged GDP variable is correlated with  $\mu_r$ . However,  $\mu_r$  can be eliminated by taking first differences. The result is that the differenced lagged dependent variable and the differenced error term are correlated. Arellano and Bond (1991) therefore suggest to use lagged levels as instruments for the differenced lagged dependent variable, the difference GMM estimator, if the error term is not autocorrelated. For further precision, we use the system-GMM estimator of Arellano and Bond (1995), which includes additionally lagged differences of the dependent variable as instruments, as Blundell and Bond (1998) showed that this approach is more efficient than the difference GMM estimator - in particular for persistent dependent variables.

Our explanatory variables *financial quality* and, especially, *financial volume* may suffer from endogeneity as a growing economy can result in an increasing demand for credits and a growing financial industry. To deal with this potential reverse causality, we follow Levine et al. (2000) and specify both variables as endogenous and, thus, include their lagged levels and differences as instruments. Details follow in Chapter 3.

## 2.2 Estimation of Banks' Efficiency

Bank efficiency is measured by a banks' *relative* ability to convert its inputs into output while maximizing profits or minimizing costs. A bank is inefficient if it uses too much inputs or allocates them in wrong proportions. This relative measurement of efficiency is less affected by endogeneity criticism than financial volume measures because a bank's ability should influence growth independently of whether the economy is growing fast or slowly. An efficient bank should support growth of an economy through its good intermediary function, i.e. by selecting the optimal projects for funding while assigning the optimal costs given risks at the same time (Hakenes et al., 2014).

In the following, we assume that banks demand as inputs fixed assets, borrowed funds and labor which can be used at given factor prices,  $W$ , to produce outputs,  $Y$ , as loans for customers and banks, and earning assets. We also include equity,  $z$ , as a net output, and a time trend. Furthermore, we either

<sup>2</sup>Regional controls used here are the growth rate of the working population and education. The latter is measured as the share of persons between 25 and 64 that obtained tertiary education on the first or second stage. These two variables and regional GDP were obtained from Eurostat for NUTS 2 regions. The country-specific variables are capturing the differences between countries in terms of the banking sector or economic freedom.

assume that banks minimize total costs, *TOC*, or maximize pre-tax profits, *PBT*. We estimate these two concepts of efficiency with stochastic frontier analysis. Therefore, we gain the following translog stochastic frontier:

$$\ln LHS_{i,t} = \alpha_i + \sum_j^J \beta_j \ln X_{i,j,t} + \frac{1}{2} \sum_k^K \sum_j^J \beta_{j,k} \ln X_{i,j,t} \ln X_{i,k,t} + \ln z_{i,t} + t + t^2 + \epsilon_{i,t} \quad (2)$$

where *LHS* represents either total costs or pre-tax profits of a bank *i*, and *X* includes the previously mentioned inputs at given factor prices *W*, outputs *Y* and equity *z*. The error terms structure is assumed to be  $\epsilon_{i,t} = v_{i,t} \pm u_{i,t}$ . Therefore, profits or costs differ from the optimal point either because of random noise,  $v_{i,t}$ , or inefficiency,  $u_{i,t}$ . Random noise is assumed to be i.i.d. and  $v_i \sim N(0, \sigma_v^2)$ . Furthermore, we impose the usual linear homogeneity restriction for the cost function by normalizing total costs, pre-tax profits and input prices by one of the input prices. Following Restrepo-Toban and Kumbhakar (2014), we do not impose such a restriction for the profit function.

The translog specification is unproblematic for analyzing cost efficiency. For profit efficiency, however, we encounter the problem that we cannot take the log of negative profits. Hence, we follow Bos and Koetter (2011) and use a negative profit indicator approach. Thus, we do not delete bank observations with negative profits, but we specify (before taking logs) its profits to be 1 and add an indicator variable that takes the absolute value of the losses. For banks with positive profits the indicator variable is zero in logs. Thereby, we keep the complete sample and include the important information about losses.

To improve the estimation, we follow Lozano-Vivas et al. (2002) and include country-specific differences of financial systems in the stochastic frontier. They found that neglecting such differences, which still exist between European countries, can bias the inefficiency estimates. In line with the literature, we include net output *z* and country-specific variables as determinants for the inefficiency distribution to capture the regulatory demand for equity as well as macroeconomic and banking-market differences between countries.<sup>3</sup> This is of considerable importance as the financial crisis is included in the estimation sample which led to stricter regulation and a worse macroeconomic environment for banks. Details follow in Section 2.3.1. Inefficiency is therefore assumed to be of the following structure:  $u_i \sim N(\mu + dZ, \sigma_u^2)$ .  $\mu$  is the estimated mean of the inefficiency distribution and  $d$  is a vector including the estimated coefficients of *Z*, the country-specific variables and the bank's equity, *z*. We also follow the standard frontier assumption of a half normal distribution for the inefficiency term. Lastly, a bank-specific fixed effect,  $\alpha_i$ , is introduced to capture the remaining heterogeneity. So, if a bank deviates from optimal profits or costs given its use of inputs, this is accounted to be due to inefficiency or random noise.

With this specification we estimate Equation (2) using a maximum likelihood estimation of a fixed-effects panel frontier with time-variant efficiency (Greene, 2005). Thus, we do not impose a monotonous trend for banks' efficiency, but allow for variation over time. The efficiency of the stochastic frontier can then be obtained by  $\exp(-u_{i,t})$ . A cost efficiency value of 80% represents, for example, that a bank could have produced the same amount of outputs with the usage of only 80% of its inputs. A profit efficiency value of 60% implies that the bank could have gained 40% more profits if it had used its inputs efficiently.

<sup>3</sup>Thereby, *z* is included in the kernel and as a determinant of the inefficiency distribution of Equation (2).

## 2.3 Data

### 2.3.1 Financial Development

We have obtained unconsolidated financial data for 3,878 banks from twelve European countries between the years 2000 and 2013 from the Bankscope database. We dropped banks as central banks, securities firms and bank holdings from the sample. 2013 is the end of the sample as regional GDP data is not available for more recent years. The financial data include loans,  $y_1$ , earning assets,  $y_2$ , bank loans,  $y_3$ , other operating expenses over fixed assets,  $w_1$ , expenses for personnel over fixed assets<sup>4</sup>,  $w_2$ , total interest expenditure over funding,  $w_3$ , equity,  $z$ , total costs,  $TOC$ , and pre-tax profits,  $PBT$ , which allows us to estimate profit and cost efficiency.

