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Does IT standardization help to boost cost and profit efficiency? Empirical evidence from German savings banks

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DOES IT STANDARDIZATION HELP TO BOOST COST AND PROFIT EFFICIENCY? EVIDENCE FROM GERMAN SAVINGS BANKS[§]

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Abstract

This paper investigates the impact of IT standardization on bank performance based on a panel of 457 German savings banks over the period from 1996 to 2006. We measure IT *standardization* as the fraction of IT expenses for centralized services over banks' total IT expenses. Bank efficiency, in turn, is measured by traditional accounting performance indicators as well as by cost and profit efficiencies that are estimated by a stochastic frontier approach. Our results suggest that IT standardization is conducive to cost efficiency. The relation is positive and robust for small and medium-sized banks but vanishes for very large banks. Furthermore, our study confirms the often cited *computer paradox* by showing that total IT expenditures negatively impact cost efficiency and have no influence on bank profits. To the best of our knowledge, this paper is first to empirically explore whether IT *standardization* enhances efficiency by employing genuine data of banks' IT expenditures.

JEL Classification: C23, G21

Keywords: IT standardization, cost and profit efficiency, savings banks

1 Introduction

The increasingly important role of information technology (IT) for the development of new products and the reduction of costs through efficient and streamlined processes are ubiquitous in banking. Investments in IT frequently account for a large part of operating expenses. This raises the question how the increasing IT expenses during past decades influenced bank profitability and cost efficiency.

While the conventional approach in previous studies was to test whether an increase in IT expenditures was significantly related to a positive impact on some performance measure, this paper focuses on standardization of IT in banks and examines its impact on bank performance. We use a unique micro data panel of all incumbent German savings banks for the years 1996 to 2006. German savings banks are ideally suited for our investigation because of their similar business models but decentralized and independent decision-making structures which allow to investigate the impact of heterogeneous IT investment decisions. Each savings bank is free to decide whether to apply own IT solutions or to give away IT processes to centralized units. These shared services centers (SSCs), which perform IT processes exclusively for German savings banks, provide a number of process modules (e.g. credit, sales, data management) and services such as payment systems, settlement and fund management. To test if processes that are "outsourced" to the SSCs enhance bank's efficiency, we proxy IT standardization by the amount of IT services processed by the centralized IT units in relation to total IT expenditures of each savings bank. Total IT expenditures comprise costs for internal IT such as hard- and software, outsourcing of services to third parties, and standardized services provided by the SSCs. As dependent variables we use traditional accounting performance measures such as the cost-income ratio, pre-tax return on equity and assets as well as cost and profit efficiencies estimated by a *Stochastic Frontier Analysis* (SFA). These measures are applied to test if the standardization proxy has an impact on bank efficiency. In a second step, we examine whether this impact is a matter of bank size by dividing the sample in quartiles of total assets. Lastly, we address the structural differences between savings banks located in the eastern and western parts of Germany.

We find that IT standardization is positively related to cost efficiency but has no significant impact on banks' profit and accounting profitability measures. These effects are robust for small and medium-sized bank groups. For very large banks the positive and significant effect from IT standardization disappears.

The inclusion of banks' total IT expenditures in all regressions supports the frequently reported effect that increasing IT investments negatively impact bank performance on the cost side and have no impact on banks' profits. Interestingly, we find that banks in eastern Germany apply much more standardized IT than their counterparts in western Germany which may explain the finding that increased IT standardization does not have an impact on cost and profit efficiencies of banks in the eastern regions. In contrast, savings banks in western Germany benefit from IT standardization on the cost side.

The vaunted benefits of IT expenditures to firm performance have long been a controversial topic in the academic literature. The fact that many studies failed to detect a significant growth of productivity or efficiency from expenditures in IT led to the often cited Solow (1987) computer paradox or productivity paradox of information technology (Brynjolfsson 1993). Later academic research, in turn, reports significant benefits from IT expenditures (Brynjolfsson and Hitt 1996; Anderson et al. 2003; Huang 2005).[1]

[1] Previous studies investigating the benefits of IT on performance have been augmented for the manufacturing sector and can be classified into several strands. These strands cover productivity enhancements (Stiroh 2001; Allen 1997; Brynjolfsson and Yang 1997), cost efficiency (Tanaka 2006; Singh 2004; Borzekowski 2002), profitability of small and medium enterprises

Rather limited research is found on the relevance of effects arising from different IT structures among firms. Andrews et al. (2007) examine the dispersion across firms in terms of returns on IT investments and find that there is in fact a substantial heterogeneity in the effect of IT investments on firm performance due to factors such as vertical integration, diversification and amount of assets and that results also differ for productivity and market value measures. Similarly, the consulting firm Alinean (2005) published a ranking that compared 200 U.S. companies achieving the greatest return on IT and discovered that it was not the amount that these companies spend on IT, but rather the alignment of IT and business goals as well as investments in innovations that mattered most. Thus, the controversy of findings in earlier studies may in part be due to a lack of considering a specific allocation of IT and the associated organizational alignment which often accompanies IT expenses.
Also studies analyzing the relationship between IT and bank performance on firm level have been rather scarce. This had probably been more due to the fact that only limited or no information at all on banks' IT expenses is disclosed in published financial statements rather than lack of academic interest toward this question. Of late, however, this field has attracted greater interest as attested by many current papers that contribute to the understanding of the productivity paradox. Martín-Oliver and Salas-Fumas (2007) and Huang (2005) investigate the substitutability of IT capital and non-computer labor for a panel of Spanish and Taiwanese commercial banks respectively. Both papers find a positive relation between IT expenditures and firm growth (Martín-Oliver and Salas-Fumas 2007) and productivity and efficiency (Huang 2005). Furthermore, Martín-Oliver and Salas-Fumas data shows that the average stock of IT capital per bank has increased tenfold during the examined period from 1983 to 2003. In a similar vein, Casolaro and Gobbi (2007) and Beccalli (2007) examine the impact of expenditures related to computer, software and other IT services[2] on bank performance for a panel of Italian and European banks respectively. While Casolaro and Gobbi find that both cost and profit frontier shifts are strongly correlated with IT capital accumulation, Beccalli's results show a non-significant relationship between costs and IT ratios and a mixed relationship between IT expenditures and improved bank profitability indicating a profitability paradox.
Our paper contributes to the empirical literature by focusing on IT standardization in banks and thus shifts the question whether banks' IT expenditures have an impact on bank performance to more structural considerations. Additionally, by investigating IT standardization decisions of each savings bank, the results of this study also may have relevance for IT standardization decisions in banking in general.
The remainder of the paper is divided into four parts. Section 2 provides an overview over the German savings bank group and the development of its IT structure. Section 3 outlines the data sources employed in the paper and discusses methodology issues. Section 4 discusses the results that spurt from the estimations performed in our model. Section 5 summarizes and concludes.

