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The implications of latent technology regimes for competition and efficiency in banking

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Abstract

Banks continue to differ in many ways, for instance with respect to business models, growth strategies, or financial health. Neglecting these differences confuses inefficiency with heterogeneity while sub-sample estimation prohibits efficiency comparisons across different samples. We use a latent class stochastic frontier model to estimate simultaneously multiple technology regimes and group membership probabilities. The latter are conditioned on six bank traits of German banks and we identify four significantly different technology regimes. Only small, retail focused banks exhibit cost inefficiencies, which are 5.4% on average and thus substantially lower compared to previous studies. We use technology regime specific cost parameters to measure competition with Lerner indices. Large, national universal banks and the smallest, most specialized banks exhibit the lowest level of competition. In turn, medium sized universal banks are both efficient and exhibit the lowest Lerner margins between 1994 and 2004.

Keywords: Banks; competition; efficiency; latent class frontier; strategy
JEL: G21; L1

Non-technical summary

The German banking industry is often described as a three pillar system comprised of commercial, cooperative, and savings banks. This taxonomy serves as an almost natural definition of market segments. But in addition to this classification, banks might also be grouped within and across pillars according to other criteria, for instance, business models, financial health, or growth strategies. Given these systematic differences, many comparative studies select a priori sub-samples of 'comparable' banks. However, any a priori selection of banking groups inevitably introduces some random element into the analysis of competition and prohibits relative efficiency comparisons across samples.

We suggest a latent class model that allows us to *estimate* different technology regimes rather than having to define market segments. We estimate bank-specific probabilities to belong to any such technology regime conditional on bank production and six bank traits that do not belong to bank's transformation technology. For each technology regime we derive Lerner indices to measure competition developments.

We identify four technology regimes: large national universal banks with some indication of a wholesale focus; medium sized universal banks with pronounced abilities to innovate in terms of technical change; very small specialized banks that presumably focus on relationship banking; and a large group of small retail banks. While the majority of banks located in groups 3 and 4 exhibit cost inefficiency on the order of five percent, the first two groups do not deviate systematically from their respective group-specific frontiers. Hence, different technology regimes imply much lower mean inefficiency since they distinguish the former from systematic differences.

Technology regimes also differ significantly regarding competitiveness and riskiness. The groups comprising large (inter)nationally active universal and very small, highly specialized retail banks exhibit both the highest frequency of distress (riskiness) and the highest Lerner margins. This suggests the existence of different business models that are more risky but also offer higher returns. In turn, the group of medium sized universal banks, of which more than half are savings banks, show simultaneously high efficiency and low Lerner margins. Overall, competition declined in all four regimes up and until 2001 but increased thereafter. At the same time, the average level of competition is relatively high compared to other European studies.

Nichttechnische Zusammenfassung

Das deutsche Bankwesen wird oft als Drei-Säulen-System bezeichnet, welches aus Sparkassen, Geschäfts-, und Genossenschaftsbanken besteht. Diese Systematik wird oft als geradezu natürliche Marktsegmentierung verstanden. Banken können sich jedoch auch zwischen und innerhalb der drei Säulen hinsichtlich anderer Kriterien unterscheiden, zum Beispiel Wachstumsstrategien, Stabilitätseigenschaften oder Geschäftsmodellen. Viele vergleichenden Studien definieren oftmals vorab Teilstichproben, um diese Unterschiede zu berücksichtigen. Jede Bildung von Bankengruppen beinhaltet jedoch unweigerlich eine zum Teil willkürliche Komponente und verhindert außerdem den Vergleich relativer Effizienzmaße zwischen Teilstichproben.

In dieser Studie benutzen wir ein *latent class frontier model* (LCFM), um unterschiedliche Technologiegruppen empirisch zu schätzen anstatt sie zu definieren. Wir ermitteln die Wahrscheinlichkeit der Gruppenzugehörigkeit (GZW) je Bank in Abhängigkeit von sechs individuellen Charakteristika. Für jede Technologiegruppe leiten wir Wettbewerbsmaße ab und untersuchen deren Entwicklung zwischen 1994 und 2004.

Wir identifizieren vier unterschiedliche Gruppen: große, (inter)national tätige Universalbanken, mittelgroße Universalbanken mit ausgeprägtem technologischen Fortschritt, sehr kleine, spezialisierte Banken und eine große Gruppe kleiner Banken. Die meisten Banken sind in den Gruppen 3 und 4 enthalten und weisen eine Ineffizienz von etwa 5% auf. Die beiden ersten Gruppen weichen jedoch nicht systematisch von ihren jeweiligen Kostenoptima ab. Die Berücksichtigung unterschiedlicher Technologiegruppen führt somit zu einer niedrigeren Kostenineffizienz, weil systematische Unterschiede besser berücksichtigt werden.

Technologiegruppen unterscheiden sich auch hinsichtlich Wettbewerb und Risiko. Die Gruppen großer Universalbanken und kleiner Spezialisten weisen die meisten Ausfallereignisse und die höchsten Lerner Indizes auf. Dies deutet auf Geschäftsmodelle hin, welche mehr Risiko, jedoch auch höhere Margen beinhalten. Im Gegensatz hierzu sind die Lerner Indizes der Gruppe 2 im Mittel am niedrigsten während die durchschnittliche Effizienz sehr hoch ist. Diese Gruppe mittelgroßer Universalbanken umfasst etwa zur Hälfte Sparkassen. Insgesamt hat die Wettbewerbsintensität bis 2001 in allen Gruppen zugenommen. Seitdem steigen Lerner Indizes wieder an, jedoch von einem recht niedrigen Niveau aus.