The country-specific variables which were used, following Lozano-Vivas et al. (2002), as determinants for the inefficiency distribution of the stochastic frontier estimation are taken from various sources. These variables control for country-specific differences in the banking industry and the macroeconomic environment. The Herfindahl index for credit institutions in regards to total assets,  $HERF$ , is taken from the ECB database. It measures the amount of concentration in the banking industry. The income per capita,  $IC$ , branches per capita,  $BC$ , and income per branch,  $IB$ , variables were taken from the OECD Banking Profitability Statistics, until it was discontinued in 2010, and were then updated with data from the ECB database. Furthermore, two economic status variables, GDP per capita and the population density were obtained from Eurostat. Both can have effects on the supply and demand of financial services. For example, in a more developed country customers demand a bigger variety of banking products. All variables are measured in real terms.

Still, we add further variables to the inefficiency distribution which in particular introduce the specific traits of the macroeconomic and regulatory environment for banks during the financial and European debt crisis. The ratio of non-performing loans (NPL) is taken from the database World Development Indicators. A higher share of NPL represents that a bank operates in a country in which borrowers default more often and the financed projects are more risky (Koetter and Poghosyan, 2009). In Figure 1 one can see that the ratio of NPL is on average strongly increasing from 2007 till 2009 and remaining then on its high level. Furthermore, the financial crisis led to a stricter regulation for banks. This is represented by the regulation indices we included. The index of financial freedom,  $HER$ , is from the Heritage Foundation and rates the financial freedom of a country. The overall inflow and outflow restrictions indexes are taken from Fernandez et al. (2015) and they assess countries' capital control restrictions. Capital controls do affect all internationally active economic entities but in particular banks which, even if small (Buch et al., 2011), hold foreign assets. That these regulations actually are affecting banks' behavior can be seen in the evolution of average held equity,  $z$ , which increased during the complete time period of our sample and particularly in the years after the financial crisis. Recall that also  $z$  is included in the inefficiency distribution of the stochastic frontier estimation.

Together with the aforementioned country-specific variables, the obtained bank data allows an efficiency estimation for about 3,878 banks with a total of 34,858 observations. The stochastic frontier

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<sup>4</sup>Usually, it is suggested to divide personnel expenses by the number of employees. However, if the latter is not available, it is common to divide it by fixed assets. An example for this is Lozano-Vivas and Pasiouras (2010). They also give an overview about further studies which make use of this approach.

estimated with Equation 2 assumes that all banks in the sample have a common technology regime. However, authors as Altunbas et al. (2001) or Koetter and Poghosyan (2009) argue that technology regimes may differ across banks due to ownership status or size. We account for this by estimating Equation 2 also for different groups of banks. Firstly, we choose different samples according to size. Thus, we estimate the stochastic frontier for banks with mean total assets of below 7 or 2 billion Euros which correspond to the 90th or 75th percentile. We denote them as local or small local banks. Secondly, we use only local<sup>5</sup> savings banks for the efficiency estimations as these banks may differ from other banking groups due to their public nature and further non-profit objectives. Following Restrepo-Toban and Kumbhakar (2014), we additionally calculated efficiency-adjusted Lerner indices which account for the possibility of foregone rents due to inefficiency. In Table 1 one can see summary statistics and the stochastic frontier outcomes for these groups of banks. The estimated values of cost and profit efficiencies do not change considerably across these groups and are comparable to Hakenes et al. (2014), Kalyvas and Mamatzakis (2014) and Koetter and Wedow (2010).

### 2.3.2 Regional Mapping

The Bankscope database allows us to map European banks to a NUTS 2 region.<sup>6</sup> For most of the countries in our sample it is possible to match a bank to a NUTS 2 region by using zip codes. In all other cases the matching was done by city names. Oversea territories are dropped from the sample. In total we mapped the banks to 131 NUTS 2 regions resulting in an average number of banks per region of about 20. Bank-based economies as Germany or Italy contain relatively more banks per regions due to their big savings and cooperative banking sectors.

After the mapping of banks to a region, our financial development variables can be calculated. The financial volume variable is calculated by summing up the loans of all banks within a region and dividing this sum by the region's GDP. A graphical illustration can be seen in Figure 2. A region's financial quality and Lerner index variables have been calculated as the weighted average of the region's banks' efficiencies and Lerner indices. The weight each bank was assigned to is its share of loans of the total loans within the region to represent its market share. As we estimated the stochastic frontier for different groups of banks, we also calculated all the financial development variables only considering the respective banks. So, we obtained a financial volume, financial quality and Lerner index variable for each region and each considered groups of banks.

Although we present results for all groups of banks in the robustness section, we prefer our specification for local banks. Local banks, which we defined to be banks with mean total assets of below 7 billion Euros, are more likely to operate only within their respective region, compare Section 4.1 for further details, not across-regions or across-countries. Also, the estimated stochastic frontier is less likely to be biased by large banks which have different technology regimes while we still have a large amount of considered banks, namely 3,527. In Table 2 regional descriptive statistics for this group of banks is presented. It can be seen that the credit-to-GDP ratio corresponds to the different banking structures of

<sup>5</sup>Local savings banks are in this regard only savings banks with mean total assets of below 7 billion Euros. We account thereby also for the aforementioned size concerns.

<sup>6</sup>A NUTS 2 region has a population between 800,000 and 3 million persons. We use the NUTS version 2010 which is the latest one for the NUTS 2 regions we are considering.