2 IT structure of the German savings banks

The German savings banks are a group of 457 local or primary savings banks (as of the end of 2006), plus 10 *Landesbanken* or regional banks which completely span the country. They often have a major share of retail and SME financing in their covered markets while the so

(Lal 2005; Foreman-Peck et al. 2006; Morikawa 2004), economic growth effects (Stiroh and Botsch 2007; Basu et al. 2003; Edwards 2002; Khatri and Lee 2003), and structural changes in industries (Berger 2003; Baldwin and Sabourin 2001).
[2] The development of growing IT applicability and technological changes within the banking industry is described by Berger (2003) and Bátiz-Lazo and Wood (2001).

called “regional principle” bars them from seeking business in each other's territory. Although legally independent, the savings banks are integrated through a highly standardized product portfolio, centralized back offices in payment systems, settlement, fund management, cash management and risk management as well as standardized process modules offered by internal IT providers or shared service centers (SSCs). The number of IT providers within the savings banks group in the last decade has declined from ten independent institutions in 1998 to, quite recently, one in 2008. These mergers are likely to induce further cost savings in the future as development costs now only accrue for a single IT platform.

Focusing on total IT expenses over total operating costs our data shows that IT expenditures are accountable for a large share of total operating cost during the past years.[3] During the examined period the average IT costs in relation to total operating costs (exclusive interest expenses) have reached a height in 2003 after a steady increase in the previous years. Notably, the years 2001 to 2003 have also witnessed the majority of mergers between the SSCs which suggests that the associated merger costs have contributed to the slightly higher IT expenses. However, compared to top-tier European banks who exhibit IT costs of around 16 percent of operating expenses in 2002 (BCG 2003) savings banks figures are relatively low and resemble a good discipline over IT expenditures even around the Y2K adaption and Euro adjustment period.

Additionally our data shows that the use of services from the SSCs accounts for more than 50% of total IT expenditures over the observation period and has steadily increased during the last decade. The IT expenses attributable to services of IT providers are not only a form of outsourcing but also represent an increasing degree of standardization because they substitute bank specific IT. Furthermore we see that expenditures for software[4] account for the smallest part of total IT expenditures and remain constant over the last eleven years. Expenditures for hardware fell considerably whereas the share of IT processes given to third parties has increased.[5]

These developments are in line with other German and European commercial banks and reflect the general trend of IT outsourcing in the banking industry. This trend aims at saving costs and keeping them variable through the alignment of work volume and IT expenses, and the ability to manage process peaks and ad hoc requirements through a flexible IT architecture. To this end the implementation of shared service centers is often regarded purposeful.

But what exactly constitutes a SSC? Shared service centers differ from similar approaches, in particular outsourcing and centralization, primarily through an internal customer and supplier relationship. A SSC is designed to optimize the processes which it incorporates by parallelizing process steps and the elimination of inefficient elements. The (internal) customer orientation originates from the alignment of the SSC with the decentralized business units.

The services offered by the savings banks IT provider are in fact a combination of both a central unit and a SSC depending on the required service. Services such as payment systems, settlement and fund management are carried out as centralized services whereas (modules of) processes may be acquired on an individual basis. This is an important distinction from centralized bank institutions where processes are rolled out uniformly throughout all branches: The decision power remains local and banks choose only services that apply to their specific situation and demand which ensures that their IT structure is in line with their business model.

[3] Detail data is not reported here because of data confidentiality with regard to the German Savings Banks Association which provides the data.

[4] Software and hardware depreciation are used as expenditures in this segments instead of capital expenditures. We assume that depreciation reflects the use of software and hardware much better than capital expenditures.

[5] Detailed information about the composition of total IT expenditures are not reported here due to sensitivity of the data.

The option to choose is also vital to avoid possible disadvantages associated with the centralization of IT services. According to a recent study (Accenture and SAP 2005) which involved 1,500 financial institutions from 17 countries banks have become increasingly discontent with their core banking systems, i.e. the software that "runs" all transactions, services and access channels. As main shortcomings of the systems the participants reported costs (around 50 percent of total IT budget was stated), lack of flexibility and integration problems. Another insight on past IT expenditures in the banking sector is that many technology expenses relate to several products and customers. Therefore, an investment that has a positive effect on one customer base or product may not necessarily be favorable for the cumulative cost base. A complementary aspect are the benefits for the banks' customers stemming from more sophisticated technology which is thought to translate into improved quality of service, greater speed and ultimately increased revenues for the banks. Those aspects relate to the profit side and raise the question whether the standardization of IT is also conducive to profit efficiency or if it is rather the proprietary IT structure which offers a greater flexibility toward customers' needs. These are important questions for the decision of banks to standardize or to differentiate their IT structure and will be addressed in section 4.
In sum, the various aspects stated above may give an indication why past research on the specific impact of IT investments on profitability or productivity measures in the financial services sector has yielded such ambiguous findings.

3 Data sample

Database The database which is used for the empirical analysis comprises all German savings banks and is provided by the German Savings Banks Association (DSGV). The sample contains 457 German savings banks at the end of 2006 and covers the period from 1996 to 2006. The panel is balanced due to backward integration of financial accounts of banks which merged during the observed period. After deleting missing values we have a working sample of 4,850 observations. All monetary variables are deflated with prices from 2005.

Table 1 shows descriptive statistics for the main bank parameters which are later used as control variables in the regressions. Descriptive statistics for the performance variables are reported in Table 2 in the next paragraph. Table 1 delineates the range of different savings banks in the savings banks group. Total assets indicate the heterogeneity in bank size by showing some very small banks but also banks with total assets around 20 €billions and more. Similarly there are savings banks with only one branch and those with more than 300. The bandwidth of risk exposure, measured by loan loss provisions over total assets, indicates considerable differences in banks portfolios. As further controls we use population per area and the growth rate of GDP for the specific region (not reported). Those data are obtained from the German bureau of Statistics (DeStatis).

Calculation additional data We argue in line with Beccalli (2007) that traditional accounting performance measures like pre-tax return on equity (ROE) or assets (ROA) and cost income ratio (CI) are only poor performance measures to reflect the various improvements IT facilitates. Therefore cost (CE) and profit (PE) efficiencies are calculated by a stochastic frontier approach (SFA). The resulting measures reflect changes in the production process as well as changes in input and output mix and should overcome the drawbacks of traditional measures.