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The implications of latent technology regimes for competition and efficiency in banking[1]

1 Introduction

Efficiency comparisons of European banks are important given the ongoing integration of the single market and the implications for competition. But banks continue to differ in many respects, which necessitates to distinguish inefficiency from other systematic differences in comparative studies (Bos and Schmiedel, 2007; Berger, 2007). Differences concern, for instance, business models (universal versus special), growth strategies (mergers versus organic), or financial health. Most efficiency studies therefore pursue two approaches to deal with this challenge.

The first strand of the literature separates bank samples a priori into 'comparable' peer groups.[2] Mester (1993, 1997) restricts the estimation of cost frontiers to specific banking groups and U.S. states, respectively. She rejects the hypothesis of identical cost parameters and concludes that benchmarking these banks against each other in a pooled frontier analysis is inappropriate. But meaningful priors, such as market delineations constituted by U.S. states prior to the Branching Act in 1996, are often unavailable and also change over time. Therefore, any a priori selection of 'adequate' peer groups is inevitably arbitrary to some extent. Moreover, efficiency scores are relative measures, which prohibits comparisons across different samples (Coelli et al., 2005). Therefore, inference relying on estimated parameters cannot be drawn from separate estimations. This is particularly cumbersome for European policy makers since competition studies using Lerner indices, for example Angelini and Cetorelli (2003) and Fernández de Guevara et al. (2007), use cost function parameter and efficiency estimates to assess the success (or failure) to enhance competitive behavior.[3]

A second strand in the literature therefore accounts for Mester's important critique by specifying additional controls to distinguish systematic differences across banks from inefficiency (see, for example, Dietsch and Lozano-Vivas, 2000; Maudos

[1]The opinions expressed here are those of the authors and not necessarily those of the Deutsche Bundesbank. We are grateful to the Bundesbank for the provision of data. This paper is part of a research project sponsored by the foundation 'Geld und Währung'. Michael Koetter gratefully acknowledges support from the Netherland's Organization for Scientific Research NWO.

[2]A priori sample selection is not confined to bank efficiency studies. For example, Porath (2006) and Stolz and Wedow (2005) restrict their analyses of default probabilities and capital buffers to sub-samples of German banks, too.

[3]Both the Panzar-Rose approach as well as Lerner indices rely on cost function parameter estimates to generate either the H-statistic or scaled Lerner margins as proxies of competition. See Bikker and Haaf (2002) for an overview.

et al., 2002; Casu and Molyneux, 2003). Additional controls usually reduce inefficiency estimates. In fact, Valverde et al. (2007) report that cost inefficiencies vanish almost entirely after accounting for environmental and industry trends in the kernel of a cost frontier for a sample of Spanish savings and commercial banks. But already Deprins and Simar (1989) pointed out that it is often hard to determine if a covariate is part of the objective function of decision making units, or if it constitutes a determinant of deviations from it's frontier.[4] Related, Bos et al. (2008) confirm that adding controls to the frontier's kernel reduces inefficiency. But specifying the same controls as determinants of the inefficiency distribution actually decreases efficiency.

Thus, there remain considerable ambiguities regarding (i) which banks to compare and (ii) how to account for systematic differences. We suggest in this paper a novel parametric method in the vein of Orea and Kumbhakar (2004) and Greene (2005). We avoid any a priori grouping of banks and formulate a stochastic frontier model as a latent variable problem. Technology regimes can differ and bank's probability to be part of one particular regime is estimated simultaneously with frontier parameters and efficiency scores. Regime membership probabilities are estimated conditional on a number of bank traits. This approach has the advantage to remain entirely agnostic as to the number and composition of banking regimes. The model allows us to test the existence of systematically different groups of banks according to criteria approximating banks business strategy, their financial health, and growth strategies.

In extension to Orea and Kumbhakar (2004) and Greene (2005), we also provide evidence on the implications of different technology regimes regarding the competitive stance of German banks. Similar to Fernández de Guevara et al. (2007), we employ cost frontier estimates to measure competition by means of Lerner indices. In contrast to previous Lerner studies (see e.g. Angelini and Cetorelli, 2003) we thus avoid the use of biased parameters due to the neglect of a composed error term. With respect to Fernández de Guevara et al. (2007), we seek to complement their evidence in two important respects. First, we allow for systematically different technology regimes by using group-specific cost frontier parameters. Second, the use of confidential financial accounts data provided by the Bundesbank allows us to specify bank outputs in a more detailed fashion compared to the aggregate measures used in their study.

Our main result is evidence in favor of four significantly different technology regimes among German universal banks. Only two regimes employ input factors

[4]Kumbhakar and Lovell (2000) provides a comprehensive overview how environmental and other controls can affect efficiency. Greene (2005) suggests a number of alternative estimators as how to deal with heterogeneity in panel frontier settings.

systematically inefficient after allowing for different technologies. The competitive behavior among large, wholesale and very small, specialized and presumably relationship focused banks is the lowest. High Lerner margins, however, are accompanied by the largest distress frequencies. Hence, this result indicates that some intermediation technologies simply incur more risks, but also yield higher margins. The group with the largest share of savings banks also yields full efficiency. Simultaneously, Lerner indices are low. This indicates that such medium sized retail banks presumably pass the benefits from operational efficiency and close to optimal scale operations on to consumers.

The remainder of this paper is structured as follows. First, we introduce the latent class stochastic frontier model, regime membership determinants, and the approach to obtain Lerner indices of competition in section 2. Results are presented in section 3. We conclude in section 4.