Table 1: Descriptive Statistics of Banking Groups

	All Banks	Local Banks	Small Local Banks	Local Savings Banks
<i>Stochastic Frontier Arguments</i>				
TOC (Total Costs)	172.92 (1305.68)	38.61 (56.06)	21.27 (21.70)	56.78 (57.38)
PBT (Pre-Tax Profits)	24.16 (182.64)	5.43 (10.87)	3.02 (5.49)	6.14 (7.83)
y1 (Loans)	2099.40 (14780.17)	506.32 (742.88)	284.11 (283.68)	781.67 (811.85)
y2 (Earning Assets)	1321.27 (16845.69)	191.50 (349.04)	109.07 (135.79)	315.94 (343.65)
y3 (Bank Loans)	940.64 (8305.48)	130.17 (358.01)	61.51 (105.51)	140.17 (253.67)
w1 (Price of Fixed Assets)	26.56 (40.05)	27.18 (41.12)	27.63 (41.43)	25.23 (14.28)
w2 (Price of Labor)	35.84 (61.58)	37.07 (63.82)	38.32 (68.32)	35.45 (18.47)
w3 (Price of Borrowed Funds)	2.52 (19.00)	2.49 (19.82)	2.32 (3.56)	2.40 (1.21)
z (Equity)	244.79 (1704.09)	60.69 (97.54)	35.49 (41.57)	79.98 (81.66)
<i>Stochastic Frontier Outcomes</i>				
Profit Efficiency	57.89 (26.41)	56.81 (26.30)	57.73 (26.03)	59.90 (25.83)
Cost Efficiency	86.65 (11.53)	87.31 (11.68)	87.41 (11.23)	90.98 (10.35)
Lerner Index	41.00 (9.07)	41.67 (9.62)	44.41 (8.27)	44.77 (12.52)
Observations	34858	32006	27491	8707

*Notes:* Monetary variables are in real values and thousands of Euros. Outputs and equity are in millions of Euros. Standard errors in parentheses. Efficiencies have been estimated for the corresponding banking groups using a stochastic frontier approach. Lerner indices are computed using the estimated stochastic cost and profit frontiers to account for potential inefficiency. Local Banks and small local banks are defined as banks with mean total assets of below 7 or 2 billion Euros, respectively.



the countries. The values are higher for Germany and Italy in which the cooperative and savings banks sectors have a bigger market share. An overview of empirical realizations of efficiencies of local banks by region in the years 2006 and 2010 are given in Figures 3 and 4 for cost efficiency and in Figures 5 and 6 for profit efficiency, respectively.

Table 2: Descriptive Statistics of Regions Across Countries between 2001 and 2013

	All Countries	Germany	France	Italy	Spain and Ireland	Northern	Remaining
Real GDP Growth	0.69 (3.48)	1.13 (2.61)	0.48 (2.38)	-0.76 (2.70)	-0.19 (4.09)	1.31 (6.58)	1.45 (2.34)
Cost Efficiency of Local Banks	83.30 (12.15)	91.26 (2.90)	82.98 (10.01)	84.17 (8.61)	86.50 (7.58)	71.97 (14.10)	73.83 (14.87)
Profit Efficiency of Local Banks	56.08 (18.54)	57.30 (12.21)	63.80 (15.65)	59.43 (20.32)	57.68 (23.02)	46.63 (21.16)	49.27 (19.81)
Credits of Local Banks to GDP	23.77 (35.60)	33.67 (14.34)	13.01 (8.18)	31.65 (73.16)	10.14 (10.87)	16.86 (45.69)	20.86 (21.07)
Number of Banks	20.98 (23.01)	39.38 (24.27)	8.52 (12.22)	23.60 (26.23)	6.51 (8.80)	8.37 (6.00)	15.61 (16.02)
Observations	1479	454	244	206	170	177	250

*Notes:* Unbalanced means across years and regions. Standard errors in parentheses. All values in percentages but the number of banks. Northern include Denmark, Finland and Sweden. The remaining group consists of Austria, Belgium, Luxembourg and the Netherlands.

### 3 Empirical Evidence

We estimate Equation (1) with the two-step system-GMM estimator using heteroskedasticity and autocorrelation robust Windmeijer (2005) standard errors. The lagged dependent variable as well as the financial volume and financial quality proxies are specified as endogenous variables. As instruments we use five lags of their levels and differences. We use a collapsed instrument matrix in the system-GMM estimation to further reduce the number of instruments as the Hansen test is not robust against too many instruments (Roodman, 2009).<sup>7</sup> The results are displayed in Table 3. While the AR(2) statistic is never significant, the Hansen statistic is, however, only if we measure financial quality by cost efficiency.

Our control variables *labor force growth*, *education* and the *Heritage Index* have the expected sign. Also our banking sector variables are significant in most cases. Financial volume enters the equation significantly positive only in some specifications. This feature is not uncommon for a sample of developed countries in a post-2000 period (Rousseau and Wachtel, 2011).<sup>8</sup> The financial quality variable is strongly and significantly positive when only represented by profit efficiency. This finding is in line with Hasan et al. (2009) and could be explained by the lower variation across regions, compare Table 2, or by a

<sup>7</sup>Roodman (2009) notes that an arbitrary rule of thumb is that the number of instruments should not exceed the number of cross-sections, but should also not converge to the number of coefficients for the Hansen test to be not weakened. We think that the number of 31 to 43 instruments in our regressions when collapsing the instrument matrix is reasonable as it lays between our number of coefficients, 22 with year dummies and all financial development variables, and cross-sections, 129 regions.

<sup>8</sup>For further studies on the effect of financial volume on economic growth compare, for example: Loayza and Ranciere (2006) and Levine et al. (2000) or, more recently, Moretti (2014) for Italy and Pascali (2014) for long-term effects.

Table 3: Financial Quality of Local Banks and its Effect on Regional Growth between 2000 and 2013