Table 1: Summary Statistics

Table 1 shows summary statistics for the main bank–specific control variables used in the regressions for the period 1996 – 2006. All monetary variables are in €million. Summaries for loan loss provisions are reported in a standardized interval between 0 and 100 due to data confidentiality.

Variable	Mean	Std. Dev.	1%	99%
Total assets	2014.9	2315.9	169.2	10681.7
Equity	87.6	102.2	7.3	510
Total operating costs	97.7	110.3	8.7	480.2
First Basel tier	4.3	0.9	2.4	7.1
No. of branches	34	30	2	144
Fte over branches	13.1	6	4.4	33
Standardized loan loss provisions	50.5	6.4	36.5	71
Observations	4,850			

To date, SFA is widely accepted and common practice to measure bank performance.[6] We implement an intermediation approach proposed by Sealey and Lindley (1977) and use a translog-function with four output measures (consumer, mortgage and corporate loans and securities) and three input prices (labor cost, cost of funding and cost of fixed assets) for the estimation of the cost efficiency. For profit efficiency, we follow Berger and Mester (1997) and use four output prices (interest rates for consumer, mortgage, corporate and securities) and the same input prices as in the cost frontier estimation. Total operating cost and profits before valuation are used as dependent variables and equity (inclusive reserves) as structural control variable. Descriptive statistics for all variables used in the frontier estimation are reported in the appendix. We control for bank specific fixed effects by implementing a fixed-effect panel estimator (Greene 2005b) as well as a time trend. An advantage of this approach is that efficiency measures are time-variant without any structure a priori imposed.
The efficiency of banks is strongly related to their market power.[7] To account for that, we calculate Lerner indices to proxy banks' power to charge prices over marginal cost and thus the ability to enjoy some kind of market power. Lerner indices are calculated by

$$\mathrm{L} = \frac{(AP + AC) - MC}{AP + AC} \quad , \qquad (1)$$

where *AP* and *AC* stand for average profits and average cost respectively which sum up to average revenues. *MC* denotes marginal cost.[8] *AP* and *AC* are obtained from the stochastic frontier estimation of profit and cost efficiencies. Thereby we take realized rents due to market power and rents foregone due to inefficiencies into account (Koetter and Vins 2008).

[6] Aigner et al.(1977) and Meeusen and van den Broeck (1977) simultaneously proposed a model to measure deviations from an efficient frontier. They split the error term in a "normal" random noise part and another error term which reflects deviations from the optimal frontier and thus explains subject specific inefficiencies. A very good overview is given by Kumbhakar and Lovell (2000) and Greene (2005a).
[7] As noted by Koetter and Vins (2008), the relation between cost and profit efficiency and Lerner indices are strongly dependent on complex (lagged) relations which lack so far any theoretical background. We therefore rely here only on relation not on causality. Our estimations show that the IT coefficients are unaffected by the inclusion of Lerner indices. However, the indices are left in due to their strong impact on banks' efficiency.
[8] Our procedure to calculate Lerner indices – as well as for the SFA procedure – is adopted from Koetter and Vins (2008).

Table 2: Performance measures

Table 2 shows summary statistics for the five performance measures and Lerner indices in % over the observation period from 1996 to 2006.

Variable	Mean	Std. Dev.	1%	99%
CI	65.06	6.92	47.56	81.8
ROE	12.97	7.94	0.1	36.95
ROA	0.54	0.3	0	1.32
CE	83.54	3.77	72.16	90.25
PE	47.13	9.1	23.94	64.44
Lerner	20.75	8.06	2.59	38.17
Observations	4,850			

Table 2 reports descriptive statistics (in %) for the five performance measures. The cost and profit efficiencies show the well-known picture that banks are often more successful on the cost side than on the profit side. The value for savings banks pre-tax return on equity is typically high but converges over the last years (2004-2006) to "normal" values lower than 10% and down to 7.89% in 2006. Lerner indices are around 20% which is in line with other studies for European banks which report measures between 20-30% (Fernandez des Guevara et al. 2007).

Modeling IT standardization The common approach in recent papers (e.g. Beccalli 2007) is to relate IT to bank performance by regressing performance measures on total IT expenditures and on IT components like hardware, software, outsourcing, etc. By obtaining positive coefficients, the interpretation is that more IT in a specific segment enhances bank's efficiency and therefore results in a general statement that more IT is better. But under efficiency aspects the use of IT is also determined by a decreasing marginal utility. This argument holds well for the shares of IT expenditures such as hardware, software and outsourcing but also for the fraction of services given to centralized units. We aim to account for this aspect in several ways. First, we comprise the IT components in IT processed within savings banks, by third parties and services given away to the centralized unit. In a second step we generate our standardization proxy by relating the IT expenditures of services given to the SSC to the total amount of IT expenditures. Third, we include the square of the IT standardization proxy to control for the decreasing marginal utility in the use of standardized processes.

4 Data sample

We start by examining the influence of IT standardization on cost and profit efficiency and traditional accounting measure such as cost-income ratio and pre-tax return on equity and assets. As control variables the amount of total operating cost, total assets and equity and the number of branches are instated. Subsequently, loan loss provisions are included to control for banks risk exposure and Lerner indices to account for the market power of savings banks in their specific region. We also include the ratio of full time equivalents (fte) to the number of branches as structural control and the regional GDP and population per area to account for macro-economic conditions. Lastly, a merger dummy is added to control for merger activities

among savings banks. We conduct a fixed-effect regression with additional time dummies for every year (not shown in the results tables) and robust standard errors.

Table 3 shows the results for the full sample over eleven years from 1996 to 2006. The first three columns report estimation results for the accounting performance measures. The coefficients for IT standardization are all non-significant and leave the question whether these measures are appropriate to reflect the main efficiency effects of banks' IT expenditure enhancements. Looking at the fourth column of Table 3 we see that IT standardization has a positive and significant influence on cost efficiency. The impact on profit efficiency (column 5) is non-significant which means that banks which "outsourced" IT processes to centralized units are more cost efficient but do not see their profitability affected. If the coefficient for total IT expenditures in relation to total operating cost is considered, we see – quite expected – a positive impact on banks cost-income ratio. This effect is non-significant for ROE and profit efficiency but positive for the ROA. The influence of total IT expenditures on cost efficiency is negative and significant. These results show that IT standardization helps banks to become more cost efficient but does not enhance (or reduce) their profits. Total IT expenditures have a negative impact on banks' cost efficiency and increase the cost-income ratios. The impact on the banks profit side is ambiguous and hints to the often stated IT profitability paradox.