2 Methodology

2.1 Latent cost frontiers

As most bank efficiency studies, we follow the intermediation approach and assume that banks minimize costs C by choosing optimal input quantities $x^*(y, w)$ at given input prices w to provide a certain monetary volume of financial services and products given their technology constraint (Sealey and Lindley, 1977). Deviations from optimal cost C^* in year t can either be due to random noise or suboptimal employment of inputs. A baseline stochastic cost frontier for a bank k is then:

$$\ln C_{kt} = f(y_{kt}, w_{kt}, trend; \beta) + \varepsilon_{kt}, \tag{1}$$

where lower case letters indicate logs, $trend$ is an interacted time trend to capture technical change and β is a vector of parameters to be estimated. The total error in equation (1) is $\varepsilon_{kt} = v_{kt} + u_{kt}$, where v_{kt} denotes random noise, and u_{kt} stands for deviations due to inefficiency. To identify the model we use standard distributional assumptions on error term components and impose the required restrictions.[5]

The most frequent approaches entail to either estimate equation (1) for an a priori selection of different samples (Dietsch and Lozano-Vivas, 2000; Maudos et al., 2002; Casu and Molyneux, 2003) and/or to augment the frontier with further control

[5]Kumbhakar and Lovell (2000) review and discuss alternative error term assumptions. Here, we assume v_{kt} is $i.i.d.$ and $v_{kt} \sim N(0, \sigma_v^2)$ and u_{kt} is $i.i.d. N|(0, \sigma_u^2)|$. Point estimates of cost efficiency are obtained by $E(u_{kt}|\varepsilon_{kt})$.

variables z_{kt} (Mester, 1993, 1997).[6] This maintains the implicit assumption of one single (augmented) production technology for all banks.

Instead, we allow for different technology regimes, where membership probabilities are conditional on a set of control variables z_{kt} as suggested in Orea and Kumbhakar (2004) and Greene (2005). This approach allows us to remain agnostic as to which banks belong into which group. In fact, we can test the predictive power of certain bank traits and institutional factors to discern different technology regimes. We write the latent class stochastic frontier model as:

$$\ln C_{kt|j} = f(y_{kt|j}, w_{kt|j}, trend; \beta_j) + v_{kt|j} + u_{kt|j}. \tag{2}$$

The difference of the latent class equation (2) and the frontier model in equation (1) is that parameters differ across the latent classes $j = 1, ..., J$. Equation (2) is estimated with maximum likelihood methods where the likelihood function is depicted by Greene (2005) as:

$$LF(k,t|j) = f(C_{kt}|y_{kt}, w_{kt}, trend; \beta_j, \sigma_j, \lambda_j) = \frac{\Phi(\lambda_j \epsilon_{kt|j})}{\Phi(0)} \frac{1}{\sigma_j} \phi(\frac{\epsilon_{kt|j}}{\sigma_j}), \tag{3}$$

where $\epsilon_{kt|j} = C_{kt|j} - f(y_{kt|j}, w_{kt|j}, trend, \beta_j)$, $\lambda_j = \sigma_{uj}/\sigma_{vj}$, $\sigma_j = \sqrt{(\sigma_{uj}^2 + \sigma_{vj}^2)}$ and Φ is the CDF. Conditional on the bank being in class j, the contribution of each firm to the likelihood function is:

$$LF(k|j) = \prod_{t=1}^{T} LF_{kt|j}. \tag{4}$$

The unconditional likelihood for each firm is averaged over the latent classes using the prior probability as weights to membership in group j:

$$LF(k) = \sum_{j=1}^{J} P(k,j) LF_{k|j} = \sum_{j=1}^{J} P(k,j) \prod_{t=1}^{T} LF_{kt|j}. \tag{5}$$

In equation (5), the term $P(k,j)$ is the prior probability that is attached to membership of bank k to class j. Note that this is based on the observed data rather than any a priori grouping. Banks reside in a class permanently and group membership probability depends on characteristics z_{kt}. To estimate group memberships, we use a multinomial logit model of the form:

$$P(k,j) = \frac{\exp \pi_j' z_{kt}}{\sum_{m=1}^{J} \exp \pi_m' z_{kt}} \text{ for } \pi_J = 0. \tag{6}$$

[6]Control variables can be specified in the kernel, the expected value of the inefficiency distribution, or the variance of the inefficiency distribution. However, Bos et al. (2008) show that such control variables z_{kt} might affect both banks' abilities to attain the frontier or the location of the frontier itself.

where the last group serving as the reference group and z_{kt} are firm specific characteristics that determine class membership.

2.2 Technology determinants and data

In line with the intermediation approach, we specify four volume measures of output y_1 to y_4: interbank loans, customer loans, securities, and off-balance sheet activities. Banks employ fixed assets, labor, and borrowed funds denoted as w_1 through w_3, respectively. As dependent variable we specify total operating cost C. All variables are obtained from financial accounts reported to the Bundesbank between 1994 and 2004. Table 1 shows descriptive statistics.

Table 1: Descriptive statistics of German banks 1994-2004

Variable		**Mean**	**Stdv**	**Percentile**	
				5th	*95th*
Interbank loans	y_1	406.0	4713.7	2.4	311.0
Customer loans	y_2	804.4	7332.1	14.1	1580.0
Securities	y_3	388.5	4157.2	4.4	669.0
Off-balance sheet	y_4	231.5	3246.4	0.7	178.0
Price of fixed assets	w_1	22.4	499.7	7.1	33.9
Price of labor	w_2	52.0	161.9	36.4	65.1
Price of borrowed funds	w_3	3.6	3.1	2.4	4.7
Cost	C	10.4	67.8	0.1	27.6
Equity	z_1	61.0	535.0	1.5	119.0
Mortgages	z_2	37.3	23.8	0.0	79.0
Branches	z_3	36.2	38.0	2.3	104.8
Distress	z_4	9.3			
Mergers	z_5	5.7			
Public	z_6	21.3			

Notes: 29,695 observations. All monetary values denoted in millions of 2000 Euros unless noted otherwise. Labor cost in thousands of Euro per employee (FTE). Funding and fixed asset cost as well as shares of public banks, mergers, and distressed events in percentages. Number of branches to total assets (in billions).

We also depict in the bottom panel of table 1 covariates to determine group membership. The first is equity as to control in the vein of Mester (1993) for different risk preferences and funding structures across banks. We specify equity not as part of the deterministic kernel but as a determinant of regime membership given it's role to serve as a signal of financial health and risk preferences of the bank.