	Cost Efficiency				Profit Efficiency		
	Quantity	Quality	Both	Interaction	Quality	Both	Interaction
Lagged GDP per Worker Growth	−0.027 (0.038)	−0.040 (0.042)	−0.033 (0.045)	−0.050 (0.043)	−0.043 (0.034)	−0.043 (0.034)	−0.042 (0.034)
Labor Force Growth	−0.951*** (0.035)	−0.947*** (0.035)	−0.945*** (0.037)	−0.943*** (0.036)	−0.977*** (0.034)	−0.966*** (0.035)	−0.974*** (0.033)
<i>Control Variables</i>							
Education	1.354*** (0.436)	0.892*** (0.229)	1.054*** (0.334)	1.021*** (0.316)	0.874*** (0.295)	1.056*** (0.358)	1.024*** (0.350)
Heritage Index	1.835 (1.333)	2.842** (1.213)	2.394* (1.256)	2.495* (1.384)	6.280*** (1.522)	5.694*** (1.561)	5.220*** (1.523)
<i>Banking Sector Variables</i>							
Herfindahl Index	0.054 (0.302)	−0.240* (0.137)	0.093 (0.278)	−0.068 (0.244)	−0.401** (0.163)	−0.241 (0.256)	−0.135 (0.228)
Lerner Index	2.107** (0.821)	0.186 (0.540)	1.574** (0.797)	1.276 (0.810)	1.715** (0.722)	3.195*** (0.926)	2.798*** (0.912)
Income per Branch	1.407*** (0.446)	2.014*** (0.397)	1.696*** (0.440)	1.852*** (0.382)	1.658*** (0.404)	1.613*** (0.417)	1.692*** (0.440)
Bank Income per Capita	−0.978** (0.418)	−1.060** (0.417)	−1.019** (0.466)	−1.101 (0.694)	−0.843* (0.436)	−1.065** (0.428)	−1.200*** (0.463)
<i>Financial Development Variables</i>							
FV	0.928** (0.370)		0.574* (0.303)	0.382 (0.276)		0.465 (0.294)	0.508 (0.350)
FQ		1.059 (1.921)	1.530 (1.613)	−0.772 (3.694)	2.816*** (0.681)	3.225*** (0.666)	2.978*** (1.037)
FQ*FV				−0.623 (0.932)			0.062 (0.368)
Constant	−22.619*** (6.942)	−35.248*** (5.524)	−28.145*** (6.118)	−30.707*** (6.388)	−43.507*** (5.554)	−37.904*** (6.735)	−36.577*** (6.754)
Observations	1238	1238	1238	1238	1238	1238	1238
Regions	129	129	129	129	129	129	129
Instruments	31	31	37	43	31	37	43
Hansen statistic	19.06	20.99	26.89	26.92	13.36	16.20	23.37
Hansen p-value	0.04	0.02	0.03	0.14	0.20	0.37	0.27
AR(2) Statistic	0.31	0.11	0.25	0.08	0.08	0.14	0.14
AR(2) p-value	0.76	0.91	0.81	0.94	0.94	0.89	0.89

*Notes:* \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors in parentheses. FV and FQ represent regionally aggregated credit per GDP and bank efficiency variables. The latter have been estimated for all local banks in the sample. All variables in logs, but the growth rates. The two-step system GMM estimation, using robust standard errors, incorporates five lags in the collapsed instrument matrix. FV, FQ and the interaction term have been specified as endogenous. Year dummies are included.

smaller correlation between cost efficiency and e.g. a better project selection team of a bank. We focus henceforth on profit efficiency.

## 4 Robustness

### 4.1 Regional Allocation

The mapping of a bank to a specific region was conducted based on the zip code or city of the banks' headquarter. This can to a certain extent be called heuristic. Koetter and Wedow (2010) analyzed exactly this problem for German banks. Their approach was to check whether a bank's branches are located in the same *Raumordnungsregion*<sup>9</sup>, which are smaller than NUTS 2 regions. They found that 93% of all cooperative banks' branches and 97% of the savings banks' branches lie into the same *Raumordnungsregion*. For large and small commercial banks, however, this is the case only for 5% and 31%, respectively, of the branches. To account for this finding, we exclude financial centers which often host nationally operating banks from our sample. Namely, we are excluding Brussels, Frankfurt, Luxembourg, Madrid, Milan, Paris and Stockholm. The corresponding estimation can be seen in the first column of Table 4. The estimated coefficient for financial quality slightly increased.

To further deal with the aforementioned problem, we follow Koetter and Wedow (2010) and take only specific banking groups into account for the efficiency estimation and for the aggregation of the regional financial quality and volume proxy. Firstly, we only used banks which are even smaller in size than our group of banks we defined to be local. These banks are more likely to operate only within their headquarter's region. We defined small banks to be banks with mean total assets of less than 2 billion Euros.<sup>10</sup> Next, we only consider local savings banks which are by law restricted to a specific region or district. The results, see Table 4, illustrate that our main findings are robust. That the coefficient of financial quality is smaller if we only consider savings banks may be due to their further non-profit objectives which lead them to finance firms also because of non-economic reasons as electoral cycles (Englmaier and Stowasser, 2013).

Another approach to deal with spillovers is to explicitly model them. We estimate a spatial lag model in which our financial development variables are allowed to spillover to neighboring regions. We use a contiguity matrix to weight the financial development variables of the neighboring regions and include the weighted average variables in our regression. We used again our group of local banks which are more likely to operate across regions than small banks, but are less likely to be nationally active. We specified the spatial lags to be potentially endogenous, too. While we do not find evidence for spatial spillovers of financial volume, we do see that growth in a region is affected by its neighboring regions' financial quality.

### 4.2 Sample Selection and Interactions with the Regional Level of GDP

To control for whether the link between financial quality and economic growth differs between a region's level of economic development, we add an interaction term between financial quality and a region's

<sup>9</sup>These are aggregations of NUTS 3 regions. They are created based on economic interdependencies between districts.

<sup>10</sup>The 75th percentile of mean total assets is about 2 billion Euros.

Table 4: Across Regional Spillovers

	No Financial Centers			Spatial Spillovers (Local Banks)			
	Local Banks	Small Local Banks	Savings Banks	FV	FQ	FQ*FV	All
Lagged GDP per Worker Growth	−0.039 (0.039)	−0.013 (0.053)	−0.027 (0.049)	−0.026 (0.033)	−0.041 (0.037)	−0.049 (0.038)	−0.046 (0.034)
FV	0.710 (0.555)	0.867** (0.401)	1.140 (0.745)	0.510 (0.372)	0.275 (0.394)	0.263 (0.394)	0.378 (0.357)
FQ	3.518*** (1.285)	5.749*** (1.656)	2.668** (1.141)	3.243*** (1.086)	2.799** (1.218)	3.109** (1.303)	2.498** (1.069)
FQ*FV	0.277 (0.501)	0.912** (0.397)	0.679 (0.419)	0.154 (0.378)	0.186 (0.383)	0.140 (0.426)	0.077 (0.302)
Spatial FV				0.032 (1.291)			−1.980 (1.395)
Spatial FQ					5.616*** (1.997)		2.008 (3.953)
Spatial FQ*FV						−1.484** (0.629)	−1.880 (1.363)
Constant	−39.204*** (7.308)	−29.276* (16.306)	−20.866 (14.326)	−37.296*** (12.296)	−40.673*** (7.021)	−38.565*** (6.488)	−53.324*** (11.323)
Country-Specific Controls	Y	Y	Y	Y	Y	Y	Y
Observations	1161	1064	978	1238	1238	1238	1238
Regions	122	114	109	129	129	129	129
Instruments	43	43	43	49	49	49	61
Hansen statistic	26.49	33.32	20.78	31.01	31.45	32.93	47.30
Hansen p-value	0.15	0.03	0.41	0.19	0.17	0.13	0.08
AR(2) Statistic	0.20	0.43	0.18	0.24	−0.14	−0.04	0.20
AR(2) p-value	0.84	0.67	0.85	0.81	0.89	0.97	0.84