If the coefficients of the quadratic terms of the IT standardization variable (Standardized IT^2) are considered we see that the marginal impact of standardization on banks' cost decreases with higher standardization. Thus a bank with a greater level of standardization increases cost efficiency to a lesser extent with each additional standardized process than a bank with lower levels of standardized IT.

As Table 3 shows, IT standardization has a positive and significant impact on banks' cost efficiency but no significant influence on the cost-income ratio. Figure 1 (Appendix) focuses on the different impact of IT standardization on the cost-income ratio as well as on cost efficiency and shows that there is much more variation over time in banks' cost-income ratio than in their cost efficiency. Furthermore those variations are much more driven by changes in income than by changes in banks costs. This seems to be in line with the notion that IT standardization helps banks to save costs but does not enhance sales or profits. The findings presented in Table 3 and Figure 1 corroborate our assumption that traditional accounting performance measures have limits in comprising all advantages of IT enhancements. Therefore a greater emphasis is put on the evaluation of the impact of IT on cost and profit efficiencies.

We start by dividing the sample by bank size in four groups to investigate whether there are differences in the IT structure. The sample for small banks includes banks that report total assets smaller than the 25% sample-percentile of total assets. Lower medium-size range in the second quartile, higher medium-sized banks in the third quartile and large banks are found in the top sample-quartile of total assets. The data shows that small banks overall are quite homogeneous in their levels of IT standardization. However, the heterogeneity in IT standardization becomes larger when bank size increases.

Table 3: Regression results – Full sample

Table 3 shows regression results for the full sample. All regressions are estimated with bank fixed effects and time effects for every year (not reported). The general formulation of the fixed effects linear panel data model is: $y_{it} = \alpha_i + \chi'_{it}\beta + \gamma_t + \varepsilon_{it}$ with i = 1, ..., N and t = 1,..., T. The K x 1 column vector of explanatory variables is denoted by $\chi'_{it}\beta$, the regression parameter β is a K x 1 vector, and α_i is a time-invariant firm-specific constant term which embodies all the observable effects and specifies an estimable conditional mean. The time effect for each year is captured by γ_t. The first three models are run with the traditional performance measures (CI, ROE, ROA) as dependent variables while the latter use the cost and profit efficiencies that were estimated in a prior step with a stochastic frontier analysis. The quadratic term of our main explanatory variable measures the marginal impact of IT standardization and aims at controlling for a non-linear relation between degree of standardization and bank efficiency.

	(1)	(2)	(3)	(4)	(5)
	CI	**ROE**	**ROA**	**CE**	**PE**
Standardized IT	0.0318	-0.0752	-0.0016	0.1019***	-0.1194
	(0.0434)	(0.0601)	(0.0021)	(0.0237)	(0.0883)
Standardized IT^2	-0.0004	0.0006	0.0000	-0.0008***	0.0011
	(0.0003)	(0.0004)	(0.0000)	(0.0002)	(0.0007)
IT exp./total operating cost	0.2337**	-0.1828	0.0134**	-0.1580***	-0.4395
	(0.1069)	(0.1677)	(0.0058)	(0.0605)	(0.2798)
Total operating cost	0.0263***	-0.0246***	-0.0006**	0.0342***	-0.0592***
	(0.0057)	(0.0089)	(0.0002)	(0.0035)	(0.0202)
Total assets	-0.0008**	0.0019***	0.0000	-0.0013***	0.0032***
	(0.0004)	(0.0005)	(0.0000)	(0.0002)	(0.0011)
Equity	-0.0002	-0.0374***	-0.0003*	0.0096***	-0.1103***
	(0.0042)	(0.0082)	(0.0002)	(0.0021)	(0.0206)
Growth of regional GDP	0.0280*	-0.037	-0.0019**	0.0059	-0.1408***
	(0.0167)	(0.0232)	(0.0008)	(0.0095)	(0.0438)
No. of branches	-0.0451***	-0.0139	-0.0001	0.003	-0.0064
	(0.0113)	(0.0150)	(0.0006)	(0.0070)	(0.0257)
Fte over branches	0.0522	-0.0279	-0.0018	-0.0503**	-0.0526
	(0.0356)	(0.0439)	(0.0016)	(0.0204)	(0.0797)
Lerner index	-0.3252***	0.1935***	0.0086***	0.7615***	-0.0355
	(0.0148)	(0.0218)	(0.0008)	(0.0094)	(0.0380)
Loan loss provisions over total assets	-1.4727***	-8.5619***	-0.3459***	0.5356***	1.4173**
	(0.2077)	(0.3280)	(0.0119)	(0.1576)	(0.5703)
Population per area	0.0006	-0.0117	-0.0017***	-0.0037	0.0474
	(0.0109)	(0.0167)	(0.0005)	(0.0082)	(0.0300)
Merger dummy	1.7642***	-1.5671***	-0.0725***	-0.2608	-3.0930***
	(0.2923)	(0.4199)	(0.0160)	(0.1602)	(0.7311)
Constant	69.1716***	20.3253***	1.0139***	67.6339***	54.3871***
	(3.1160)	(4.8945)	(0.1443)	(2.2426)	(8.2632)
Observations	4,838	4,838	4,838	4,838	4,838
R^2	0.44	0.60	0.57	0.75	0.16

Standard errors in parentheses
** p < 0.10, ** p < 0.05, *** p < 0.01*

Table 4 reports the regression results for the four size groups. Overall we find that IT standardization has a positive and significant impact on banks' cost efficiency for the first three bank-size groups. For large banks no impact of IT standardization is found. The results also show that the standardization effects are more significant for higher medium-sized banks than for lower medium-sized and very small banks. Looking at the quadratic term we see that effects from IT standardization diminish with higher levels of standardized IT for three bank-size groups. Turning to the profit side we find that IT standardization has no impact on small, lower medium-sized and large banks. But we find a significant negative impact for higher medium-sized banks. Those effects become smaller with higher levels of IT standardization as shown by the significant positive coefficient for the quadratic term of IT standardization for higher medium-sized banks.

Total IT expenditures have no impact on cost efficiency for the first two bank-size groups. Yet for higher medium-sized and large banks we find a negative impact of total IT expenditures on cost efficiency. On the profit side, effects from total IT expenditures become only negative and significant for lower medium-sized banks.