Second, we control for bank's share of real estate loans in long-term lending. Universal banks in Germany are allowed to venture into virtually any line of business. Bank failure studies, for example by Harrison and Ragas (1995) and Gan (2004), show that larger exposures to real estate markets increase the odds of bank distress.

Additionally, Davis and Zhu (2005) point out that banks can also be affected indirectly. Adverse price developments can put bank customers at jeopardy, thereby causing subsequent (non-mortgage) credit failures and performance deteriorations at banks without large direct exposures, too.

Third, we account for distinctively different business models among German universal banks. Large commercial banks operate nationwide as well as in international financial markets and engage extensively in wholesale and investment banking activities. The vast majority of banks, in turn, is small in size and regional in scope (Hackethal, 2004). Regarding the latter, both local savings banks and cooperative banks explicitly aim to provide comparably small corporate and private customers with financial services. This focus on small and medium enterprises and private customers usually implies relatively extensive branching networks, which might be detrimental to bank efficiency (Lang and Welzel, 1999). Therefore, we control for the number of branches per billion of Euros in total bank assets.

Fourth, we specify a direct measure of bank's financial health as a determinant of it's technology regime membership. Williams (2004) reports for European savings banks that it is primarily bad management that deprives efficiency. Related, Hughes et al. (2000) show that accounting explicitly for different risk-characteristics across banks yields substantially different efficiency, productivity, and performance results in benchmarking exercises.[7] We use observed distress events collected by the Bundesbank as a determinant of systematically different production technologies given the quality and riskiness of the bank. Distressed events are defined pursuant to the credit act and guidelines issued by the Federal Financial Supervisory Authority (*BaFin*). The data comprise obligatory notifications from banks in line with the credit act, compulsory notifications about losses amounting to 25 percent of the liable capital, a decline of operational profits by more than 25 percent, or more direct measures forwarded by the *BaFin*, for example official warnings to the bank CEO, orders to restructure operations, restrictions to lending and deposit taking, and dismissal of the bank CEO.[8]

The fifth control indicates if another bank was acquired. Previous evidence shows that bank mergers do either yield no or small cost efficiency gains (Lang and Welzel, 1999; Focarelli et al., 2002; Koetter, 2008). Potentially, the integration of targets is relatively factor intensive compared to 'business-as-usual' among non-merging peers. Also, a number of studies show that absorbed banks are financially weak and mergers provide a mean to let these banks exit the market without disrupting the system

[7]For example, a bank that is more risk-inclined might also yield a more productive intermediation technology.

[8]A more detailed data description can be found in Kick and Koetter (2007).

(Koetter et al., 2007). This would further explain lower cost efficiency due to mergers. However, immediate inefficiencies may be the price banks pay to attain more productive intermediation technologies, for example by reaping larger economies of scale, by diversifying revenue sources, and complementing existing product and service portfolios. Mergers might thus help to identify technology regimes and associated efficiency estimates. Finally, a dummy variable controls for public ownership of the bank.

2.3 Competition

We expect to identify distinctively different technology regimes among German banks conditional on these six characteristics. The implications of different technology regimes, in turn, go beyond the mere documentation of bank-specific efficiency scores measured against appropriate frontiers. Instead, different cost function parameters obtained for each regime also imply different estimates of bank's marginal costs.

This affects competition measures, too, since these often rely on estimated cost function parameters. Akin to Angelini and Cetorelli (2003) and Maudos and Guevara (2007) we therefore use Lerner indices to assess the competitive behavior of individual banks. Competition is measured as the (scaled) difference between average revenues AR and marginal cost MC (Lerner, 1934):

$$L = \frac{(AR - MC)}{AR}. \tag{7}$$

In competitive markets, marginal cost equal average revenues. Therefore, low values of Lerner indices L indicate more competition and vice versa. Most studies estimating Lerner indices obtain marginal cost estimates from cost function specifications similar to equation (1) with two important differences. First, most studies specify aggregate output proxies, such as total assets or total loans (Angelini and Cetorelli, 2003). Second, with the exception of Fernández de Guevara et al. (2007), virtually no competition study accounts for the bias in cost function parameters when neglecting the composed error term component. Additionally, we account for the group specific differences of cost frontier parameters. Marginal costs equal scale economies times average cost. We use group-specific cost parameters from equation (2) to write:

$$MC_{kt|j} = \sum_m \frac{\partial \ln C_{kt|j}}{\partial \ln y_{mkt|j}} \times \frac{C_{kt|j}}{\sum_m y_{mkt|j}} \tag{8}$$

Note that in extension to Angelini and Cetorelli (2003) partial cost derivatives account for inefficiency since we obtain them with stochastic frontier analysis. Further, we specify four outputs $m = 1, .., 4$ instead of only one or two (sub)aggregates (Fernández de Guevara et al., 2007). This allows us to distinguish more carefully for the product mix of banks and it's implications for the competitiveness.[9] Finally, Lerner indices $L_{kt|j}$ are group-specific and are therefore conditional on group membership determinants z, too. At the same time, we do not impose any a priori grouping of banks. Instead, we estimate the likelihood of belonging to a certain regime with an identical frontier. Estimates of group membership therefore also provide an indication as to which banks compete with another.

3 Results

First, we need to specify the number of classes J when estimating equations (2) and (6). As suggested in Greene (2005), we begin by allowing up to five technology regimes and then 'test down' if the model can be reduced to fewer classes. In addition to log likelihood values (LF) and according LR-tests, we provide in table 2 also the Akaike Information Criterion (AIC) as suggested in Orea and Kumbhakar (2004).[10]

Table 2: Specification tests on number of latent classes

Classes J	**AIC**	**LF**	**LR-test**	**K**
1	-15,432	7,754	0.000	17
2	-27,975	14,068	0.000	36
3	-38,835	19,538	0.000	54
4	-43,128	22,025	0.000	72
5	-42,285	21,344	n/a	90

Notes: Observations: N; $AIC = -2lnLF(J) + 2m$; $LR - test = -2[LF(R) - LF(U)]$; where LF is the log-likelihood value, J is the number of classes, K is the number of parameters, and U and R unrestricted and restricted LF values, respectively.