Notes: \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors in parentheses. FV and FQ represent regionally aggregated credit per GDP and bank efficiency variables. The latter have been estimated for the specific groups of banks in the sample. All variables in logs, but the growth rates. The two-step system GMM estimation, using robust standard errors, incorporates five lags in the collapsed instrument matrix. FV, FQ and the interaction terms have been specified as endogenous. Year dummies are included.

initial GDP per worker in Table 5. The interaction term has been specified as potentially endogenous as well. The estimated negative coefficient of the interaction term reveals that the channel between financial quality and growth is stronger for less developed European regions. This finding is comparable to Hakenes et al. (2014) who found a similar effect for Germany. Thus, our finding emphasizes the importance of efficient banks for the convergence of European regions.

Table 5: Germany, GDP Interaction Term and a Crisis Sample

	No Financial Centers			Without Germany		
	Baseline	GDP Interaction Term	Sample 2007-2013	Baseline	GDP Interaction Term	Sample 2007-2013
Lagged GDP per Worker Growth	−0.039 (0.039)	−0.053 (0.039)	−0.072 (0.059)	−0.058 (0.048)	−0.079* (0.045)	−0.057 (0.075)
FV	0.710 (0.555)	0.412 (0.489)	0.313 (0.503)	0.874 (0.559)	0.230 (0.510)	0.846 (0.541)
FQ	3.518*** (1.285)	79.297*** (24.598)	3.033** (1.178)	2.246 (1.852)	68.519** (27.496)	3.128* (1.798)
FQ*FV	0.277 (0.501)	0.055 (0.402)	0.103 (0.436)	0.023 (0.565)	−0.419 (0.461)	0.182 (0.539)
Log Initial GDP per Worker		−4.392*** (1.333)			−3.116* (1.709)	
FQ*Log Initial GDP per Worker		−7.070*** (2.280)			−6.283** (2.539)	
Constant	−39.204*** (7.308)	8.261 (14.024)	−54.025*** (9.521)	−41.167*** (10.882)	−4.283 (19.575)	−36.736** (18.370)
Country-Specific Controls	Y	Y	Y	Y	Y	Y
Observations	1161	1161	732	761	761	501
Regions	122	122	114	85	85	77
Instruments	43	50	39	43	50	39
Hansen statistic	26.49	27.57	24.41	27.11	28.36	23.75
Hansen p-value	0.15	0.33	0.23	0.13	0.29	0.25
AR(2) Statistic	0.20	0.06	−0.02	0.32	0.22	0.31
AR(2) p-value	0.84	0.96	0.98	0.75	0.83	0.76

*Notes:* \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors in parentheses. FV and FQ represent regionally aggregated credit per GDP and bank efficiency variables. The latter have been estimated for all local banks in the sample. All variables in logs, but the growth rates. The two-step system GMM estimation, using robust standard errors, incorporates five lags in the collapsed instrument matrix. FV, FQ and the interaction terms have been specified as endogenous. Year dummies are included.

Our sample includes the financial crisis period. Although we include time dummies in all our estimations to capture year-specific effects on economic growth, it can be suspected that the link between financial quality and economic growth is non-existent for our later sample period. Therefore, we implement an estimation for the time period 2007-2013. The obtained coefficients are similar to our baseline estimation which used the complete sample. Therefore, financial quality fosters growth even if the economy is experiencing a crisis. So, more efficient banks are able to identify firms that increase their productivity during “normal” times and are resilient to turmoil in “bad” ones.

Our results could be driven by the dominance of German banks in the sample. German banks represent 48% of the banks in our sample. Additionally, German banks are relatively small and often savings or cooperative banks which operate only locally (either by law or due to their cooperative nature). The last columns of Table 5 show that excluding German regions does weaken our results. A reason for that can

be that the market share of the local banks we are using here is smaller in other European countries, compare Table 2 or the reduced sample size. Nevertheless, if we reintroduce the GDP interaction term or take the crisis sample, we still obtain a significantly positive result for our financial quality measure.

### 4.3 Other Objectives and Groups of Banks

Also other objectives than GDP per worker as a productivity measure are of importance for policy makers. Thus, we also use GDP per capita and unemployment as dependent variables for the estimation of our growth equation. Table 6 shows that the results for GDP per capita are very similar to the previous ones. However, for unemployment we only find a beneficial effect of financial quality if we do not only look at the crisis sample. Therefore, it cannot be said that higher financial quality shields a region against rising unemployment during a crisis, but only against economic downturn. A reason for that could be that more efficient banks financed the firms that are keeping up their productivity even during a crisis period. One way for firms to not loose productivity is by reducing their workforce. This would explain why we obtained a significantly positive coefficient for the GDP per worker growth but not for unemployment.