In sum, Table 4 shows that effects from IT standardization differ with bank size and that effects on bank efficiency are stronger for small and medium-sized banks. Higher medium-sized banks profit from IT standardization on the cost side but experience drawbacks on profit efficiency. For very large banks IT standardization does not help to enhance bank efficiency. The coefficients for total IT expenditures might indicate that larger savings banks already overinvest in IT or that their IT expenditures are misallocated. The negative effects of increased IT standardization on profit efficiency for higher medium-sized banks also shows that in some situations banks have to weigh the benefits on the cost site against losses on the profit side. This can be the case if banks are not able to align the standardized IT well enough to customers' needs.

Finally we investigate the potential differences in effects from IT standardization between banks located in eastern and western Germany. Traditionally these two subgroups of German savings banks differ the most because business of eastern German banks is much more focused on generating deposits than on providing loans (see Table 7). This is driven by differences in the macro-economic conditions in eastern Germany. Second, as our data shows, savings banks in eastern Germany have overall higher levels of IT standardization (Figure 2, Appendix).

Furthermore banks in eastern Germany are very homogeneous in their IT structure. We find only one single observation which has a standardization level lower than 50%. On the other hand, banks located in western Germany increase their standardized IT - from a lower level in regard to eastern banks - constantly but show overall a high heterogeneity in IT standardization. With those differences we expect the effects from IT standardization for western German savings banks to be more significant than those for the already highly IT standardized banks in eastern Germany.

The regression results for the comparison of savings banks located in eastern and western Germany are shown in Table 5. As expected, the impact on cost efficiency from IT standardization is positively significant for savings banks in western Germany. Additionally, western German savings banks face significant drawbacks from standardized IT on the profit side. Looking at the coefficients for eastern German savings banks we find no impact from IT standardization on bank efficiency. The coefficients of total IT expenditures are negatively related to cost efficiency for both bank groups which is in line with the findings of previous studies regarding efficiency effects from banks' total IT expenditures.

Table 4: Regression results – bank size

Table 4 shows the regression results for the impact of IT standardization as well as cost and profit efficiencies for different bank-size groups. Banks are grouped by sample-quartiles of total assets in small banks (less than 25%-quartile), lower medium banks (between 25% and 50%-quartile), higher medium banks (between 50% and 75%-quartile) and large banks (higher than 75%-quartile).

	Small banks		Lower medium banks		Higher medium banks		Large banks	
	CE	**PE**	**CE**	**PE**	**CE**	**PE**	**CE**	**PE**
Standardized IT	0.1120*	0.329	0.1698*	0.0913	0.1475***	-0.3297***	0.0275	-0.1011
	(0.0578)	(0.2509)	(0.0975)	(0.2117)	(0.0332)	(0.1224)	(0.0409)	(0.1193)
Standardized IT^2	-0.0008*	-0.0014	-0.0012*	-0.0005	-0.0013***	0.0029***	-0.0002	0.0001
	(0.0004)	(0.0018)	(0.0007)	(0.0016)	(0.0003)	(0.0011)	(0.0003)	(0.0010)
IT exp./total operating cost	-0.0093	-0.0869	-0.0787	0.9430**	-0.4342***	-0.7892	-0.2904***	-0.6976
	(0.1345)	(0.5737)	(0.1155)	(0.4523)	(0.1369)	(0.5695)	(0.1048)	(0.5317)
Total operating cost	0.3901***	-2.3824***	0.1889***	-1.1690***	0.1268***	-0.7128***	0.0192***	-0.0214
	(0.0690)	(0.2818)	(0.0360)	(0.1629)	(0.0177)	(0.0727)	(0.0040)	(0.0171)
Total assets	-0.0065	0.1323***	-0.0057***	0.0695***	-0.0055***	0.0318***	-0.0005**	0.0012
	(0.0044)	(0.0176)	(0.0019)	(0.0083)	(0.0013)	(0.0046)	(0.0002)	(0.0009)
Equity	0.1588***	-1.5907***	0.0154	-1.0290***	0.0167	-0.4550***	0.0112***	-0.0761***
	(0.0367)	(0.1333)	(0.0164)	(0.0599)	(0.0107)	(0.0420)	(0.0021)	(0.0129)
Growth of regional GDP	-0.0239	-0.2347**	0.0360*	-0.1134	-0.0071	0.0028	0.025	-0.1355*
	(0.0206)	(0.0959)	(0.0196)	(0.0762)	(0.0164)	(0.0767)	(0.0156)	(0.0739)
No. of branches	-0.0867	0.6625***	-0.0818***	-0.1439	0.0058	0.0349	-0.0031	0.0014
	(0.0551)	(0.2219)	(0.0271)	(0.1114)	(0.0145)	(0.0557)	(0.0097)	(0.0324)
Fte over branches	-0.0811***	0.1198	-0.0371	-0.5437*	-0.1133**	-0.2033	0.0415	-0.2878
	(0.0289)	(0.1130)	(0.0551)	(0.2789)	(0.0516)	(0.1760)	(0.0489)	(0.2038)
Lerner index	0.7632***	-0.3111***	0.7698***	-0.2302***	0.7930***	0.0972	0.7406***	0.0123
	(0.0192)	(0.0634)	(0.0186)	(0.0737)	(0.0184)	(0.0791)	(0.0179)	(0.0702)
Loan loss provisions over total assets	0.5683**	3.1585***	0.2852	4.1303***	0.3118	3.5513***	0.6167***	0.0877
	(0.2212)	(1.0024)	(0.4209)	(1.1126)	(0.2540)	(1.0685)	(0.2111)	(1.0936)
Population per area	-0.0176*	0.0476	-0.0333**	-0.0297	0.017	0.0727*	0.008	0.1442***
	(0.0106)	(0.0553)	(0.0161)	(0.0308)	(0.0113)	(0.0438)	(0.0122)	(0.0511)
Merger dummy	-0.0469	-1.3943	-1.8982	-4.6162	0.1336	-1.6266	-0.1545	-2.3200**
	(0.7295)	(2.4384)	(0.5655)	(2.4387)	(0.2626)	(1.4206)	(0.1930)	(0.9601)
Constant	64.4852***	34.6315*	70.6543***	86.6284***	66.5612***	81.4586***	56.0006***	31.6329**
	(3.4868)	(19.1948)	(4.9833)	(11.5298)	(2.9489)	(10.4927)	(4.0224)	(16.0220)
Observations	1,205	1,205	1,209	1,209	1,212	1212	1,212	1,212
R^2	0.77	0.28	0.76	0.40	0.78	0.344	0.76	0.24

Standard errors in parentheses

** p < 0.10, ** p < 0.05, *** p < 0.01*

Table 5: Regression results – eastern/western Germany

Table 5 shows the regression results for the impact of IT standardization on cost and profit efficiency for savings banks located in eastern and western Germany respectively.