Information criteria support univocally a latent class specification with four regimes. Note, that information criteria in table 2 are based on unconditional latent class estimations, i.e. excluding the vector of controls z in equation (6). Qualitatively, results are identical for tests including a slightly reduced vector z.[11]

[9] Ideally, we would match product-specific marginal cost with according revenue streams to assess competition per output category. Unfortunately, product-specific income flows are not available.

[10] The preferred model is supported by low AIC and high LF values. LR-tests conducted for the previous latent class model with $J - 1$ classes.

[11] A model with five latent classes and all controls is overspecified and could not be maximized. Therefore, we report here test results without z. We also tested the translog functional form including factor and output interaction terms. The large number of parameters implied overspecification and maximization problems, too. Since interaction terms have no economic meaning but help to approximate the data in a more flexible fashion, we prefer here to avoid inherent multicollinearity

Consider therefore parameter estimates of both the deterministic kernel and technology regime membership determinants from a latent class model with four groups in table 3. It is important to note that parameters are obtained simultaneously for each group. Before turning to a more in-depth description of group characteristics, already these results indicate significant differences across classes.[12]

Table 3: Latent cost frontier and group determinants

Class	*1*		*2*		*3*		*4*	
Kernel	β_j	*p value*	β_j	*p value*	β_j	*p value*	β_j	*p value*
Intercept	-1.472	0.033	-2.153	1.000	-1.264	0.000	-3.178	0.000
w_1	0.132	0.000	-0.035	0.000	0.144	0.000	0.004	0.088
w_2	0.315	0.000	0.720	0.000	0.065	0.000	0.113	0.000
y_1	0.211	0.000	0.202	0.000	0.035	0.000	0.118	0.000
y_2	0.617	0.000	0.231	0.000	0.755	0.000	0.567	0.000
y_3	0.100	0.000	0.569	0.000	0.045	0.000	0.295	0.000
y_4	-0.070	0.000	-0.128	0.000	0.021	0.000	0.001	0.215
$Time$	-0.063	0.000	-0.106	0.000	-0.049	0.000	-0.049	0.000
$Time^2$	-0.006	0.000	0.002	0.006	0.001	0.001	-0.001	0.000
$Time \times y_1$	-0.006	0.000	0.005	0.000	0.003	0.000	-0.003	0.000
$Time \times y_2$	-0.011	0.000	0.042	0.000	0.002	0.000	0.012	0.000
$Time \times y_3$	0.018	0.000	-0.049	0.000	-0.002	0.000	-0.010	0.000
$Time \times y_4$	0.002	0.019	0.012	0.000	-0.001	0.007	0.001	0.000
$Time \times w_1$	0.001	0.214	0.019	0.000	-0.001	0.395	0.003	0.000
$Time \times w_2$	0.030	0.000	-0.051	0.000	0.004	0.050	0.023	0.000
σ	0.191	0.000	0.240	0.000	0.149	0.000	0.158	0.000
λ	0.074	0.987	0.000	1.000	0.579	0.000	3.091	0.000
Group determinants	π_j	*p value*	π_j	*p value*	π_j	*p value*	π_j	*p value*
Intercept	-9.716	0.000	5.380	0.000	-2.140	0.015	- control group -	
Equity	0.667	0.000	-0.555	0.000	0.117	0.040	- control group -	
Mortgages	-0.082	0.000	0.000	0.985	-0.025	0.000	- control group -	
Distress	0.094	0.055	0.021	0.770	0.135	0.002	- control group -	
Branches	0.007	0.000	0.022	0.000	-0.017	0.103	- control group -	
Mergers	-1.242	0.000	-1.702	0.000	-0.955	0.063	- control group -	
Public	-3.948	0.000	3.017	0.000	-0.688	0.003	- control group -	
Observations	3,227		1,872		3,589		21,007	

Notes: 29,695 observations; 3,524 banks; dependent variable is $\ln C$; LF: 23,015; $\sigma = \sigma_u + \sigma_v$; $\lambda = \sigma_u/\sigma_v$.

Inefficiency does not prevail in all technology regimes. Estimates of λ are only significant in groups 3 and 4. Since these groups are the largest, the result that most banks forego some resources systematically is in line with previous evidence. However, our results also highlight that inefficiencies do not exist in two technology regimes accounting for approximately a quarter of all banks.

Fully efficient technology regimes may indicate well-established technologies and standardized processes. Potentially, banks in these groups are very experienced to operate these technologies and therefore incur little or no systematic operational slack. In turn, this might also imply that banks in these groups exhibit fairly low or no technological progress if inefficiencies are more likely present when innovating.

problems. We add flexibility by allowing for different technology classes conditioned on controls z which permit economic inference and interaction terms regarding the time trend.

[12]We conducted Wald tests on both the joint and individual identity between parameters of different groups. The vast majority of tests reject that both production technology and regime membership coefficients are equal across groups.

Parameter estimates of time trends confirm differences across groups and we describe below each technology regime also in terms of technological change, measured by partial derivatives of cost w.r.t these parameters.

Consider beforehand that parameters for both kernel and the six group determinants in the bottom panel of table 3 are almost all significant at the 1%-level. Especially the latter is important since it highlights that group membership probabilities can be estimated rather than being imposed. But the effects of individual controls differ at times substantially across technology regimes. For example, better capitalized banks are, relative to the control group, more likely to be in the second regime and less likely to be a member in the first regime. While both groups are fully efficient, as indicated by insignificant λ's, this indicates already fundamental differences between these two group's risk-taking attitude.