Table 6: Other Objectives and Groups of Banks

	GDP per Capita		Unemployment		Other Groups of Banks for Efficiency Estimation			
	Baseline	Sample 2007-2013	Baseline	Sample 2007-2013	All Banks	Local Banks	Small Local Banks	Local Savings Banks
Lagged Dependent Variable	-0.020 (0.058)	-0.083 (0.056)	0.159** (0.081)	0.152** (0.061)	-0.028 (0.044)	-0.039 (0.039)	-0.013 (0.053)	-0.027 (0.049)
FV	0.569 (0.484)	0.425 (0.367)	-6.886* (3.774)	-6.850 (5.245)	0.633* (0.348)	0.710 (0.555)	0.867** (0.401)	1.140 (0.745)
FQ	3.102** (1.523)	2.981*** (0.936)	-26.836** (10.939)	-19.253 (14.199)	2.242** (1.011)	3.518*** (1.285)	5.749*** (1.656)	2.668** (1.141)
FQ*FV	0.246 (0.520)	0.231 (0.293)	-7.230** (3.201)	-4.289 (5.882)	0.235 (0.537)	0.277 (0.501)	0.912** (0.397)	0.679 (0.419)
Constant	-45.290*** (6.876)	-57.638*** (8.148)	-15.778 (71.841)	58.640 (91.880)	-50.947*** (6.746)	-39.204*** (7.308)	-29.276* (16.306)	-20.866 (14.326)
Country-Specific Controls	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1161	732	1149	725	1202	1161	1064	978
Regions	122	114	121	113	124	122	114	109
Instruments	43	39	43	39	43	43	43	43
Hansen statistic	31.66	25.16	46.52	31.33	35.94	26.49	33.32	20.78
Hansen p-value	0.05	0.20	0.00	0.05	0.02	0.15	0.03	0.41
AR(2) Statistic	0.33	-0.18	1.33	-0.65	0.26	0.20	0.43	0.18
AR(2) p-value	0.74	0.85	0.18	0.51	0.79	0.84	0.67	0.85

Notes: \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors in parentheses. FV and FQ represent regionally aggregated credit per GDP and bank efficiency variables. The latter have been estimated for the respective banks in the sample. All variables in logs, but the growth rates. The two-step system GMM estimation, using robust standard errors, incorporates five lags in the collapsed instrument matrix. FV, FQ and the interaction terms have been specified as endogenous. Year dummies are included.

Lastly, we present that our results are robust to efficiency estimations with different samples of banks. Estimating a stochastic frontier of all types and sizes of banks could lead to biased results as, for example, big banks have other technology regimes or savings banks do also have objectives next to profit maximization (Koetter and Poghosyan, 2009). To account for this, we estimated the stochastic frontier for different groups of banks. These groups consist of either all banks, local banks, small local banks or

only local savings banks.<sup>11</sup> Recall that the efficiency results do not change considerably, compare Table 1. The results are that our financial quality measure is still significantly positive for all specifications. The size of the coefficient, however, is smaller if a sample of all banks or savings banks is taken. For the sample of all banks this could be due to a biased stochastic frontier estimation. For savings banks this could be either to decreased sample size or as savings banks do not always choose the firm to finance which are the most productive but also have to take into account their other non-economic objectives (Englmaier and Stowasser, 2013).

## 5 Conclusion

While most studies analyzing the link between banks and economic growth considered only a financial *volume* measure to assess financial development, we also include a financial *quality* measure. We used as a proxy for financial quality the average estimated efficiency of banks within a region. For a sample of 131 regions from twelve European countries we found that the financial quality channel is stronger than the volume one. This is of particular interest as the years during the financial crisis are included. Thus, more efficient banks promote growth in developed countries not only in “normal” times, but also in “bad” ones.

One goal in the European Union is to promote growth in less developed regions to obtain convergence. We found in our analysis that the link between financial quality and economic growth is stronger in regions with low GDP per worker. Thus, improving efficiency of banks which operate in such regions is a reasonable instrument to reduce economic disparity. Furthermore, as we found that our results are robust across different banking groups, there are different options available to encourage efficiency gains as, for example, by adjusting laws for savings and cooperative banks or fostering investment in commercial banks’ IT.

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<sup>11</sup> Definitions are: Local banks are banks with less than 7 billion of mean total assets or the 90th percentile of the complete sample, small local banks are banks with less than 2 billion or the 75th percentile and local savings banks are local banks which are also savings banks.

## References

- Altunbas, Y., Evans, L., and Molyneux, P. (2001). Bank ownership and efficiency. *Journal of Money, Credit and Banking*, 33(4):926–954.
- Arellano, M. and Bond, O. (1995). Another look at the instrumental variable estimation of error-component models. *Journal of Econometrics*, 68:29 – 51.
- Arellano, M. and Bond, S. (1991). Some tests for specification of panel data: Monte carlo evidence with an application for employment equations. *Review of Economic Studies*, 58:277 – 299.
- Blundell, R. and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87:115 – 143.
- Bos, J. and Koetter, M. (2011). Handling losses in translog profit models. *Applied Economics*, 43(3):307 – 312.
- Bos, J. and Kool, C. (2006). Bank efficiency: the role of bank strategy and local market conditions. *Journal of Banking and Finance*, 30:1953 – 1974.
- Buch, C., Koch, C., and Koetter, M. (2011). Size, productivity, and international banking. *Journal of International Economics*, 85(2):329–334.
- Cuaresma, J. C., Doppelhofer, G., and Feldkircher, M. (2014). The determinants of economic growth in european regions. *Regional Studies*, 48(1):44–67.
- Englmaier, F. and Stowasser, T. (2013). Electoral Cycles in Savings Bank Lending. CESifo Working Paper Series No. 4402, CESifo Group Munich.
- Fernandez, A., Klein, M., Rebucci, A., Schindler, M., and Uribe, M. (2015). Capital control measures: A new dataset. NBER Working Papers No. 20970, National Bureau of Economic Research.
- Greene, W. (2005). Reconsidering heterogeneity in panel data estimators of the stochastic frontier model. *Journal of Econometrics*, 126:269 – 303.
- Guiso, L., Sapienza, P., and Zingales, L. (2004). Does local financial development matter? *The Quarterly Journal of Economics*, 119(3):929–969.
- Hakenes, H., Hasan, I., Molyneux, P., and Xie, R. (2014). Small banks and local economic development. *Review of Finance*, Forthcoming.
- Hasan, I., Koetter, M., and Wedow, M. (2009). Regional growth and finance in europe: Is there a quality effect of bank efficiency? *Journal of Banking and Finance*, 33(8):1446 – 1453.
- Higgins, M. J., Levy, D., and Young, A. T. (2006). Growth and convergence across the united states: Evidence from county-level data. *The Review of Economics and Statistics*, 88(4):671–681.
- Kalyvas, A. N. and Mamatzakis, E. (2014). Does business regulation matter for banks in the european union? *Journal of International Financial Markets, Institutions and Money*, 32:278 – 324.