	Banks in eastern Germany		Banks in western Germany	
	CE	**PE**	**CE**	**PE**
Standardized IT	0.1954	0.2831	0.0932***	-0.2088**
	(0.1215)	(0.2789)	(0.0207)	(0.0826)
Standardized IT^2	-0.0013	-0.0012	-0.0008***	0.0017**
	(0.0009)	(0.0022)	(0.0002)	(0.0007)
IT exp./total operating cost	-0.4727***	0.4564	-0.4091***	-1.2184***
	(0.1797)	(0.7551)	(0.0689)	(0.3245)
Total operating cost	0.0789***	-0.2532***	0.0285***	-0.0535***
	(0.0146)	(0.0664)	(0.0032)	(0.0188)
Total assets	-0.0033***	0.0110***	-0.0009***	0.0024**
	(0.0008)	(0.0036)	(0.0002)	(0.0011)
Equity	-0.0164***	-0.2352***	0.0118***	-0.0972***
	(0.0057)	(0.0475)	(0.0020)	(0.0195)
Growth of regional GDP	-0.0015	-0.2526**	0.0169*	-0.0933**
	(0.0289)	(0.1132)	(0.0093)	(0.0471)
No. of branches	-0.0376	0.1268	0.0096	-0.0082
	(0.0262)	(0.1099)	(0.0066)	(0.0265)
Fte over branches	-0.0039	0.3336	-0.0344	-0.0402
	(0.0741)	(0.3167)	(0.0211)	(0.0822)
Lerner index	0.7718***	-0.2191**	0.7584***	0.038
	(0.0241)	(0.0996)	(0.0093)	(0.0395)
Loan loss provisions over total assets	0.7352	3.0987**	0.5484***	1.1868*
	(0.6069)	(1.2433)	(0.1215)	(0.6196)
Population per area	0.0109	-0.0154	0.0213**	0.1931***
	(0.0116)	(0.0331)	(0.0086)	(0.0371)
Merger dummy	-0.1194	-1.8301	-0.0596	-3.1820***
	(0.5538)	(2.3273)	(0.1522)	(0.7686)
Constant	55.3678***	37.3929***	61.3849***	23.7705**
	(5.1173)	(12.3458)	(2.3825)	(10.3391)
Observations	787	787	4,051	4,051
R^2	0.78	0.24	0.76	0.17

Standard errors in parentheses
** p < 0.10, ** p < 0.05, *** p < 0.01*

Overall the results show that further standardization of the already highly standardized IT infrastructure of eastern German savings banks has no effect on efficiency. We find a p-value of 10.8% for the impact of IT standardization on eastern German banks' cost efficiency which might indicate that there are only small effects that are responsible for the insignificant results. Perhaps our construction of the estimated cost function does not fully reflect the business of eastern German savings banks which are much more focused on generating deposits than on selling loans; since the output of our cost function comprises three types of loans and securities and does not account for output on the liabilities side (i.e. deposits) the estimated cost efficiencies may underestimate the performance of eastern German savings banks and thus the impact of IT standardization.

5 Conclusion

This paper investigates the impact of IT standardization on bank efficiency by employing a sample of all incumbent German savings banks over the period from 1996 to 2006. IT standardization is proxied by the ratio of IT expenditures attributable to centralized service centers over banks' total IT expenditures. As dependent variables traditional accounting measures are used as well as the more comprehensive efficiency measures of cost and profit efficiency estimated by a *Stochastic Frontier Analysis*.
German savings banks independently choose whether to give IT processes to centralized units or perform own IT solutions which makes them ideal to investigate whether standardization of IT can ameliorate bank efficiency. Moreover, due to the independent decision-making structure of German savings banks in terms of IT investments, the results and implications of IT standardization are likely to hold for other banking groups as well.
We find that IT standardization has a positive and significant impact on banks' cost efficiency whereas no evidence is found in favor of higher IT standardization for bank profitability. Furthermore, traditional accounting measures seem to have limited ability to comprise all effects induced by banks IT expenditures particularly if a measure of IT standardization is applied. Therefore we concentrate on the results for cost and profit efficiency. By dividing the sample by bank size we find positive effects on cost efficiency from IT standardization for small- and medium-sized banks. Large banks, in turn, seem not be able to increase their cost efficiency by applying standardized IT. An interesting observation is made if the sample is divided into eastern and western parts of Germany. We find that IT standardization positively affects banks' cost efficiency in the western states yet no effects are found for the highly IT standardized eastern German savings banks. We argue that this might be due to factors which affect the business of eastern German savings banks which are not fully reflected by our cost efficiency estimation. For most regressions we find negative effects from total IT expenditures on cost efficiency whereas no impact is found on banks' profit efficiency. These results reverberate findings of many prior studies which support the IT (profitability) paradox theory. However, our findings suggest that IT standardization seems to be an effective way to improve banks' cost efficiency. In this regard future research should concentrate on composition and structure of IT expenditures rather than on evaluating the impact of IT investments in general.

References

Accenture, and SAP. 2005. “Redefining Core Banking.” Technical Report, Worldwide Survey.

Aigner, D., C. Lovell, and P. Schmidt. 1977. “Formulation and estimation of stochastic frontier production function models.” Journal of Econometrics 6 (1): 21–37.

Alinean. 2005. Alinean Highlights Top 200 U.S. Companies Achieving the Greatest Return on IT (ROIT). http://www.alinean.com/PR/PR-SearchCIO200.asp. download: 10th August 2008.

Allen, D. 1997. “Where’s the productivity growth (from the information technology revolution)?” Review, no. Mar:15–25.

Anderson, M., R. Banker, and S. Ravindran. 2003. “The new productivity paradox.” Commun. ACM 46 (3): 91–94.

Andrews, R., I. Currim, and S. Dewan. 2007. “Why do Firms differ in the Effect of Information Technology Investments on Firm Performance?” Technical Report, The Crito consortium.

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.

Baldwin, J., and D. Sabourin. 2001, October. “Impact of the Adoption of Advanced Information and Communication Technologies on Firm Performance in the Canadian Manufacturing Sector.” Analytical studies branch research paper series 2001174e, Statistics Canada, Analytical Studies Branch.