Technology and group membership parameters show that even within one country significantly different bank technology regimes exist. Simultaneous estimation of group-specific frontiers permits a comparison of relative efficiency measures and highlights that in Germany around a quarter of the sample did not incur significant operational slack between 1994 and 2004. To assess the characteristics of identified technology regimes, we describe each group in table 4 in terms of specified group membership determinants and economic performance indicators derived from ancillary calculations based on estimated latent class parameters.

The top panel in table 4 provides the mean and standard deviation of variables specified in the latent class model. The first technology regime includes the largest banks, as measured by the level of equity.[13] This group exhibits below average involvement in mortgage lending activities but maintains the most extensive branching networks. The former suggests that these banks are less focused on retail banking activities. The latter, in turn, is in line with nation wide operations with relatively many representations. When comparing the classification based on the latent class model to the three pillar taxonomy of commercial, savings, and cooperative banks, we find in fact that this group is dominated by commercial, central savings and cooperative bank-year observations. Moreover, the output portfolio in terms of specified outputs y_m is the most diversified one across groups, yielding a Hirschman-Herfindahl-Index (HHI) across the four outputs of 2,789. Therefore, we classify group 1 as large, national universal banking regime. Note also that this technology regime exhibits the highest frequency of distress events. This may indicate that a larger appetite for risk is characteristic for this banking regime. At the same

[13] We also checked total assets, which confirm inference drawn based on equity levels. Also, we analyzed capitalization ratios since equity levels alone might not convey all information. Equity ratios did not differ significantly across groups and are therefore not reported to conserve on space.

time, Lerner indices are considerably larger than the overall industry average, suggesting that higher risks also enable banks to realize higher margins.[14] In contrast to many other banking studies, we also find that these very large banks still face considerable scale economies. Large banks thus seem to face indeed a significantly different production technology for which we account here. The relatively large share of mergers indicates that banks in this technology regime aim to grow by acquiring other banks more actively than other groups. At the same time, technical change estimates suggest no success to reduce costs by innovating.

Table 4: Characteristics per group

Group	**1**		**2**		**3**		**4**		**All**	
	Mean	*Stdev*	*Mean*	*Stdev*	*Mean*	*Stdev*	*Mean*	*Stdev*	*Mean*	*Stdev*
Equity$^{1)}$	196.1	1,324.4	71.9	286.9	20.8	84.5	46.1	351.4	61.0	535.0
Mortgages$^{2)}$	20.9	21.6	38.6	22.6	34.0	28.7	40.3	22.2	37.3	23.8
Distress$^{2)}$	16.5	84.6	8.9	60.6	11.9	73.6	7.8	59.8	9.3	64.8
Branches$^{3)}$	48.1	51.8	37.0	40.3	32.0	39.7	35.0	34.5	36.2	38.0
Merger$^{2)}$	6.8	27.2	7.6	32.4	3.0	18.4	5.9	27.3	5.7	26.7
Public$^{2)}$	4.0	19.6	53.2	49.9	8.2	27.4	23.3	42.3	21.3	40.9
Scale Economies$^{2)}$	87.0	0.7	94.5	3.3	86.8	0.6	97.6	0.2	94.9	4.5
Technical change$^{2)}$	1.4	1.8	-1.9	6.6	0.2	0.7	1.0	0.8	0.7	2.0
Cost efficiency$^{2)}$	99.0	0.0	100.0	0.0	96.8	1.0	93.1	3.9	94.6	4.1
Lerner index$^{2)}$	21.5	15.1	15.8	20.6	25.0	8.2	16.8	5.5	18.2	9.5
Observations	*3,227*		*1,872*		*3,589*		*21,007*		*29,695*	

Notes: 29,697 observations; 3,524 banks; $^{1)}$in millions of Euro; $^{2)}$in percent; $^{3)}$number. Scale economies: $\sum_m \ln C_{kt|j} / \ln y_{mkt|j}$; Technical change: $\partial \ln C_{kt|j} / \partial trend$.

Banks in the second technology regime are on average much smaller but still the second largest group and also fully efficient. In contrast to group 1, mean mortgage shares indicate a stronger focus on retail customers. Branching intensity is lower, which might reflect a more regional scope. The output HHI of 3,035 also indicates diversified portfolios of a universal banking type. While these banks experienced substantially less often distressed events than group 2, estimated Lerner margins are also the lowest. Therefore, these banks did not behave (relatively) uncompetitive. Scale economy estimates indicate an almost optimal size of operation as well as significant technical progress. Paired with the highest merger frequency across technology regimes, this suggests that banks in this group consolidated most effectively and succeeded to improve performance. The business model of this group appears to be a low risk-low return strategy and we describe this regime as medium sized universal retail innovators.

The third technology regime comprises the smallest banks. Retail intensity is low when considering branching networks and mortgage shares. The small scale paired with the highest output portfolio concentration of 4,819 and 66% of total assets being customer loans is indicative of a highly specialized business model. Potentially,

[14] The overall mean of 18.2 is comparable to results reported by Fernández de Guevara et al. (2007).

these banks aim to establish firm relationships with customers. The highest Lerner indices realized in the sample support this notion since such relationship bankers might be able to extract rents from their customers. At the same time, relatively high distress frequencies also bear witness that such higher margins involve higher risks. Large scale economies paired with low merger activity further implies that these banks are likely to experience future consolidation as to approach a more productive size of operations. Given this relatively large potential to realize cost reductions, cost inefficiencies on the order of three percent entail only limited room for improvements. We therefore consider this group small relationship specialists.