- Kendall, J. (2012). Local financial development and growth. *Journal of Banking and Finance*, 36(5):1548 – 1562.
- Koetter, M. and Poghosyan, T. (2009). The identification of technology regimes in banking: Implications for the market power-fragility nexus. *Journal of Banking and Finance*, 33(8):1413–1422.
- Koetter, M. and Wedow, M. (2010). Finance and growth in a bank-based economy: Is it quantity or quality that matters? *Journal of International Money and Finance*, 29(8):1529 – 1545.
- Levine, R. (2005). Finance and growth: theory and evidence. In *Aghion, P., Durlauf, S. (Eds.), Handbook of Economic Growth*. North-Holland, Amsterdam.
- Levine, R., Loayza, N., and Beck, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics*, 46(1):31 – 77.
- Loayza, N. V. and Ranciere, R. (2006). Financial development, financial fragility, and growth. *Journal of Money, Credit and Banking*, 38(4):1051–1076.
- Lozano-Vivas, A. and Pasiouras, F. (2010). The impact of non-traditional activities on the estimation of bank efficiency: International evidence. *Journal of Banking and Finance*, 34(7):1436 – 1449.
- Lozano-Vivas, A., Pastor, J., and Pastor, J. (2002). An efficiency comparison of european banking systems operating under different environmental conditions. *Journal of Productivity Analysis*, 18:59 – 77.
- Moretti, L. (2014). Local financial development, socio-institutional environment, and firm productivity: Evidence from Italy. *European Journal of Political Economy*, 35:38 – 51.
- Pascali, L. (2014). Banks and development: Jewish communities in the Italian Renaissance and current economic performance. *Review of Economics and Statistics*, Forthcoming.
- Quah, D. (1996). Regional convergence clusters in Europe. *European Economic Review*, 40:951 – 958.
- Restrepo-Toban, D. and Kumbhakar, S. (2014). Enjoying the quiet life under deregulation? not quite. *Journal of Applied Econometrics*, 29:333–343.
- Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, 9(1):86–136.
- Rousseau, P. L. and Wachtel, P. (2011). What is happening to the impact of financial deepening on economic growth? *Economic Inquiry*, 49(1):276–288.
- Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, 126:25 – 51.

A   Figures

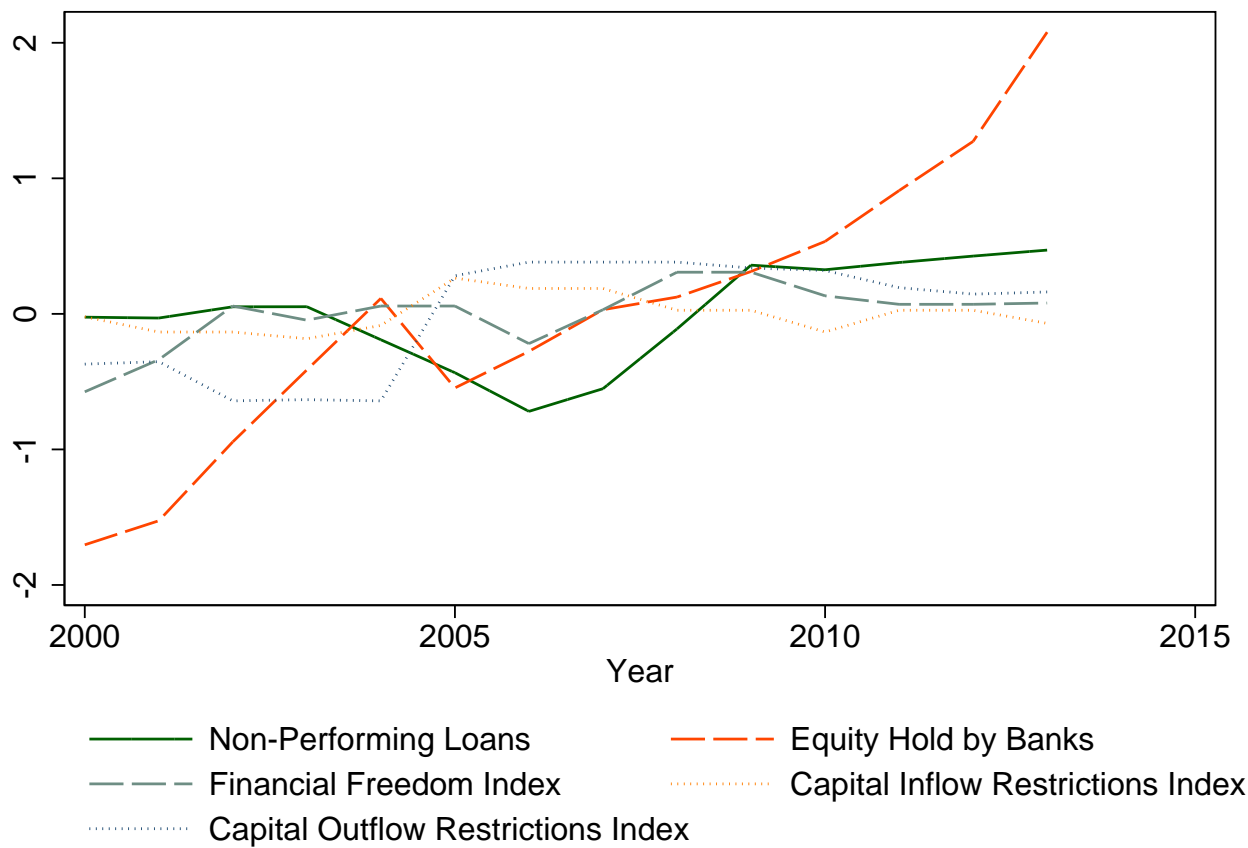


Figure 1: All variables have been standardized to a mean of zero and a standard deviation of one for comparability. Variables show across-country means over the period 2000-2013. Higher values of the indices represent stricter regulation. The GDP per capita and equity variables are measured in real values.