Basu, S., J. Fernald, N. Oulton, and S. Srinivasan. 2003, October. “The Case of the Missing Productivty Growth: Or, Does Information Technology Explain why Productivity

Accelerated in the US but not the UK?” Nber working papers 10010, National Bureau of Economic Research, Inc.

BCG. 2003. “IT Costs in Banks: Revisit Your Beliefs!” Technical Report, Study.

Beccalli, E. 2007. “Does IT investment improve bank performance? Evidence from Europe.” Journal of Banking & Finance 31 (7): 2205–2230.

Berger, A. 2003. “The Economic Effects of Technological Progress: Evidence from the Banking Industry.” Journal of Money, Credit and Banking 35 (2): 141–76 (April).

Berger, A., and L. Mester. 1997. “Inside the black box: what explains differences in the efficiencies of financial institutions?” Journal of Banking and Finance 21:895–947.

Borzekowski, R. 2002. “Measuring the cost impact of hospital information systems: 1987-1994.” Finance and economics discussion series 2002-42, Board of Governors of the Federal Reserve System (U.S.).

Brynjolfsson, E. 1993. “The productivity paradox of information technology.” Communications of the ACM 36 (12): 66–77.

Brynjolfsson, E., and L. Hitt. 1996. “Paradox lost? Firm-level evidence on the returns to information systems spending.” Manage. Sci. 42 (4): 541–558.

Brynjolfsson, E., and S. Yang. 1997. “Information Technology and Productivity: A Review of the Literature.” Working paper series 202, MIT Center for Coordination Science.

Bátiz-Lazo, B., and D. Wood. 2001. “Information technology innovations and commercial banking: a review and appraisal from an historical perspective.” Technical

Report 01/5, Accounting and Finance Research Unit (AFRU).

Casolaro, L., and G. Gobbi. 2007. “Information Technology and Productivity Changes in the Banking Industry.” Economic Notes 36 (1): 43–76.

Edwards, S. 2002. “Information Technology and Economic Growth in Developing Countries.” Challenge 45 (3): 19–43 (May).

Fernandez de Guevara, J., J. Maudos, and F. Perez. 2007. “Integration and competition in the European financial markets.” Journal of International Money and Finance 26 (1): 26–45.

Foreman-Peck, J., G. Makepeace, and B. Morgan. 2006. “Growth and profitability of small and medium-sized enterprises: Some Welsh evidence.” Regional Studies 40 (4): 307–320 (June).

Greene, W. 2005a. “The Econometric Approach to Efficiency Analysis.” Chapter 2 of The Measurement of Productive Efficiency: Techniques and Applications, edited by H. Fried, C. Lovell, and S. Schmidt, 2nd, 68–119. Oxford University Press.

Greene, W. 2005b. “Reconsidering heterogeneity in panel data estimators of the stochastic frontier model.” Journal of Econometrics 126:269–303.

Huang, T. 2005. “A Study on the Productivities of IT Capital and Computer Labor: Firm-level Evidence from Taiwans Banking Industry.” Journal of Productivity Analysis 24 (3): 241–257 (November).

Jondrow, J., K. Lovell, I. Materov, and P. Schmidt. 1982. “On the estimation of technical inefficiency in the stochastic frontier production function model.” Journal of Econometrics 19 (2-3): 233–238.

Khatri, Y., and I. Lee. 2003, February. “Information Technology and Productivity Growth in Asia.” Imf working papers 03/15, International Monetary Fund.

Koetter, M., J. Kolari, and L. Spierdjik. 2008. “Effcient Competition? Testing the ’Quiet Life’ of U.S. Banks with Adjusted Lerner Indices.” Proceedings of the 44th banking market competition and structure conference, Federal Reserve Bank of Chicago.

Koetter, M., and O. Vins, 2008. “The Quiet Life Hypothesis in Banking - Evidence from German Savings Banks”, Working Paper Series: Finance and Accounting, Goethe-University Frankfurt/Main Nr. 190.

Kumbhakar, S., and K. Lovell. 2000. Stochastic Frontier Analysis. Cambridge University Press.

Lal, K. 2005. “New Technologies and Indian SMEs.” Discussion papers 06, United Nations University, Institute for New Technologies.

Martín-Oliver, A., and V. Salas-Fumas. 2007, Dec. “The output and profit contribution of information technology and advertising investments in banks.” Banco de españa working papers 0740, Banco de España.

Meeusen, W., and J. van den Broeck. 1977. “Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error.” International Economic Review 18 (2): 435–444.

Morikawa, M. 2004. “Information Technology and the Performance of Japanese SMEs.” Small Business Economics 23 (3): 171–177.

Sealey, C., and J. Lindley. 1977. “Inputs, Outputs, and a Theory of Production and Cost at Depository Financial Institutions.” Journal of Finance 32 (4): 1251–66.

Singh, N. 2004, December. “Transaction Costs, Information Technology and Development.” Development and comp systems 0412005, EconWPA.

Solow, R. 1987. “We’d Better Watch Out.” Technical Report, New York Times Book Review.

Stiroh, K. 2001. “Investing in information technology: productivity payoffs for U.S. industries.” Current Issues in Economics and Finance, Jun.

Stiroh, K., and M. Botsch. 2007. “Information Technology and Productivity Growth in the 2000s.” German Economic Review 8 (05): 255–280.

Tanaka, T. 2006, August. “Cost Efficiency in Japanese Local Governments: the Economic

Effect of Information Technology in Japanese Local Governments.” Ersa conference papers ersa06p234, European Regional Science Association.

Deriving Cost and Profit efficiency

Table 6: Summary Statistics – Efficiency estimation

Table 6 shows summary statistics for all variables used for the estimation of cost and profit efficiencies via SFA. The sample includes 5,022 observations over the period 1996 - 2006 for all 457 incumbent savings banks at the end of year 2006. All monetary variables are in € million.