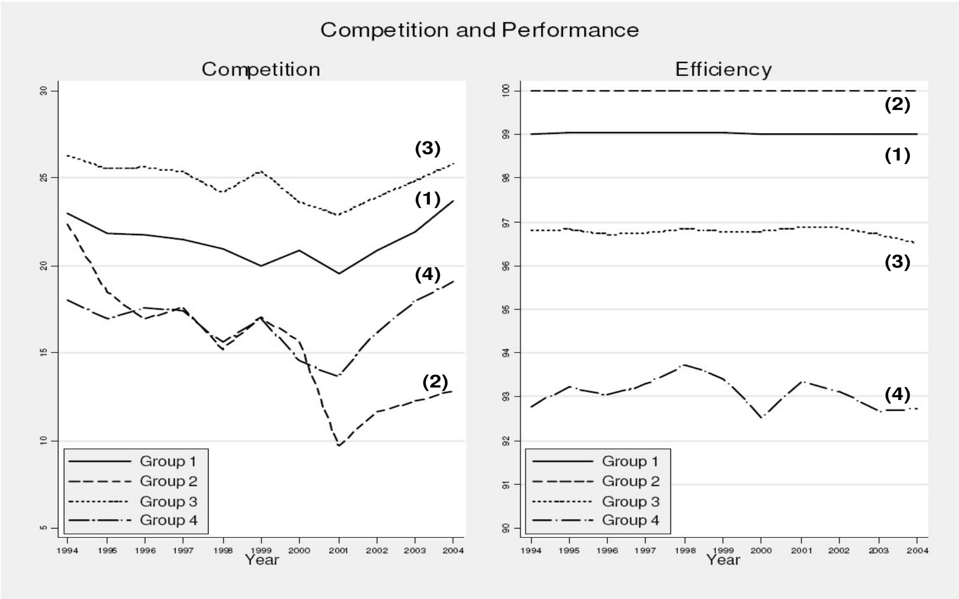
The final group comprises the most banks in our sample. A quarter of these fairly small banks are public and most of the remaining ones are small cooperative banks. Their high mortgage share suggests a focus on private rather than corporate customers. While scale economies still exist, they are small and bear less potential for improvements compared to operational inefficiencies of seven percent of total cost. Note, however, that overall efficiency estimates are substantially lower when comparing banks to their respective technology regime conditional on bank traits. This result is in line with, for example, Valverde et al. (2007) who report also that systematic deviations from optimal cost decline when controlling appropriately for heterogeneity across firms. Finally, the estimates of Lerner margins indicate that the vast majority of banks in Germany are fairly competitive since group 4 estimates are low compared to Fernández de Guevara et al. (2007).

Group characteristics are informative to understand the nature of different technology regimes in German banking better. In addition, the development of efficiency and competition is of particular interest as to assess whether ongoing deregulation and international integration also affected German banking positively. It is possible that both efficiency and competition developed differently depending on the respective technology regimes identified. Either measure's evolution is depicted in figure 1.

Overall competition increased for all four technology regimes up and until the stock market crash at the turn of century. While large wholesale orientated and small relationship specialists, groups 1 and 3 respectively, were constantly the least competitive banking regimes, especially the medium sized retail innovators of group 3 exhibit the largest reduction in Lerner indices. Apparently, this group faced most competitive pressure. Note that efficiency was stable for almost all groups over the sample period. Thus, it appears that large wholesale banks are able (and willing) to transform their benchmark efficiency into higher margins, while group 2 banks are not (willing to do so).

Since 2001, competition deteriorated in all four technology regimes. Especially

Figure 1: Group-specific competition and performance developments 1994 to 2004



the largest group 4 of fairly small retail banks yields margin hikes of around 50% between 2001 and 2004. At the same time, banks in this regime exhibited the highest inefficiency. Given the comparably low level of Lerner indices, this might not necessarily indicate excessive welfare losses for consumers but rather results from successful restructuring efforts of incumbents remaining in the market after the turmoil in financial markets. In that sense, this result is in line with the model of Boyd and De Nicolo (2005), who argue that banks remaining in the market after consolidation begin to extract rents. However, we caution that an assessment of welfare implications would require more rigorous analysis, for example using the welfare triangle as in Berger and Hannan (1998). Here, we limit ourselves to the conclusion that both competition and efficiency differ significantly across bank technology regimes and exhibit also diverging developments during the last decade.

4 Conclusion

In this paper we test for the existence of different technology regimes among German universal banks between 1994 and 2004. We estimate simultaneously cost frontiers and bank's group membership probabilities, which are conditioned on six indicators of business models (universal versus special), financial health, growth strategy (merger versus organic), and ownership (public versus private). Thereby we avoid any arbitrary a priori sample selection when estimating comparable efficiency scores on the one hand and Lerner indices as measures of competition on the other.

We find evidence of four significantly different technology regimes among German universal banks. Large, wholesale oriented and medium sized banks with a retail focus do not incur significant inefficiencies. The majority of banks are located in the remaining two regimes and exhibit mean cost inefficiency on the order of five percent. Hence, allowing for different technology regimes yields substantially lower inefficiency scores compared to previous efficiency studies of German banks (Lang and Welzel, 1999; Altunbas et al., 2001).

Overall Lerner indices are 18.2 on average, which is comparable to results reported in Fernández de Guevara et al. (2007) for Germany and relatively low in their European comparison. Up and until 2001 competition increased continuously. Thereafter, we find that some technology regimes yield Lerner index hikes of up to 50%. Potentially, this result indicates in line with Boyd and De Nicolo (2005) that once markets consolidated, remaining incumbents begin to reap rents in increasingly concentrated markets.

The groups comprising large, national universal bank and very small, specialized banks yield the highest Lerner margins and, thus, the lowest level of competition. The most competitive group is that of medium sized universal banks that presumably have a retail focus. Potentially, these banks pass their high operational efficiency on to consumers in the form of lower margins. However, we also find that technology regimes exhibiting the largest margins also experienced the highest frequency of distress. Given the generally low level of Lerner indices, this result might therefore simply reflect that some banking technologies are pursuing higher risk-higher return strategies while others are less inclined towards risk-taking and associated larger margins.