Regional Financial Volume of Local Banks  
2007

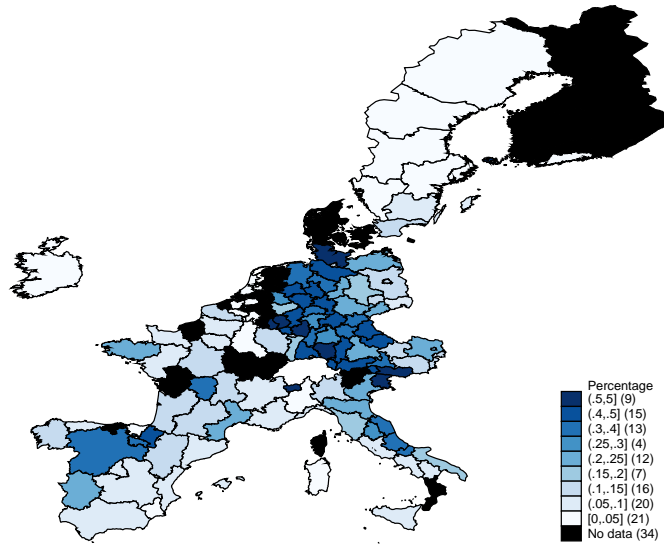


Figure 2: Regional financial volume is measured as the ratio between aggregated loans of all local banks within a region and GDP.

Regional Cost Efficiency of Local Banks  
2007

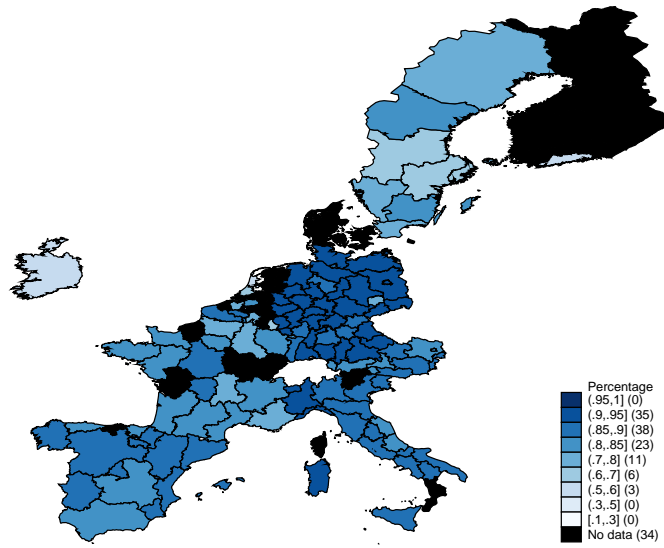


Figure 3: Regional cost efficiency represents the average estimated cost efficiency of all local banks within a region.

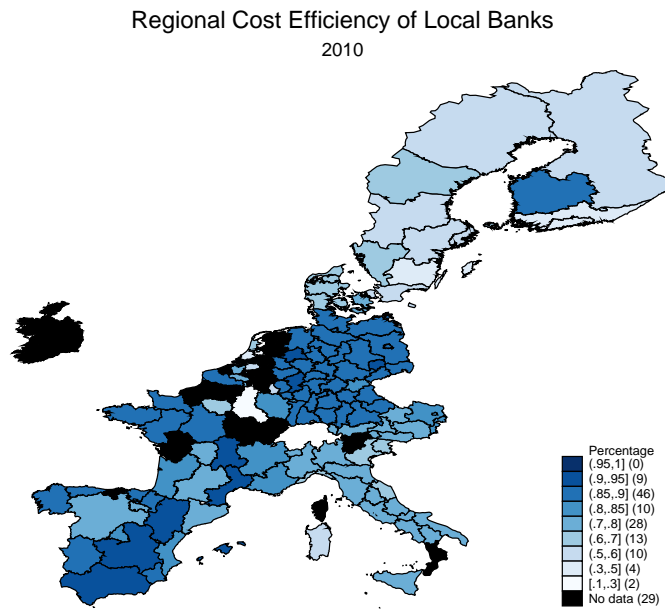


Figure 4: Regional cost efficiency represents the average estimated cost efficiency of all local banks within a region.

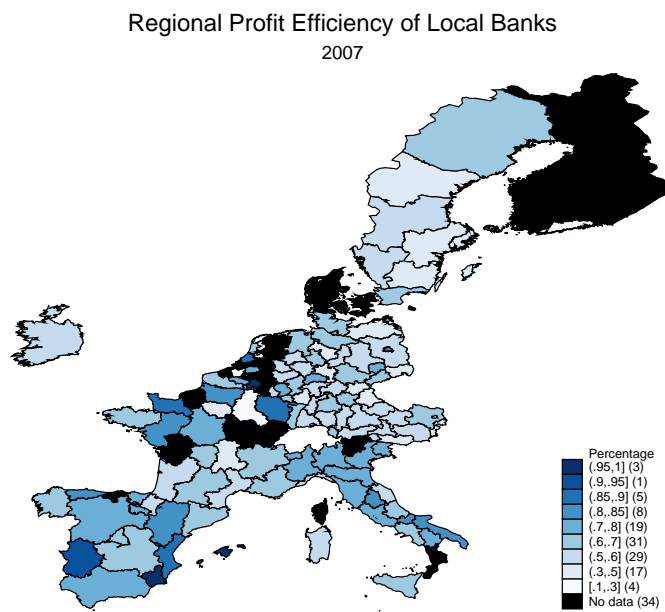


Figure 5: Regional profit efficiency represents the average estimated profit efficiency of all local banks within a region.

Regional Profit Efficiency of Local Banks  
2010

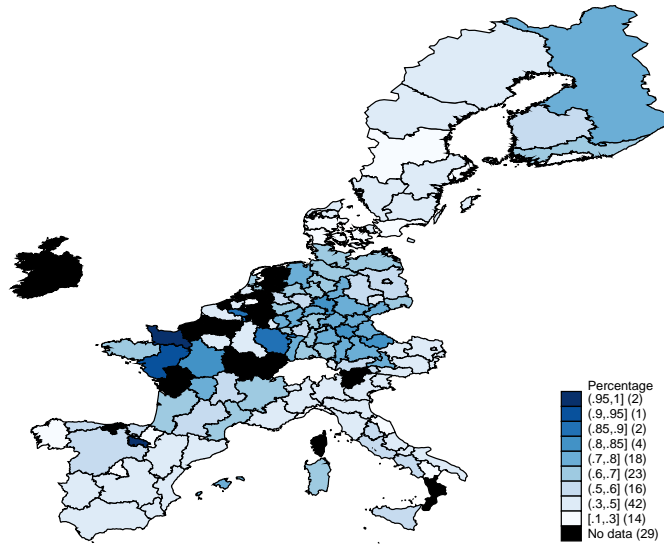


Figure 6: Regional profit efficiency represents the average estimated profit efficiency of all local banks within a region.