References

Altunbas, Y., L. Evans, and P. Molyneux (2001). Bank Ownership and Efficiency. *Journal of Money, Credit, and Banking 33*(4), 926–954.

Angelini, P. and N. Cetorelli (2003). The Effects of Regulatory Reform on Competition in the Banking Industry. *Journal of Money, Credit, and Banking 35*(5), 663–84.

Berger, A. L. and T. Hannan (1998). The Efficiency Cost of Market Power in the Banking Industry: A Test of the "Quite Life" and related Hypothesis. *Review of Economics and Statistic 80*, 454–465.

Berger, A. N. (2007). International comparisons of banking efficiency. *Financial Markets, Institutions & Instruments 16*(3), 119–144.

Bikker, J. A. and K. Haaf (2002). Measures of competition and concentration: A review of the literature. *Economics and Financial Modelling 9*, 53–98.

Bos, J. W. and H. Schmiedel (2007). Comparing Efficiency in European Banking: A Meta Frontier Approach. *Journal of Banking & Finance 31*, 2081–2102.

Bos, J. W. B., M. Koetter, J. W. Kolari, and C. J. M. Kool (2008). Effects of Heterogeneity on Bank Efficiency Scores. *European Journal of Operational Research*, forthcoming.

Boyd, J. H. and G. De Nicolo (2005). The Theory of Bank Risk Taking and Competition Revisited. *Journal of Finance 60*(3), 1329–1343.

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

Coelli, T., D. P. Rao, and G. E. Battese (2005). *An Introduction to Efficiency Analysis* (2 ed.). New York: Springer.

Davis, E. and H. Zhu (2005). Commercial property prices and bank prformance. *BIS Working Paper 175.*

Deprins, D. and L. Simar (1989). Estimating Technical Inefficiencies with Corrections for Environmental Conditions with an Application to Railway Companies. *Annals of Public and Cooperative Economics 60*(1), 81–102.

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

Fernández de Guevara, J., J. Maudos, and F. Pérez (2007). Integration and competition in the european financial markets. *Journal of International Money and Finance 26*, 26–45.

Focarelli, D., F. Panetta, and C. Salleo (2002). Why Do Banks Merge. *Journal of Money, Credit, and Banking 23*(4), 1047–1066.

Gan, J. (2004). Banking market structure and financial stability: Evidence from the Texas real estate crisis in the 1980s. *Journal of Financial Economics 73*, 567–601.

Greene, W. (2005). Reconsidering Heterogeneity in Panel Data Estimators of the Stochastic Frontier Model. *Journal of Econometrics 126*, 269–303.

Hackethal, A. (2004). German banks and banking structure. In J. Krahnen and R. Schmidt (Eds.), *The German Financial System*, pp. 387–424. Oxford: Oxford University Press.

Harrison, P. and W. R. Ragas (1995). Financial variables contributing to savings and loan failures 1980-1989. *Review of Financial Economics 4*(2), 197–210.

Hughes, J. P., W. Lang, L. J. Mester, and C.-G. Moon (2000). Recovering Risky Technologies Using the Almost Ideal Demand System: An Application to U.S. Banking. *Journal of Financial Services Research 18:1*, 5–27.

Kick, T. and M. Koetter (2007). Slippery Slopes of Stress: Ordered Failure Events in German Banking. *Journal of Financial Stability 3*(2), 132–148.

Koetter, M. (2008). An assessment of bank merger success in Germany. *German Economic Review 9*(2), 231–263.

Koetter, M., J. W. B. Bos, F. Heid, J. W. Kolari, C. J. M. Kool, and D. Porath (2007). Accounting for Distress in Bank Mergers. *Journal of Banking & Finance 31*, 3200–3217.

Kumbhakar, S. C. and C. A. K. Lovell (2000). *Stochastic Frontier Analysis*. Cambridge: Cambridge University Press.

Lang, G. and P. Welzel (1999). Mergers among german cooperative banks - a panel based stochastic frontier analysis. *Journal of Small Business Economics 13*(4), 273–286.

Lerner, A. (1934). The Concept of Monopoly and the Measurement of Monopoly Power. *Review of Economic Studies 1*(3), 157–175.

Maudos, J. and J. F. Guevara (2007). The cost of market power in banking: Social welfare loss vs. cost inefficiency. *Journal of Banking & Finance 31*, 2103–2135.

Maudos, J., J. M. Pastor, F. Perez, and J. Quesada (2002). Cost and Profit Efficiency in European Banks. *Journal of International Financial Markets, Institutions and Money 12*(1), 33–58.

Mester, L. J. (1993). Efficiency in the Savings and Loan Industry. *Journal of Banking & Finance 17*(2/3), 267–286.

Mester, L. J. (1997). Measuring Efficiency at U.S. Banks: Accounting for Heterogeneity Matters. *Journal of Operational Research 98*(2), 230–242.

Orea, L. and S. Kumbhakar (2004). Efficiency measurement using a latent class stochastic frontier model. *Empirical Economics 29*.

Porath, D. (2006). Estimating Probabilities of Default for German Savings Banks and Credit Cooperatives. *Schmalenbach Business Review 58*, 214–233.

Sealey, C. W. and J. T. Lindley (1977). Inputs, Outputs, and a Theory of Production and Cost and Depository Financial Institutions. *The Journal of Finance 32*(4), 1251–1265.

Stolz, S. and M. Wedow (2005). Banks Regulatory Capital Buffer and the Business Cycle: Evidence for German Savings and Cooperative Banks. *Deutsche Bundesbank Discussion Paper Series 2 7*.

Valverde, S. C., D. B. Humphrey, and R. L. Del Paso (2007). Opening the black box: Finding the source of cost inefficiency. *Journal of Productivity Analysis 27*, 209–220.

Williams, J. (2004). Determining Management Behaviour in European Banking. *Journal of Banking & Finance 28*(10), 2427–2460.

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