Variable	Mean	Std. Dev.	1%	99%
Total operating cost	106.33	143.21	8.65	677.87
Profits before valuation	23.01	30.91	1.79	132.64
Consumer loans	160.07	224.83	13.83	929.4
Mortgage loans	628.09	905.24	47.8	4744.8
Corporate loans	447.53	684.46	21.41	2955.83
Securities	597.78	801.34	33.38	4657.58
Labor cost	56.07	6.63	39.33	69.48
Cost of funding	3.82	0.71	2.42	5.16
Cost of fixed assets	50.49	25.6	21.98	131.29
Interest rate consumer	5.61	2.68	1.12	12.67
Interest rate mortgage	7.41	3.14	3.67	15.86
Interest rate corporate	2.1	0.73	0.91	4.27
Interest rate securities	5.22	1.02	3.2	7.45
Equity incl. Reserves	115.63	161.55	7.76	822.95
Observations	5,022			

To calculate bank's cost and profit efficiencies and Lerner indices, we specify optimal total cost and profit frontiers to estimate banks' marginal costs and average revenues as in (Koetter, Kolari, and Spierdjik 2008). We assume that banks minimize total costs C by choosing optimal output quantities $x^*(y, w)$ at given input prices w and technological constraints to provide financial products y. Deviations from optimal cost C^* or profits PBV^* in year t can be either due to random noise or suboptimal employment of inputs. A baseline stochastic frontier for a bank i is given by $\ln LHSit = f(x_{it}, w_{it}, c, trend, \beta) + w_{it}$, where lower case letters indicate logarithms, c is a structural control variable which includes bank's equity inclusive reserves, *trend* is a time trend and β is a vector of parameters to estimate. *LHS* is a short-hand for either the log of total operating cost ln C or profits before tax ln PBV. Frontier arguments are abbreviated x and capture output volumes in case of a cost frontier y or output prices p, which are exogenous in the case of a profit frontier. The data is summarized in Table 6.

We assume that w_{it} consists of a noise component *vit*, and an inefficiency component *uit*, where $w_{it} = v_{it} + u_{it}$. Here, v_{it} is normally distributed and i.i.d. with $v_{it} \sim N(0, \sigma v^2)$. The inefficiency term u_{it} is drawn from a non-negative half-normal distribution and i.i.d. with $u_{it} \sim |N(0, \sigma u^2)|$ Kumbhakar and Lovell 2000). Point estimates which denote cost and profit efficiencies are obtained as the expected value of u_{it} given w_{it} (Jondrow et al. 1982).

We use cost parameters obtained from the cost frontier to calculate group-specific marginal costs as:

$$MC_{it} = \sum_{m}^{4} \frac{\partial \ln C_{it}}{\partial \ln y_{mit}} \times \frac{C_{it}}{\sum_{m}^{4} y_{mit}} \qquad (2)$$

Average revenues are obtained by summing predicted profits and estimated average cost both net of inefficiency. Using average revenues and marginal cost from Equation (2), we calculate Lerner indices as in (Angelini and Cetorelli 2003) and (Fernandez de Guevara et al. 2007) as

$$\mathrm{L_{it}} = \frac{(AR_{it} - MC_{it})}{AR_{it}} \quad .$$

In competitive markets, marginal costs *MCit* are equal to average revenues *ARit*. High values of Lerner indices *Lit* therefore indicate higher levels of competitiveness pertinent to a bank and vice versa.

Additional Tables

Table 7: Summary Statistics – Characteristics of eastern and western German savings banks

Table 7 shows features of eastern and western German savings banks. Total assets and the book value of equity are denoted in € million. The tables comprise 803 observations over the period 1996 - 2006 for eastern and 4085 observations for western savings banks respectively. Surplus deposits are calculated as all non-bank deposits over all non-bank loans and depict the percentage of loans that are covered by deposits.

Eastern German savings banks

Year	IT standardization	Total assets	Equity	No. of branches	Surplus deposits
1996	79%	1,509	40	36	188%
1997	76%	1,528	43	37	179%
1998	75%	1,532	45	35	173%
1999	74%	1,598	49	35	174%
2000	74%	1,614	51	34	170%
2001	74%	1,494	50	31	176%
2002	73%	1,461	50	29	177%
2003	74%	1,342	49	26	176%
2004	75%	1,582	57	28	183%
2005	76%	1,559	59	28	188%
2006	78%	1,541	61	27	190%
Average	75%	1,526	50	32	179%

Western German savings banks

Year	IT standardization	Total assets	Equity	No. of branches	Surplus deposits
1996	65%	1,907	78	40	121%
1997	66%	1,967	82	39	120%
1998	64%	2,065	87	39	120%
1999	64%	2,222	96	38	121%
2000	65%	2,271	100	37	119%
2001	67%	2,277	99	35	124%
2002	69%	2,256	100	34	126%
2003	71%	2,357	107	32	125%
2004	73%	2,340	110	32	125%
2005	75%	2,324	112	31	126%
2006	75%	2,346	118	31	126%
Average	68%	2,213	99	35	123%

Additional Figures

Figure 1: Cost-income ratio and cost efficiency

Figure 1 shows the development of cost efficiency and cost-income ratio (left panel, in percent) and income and cost (right panel, in € thousands) over the observation period.

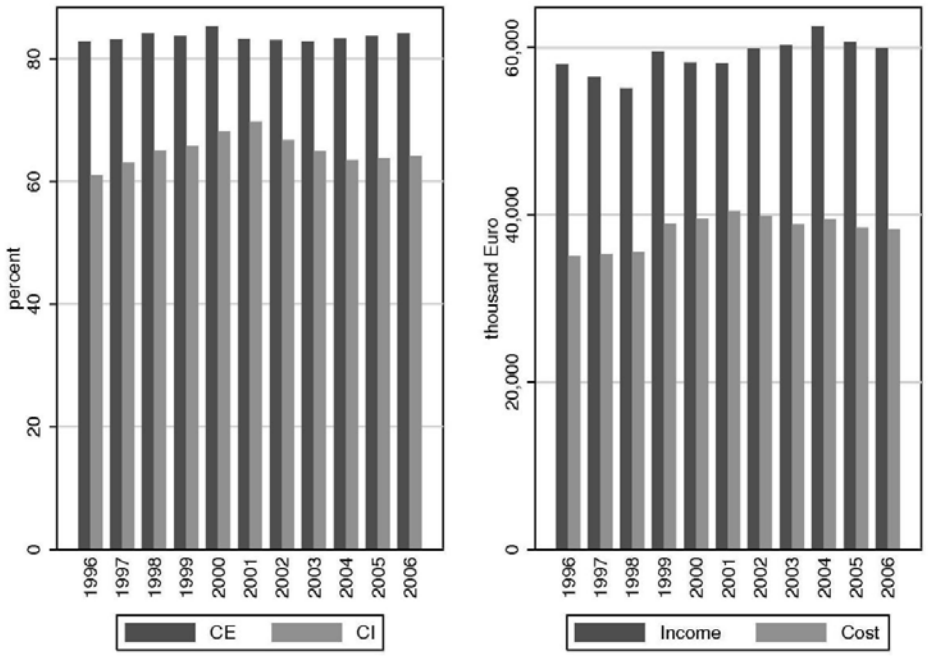
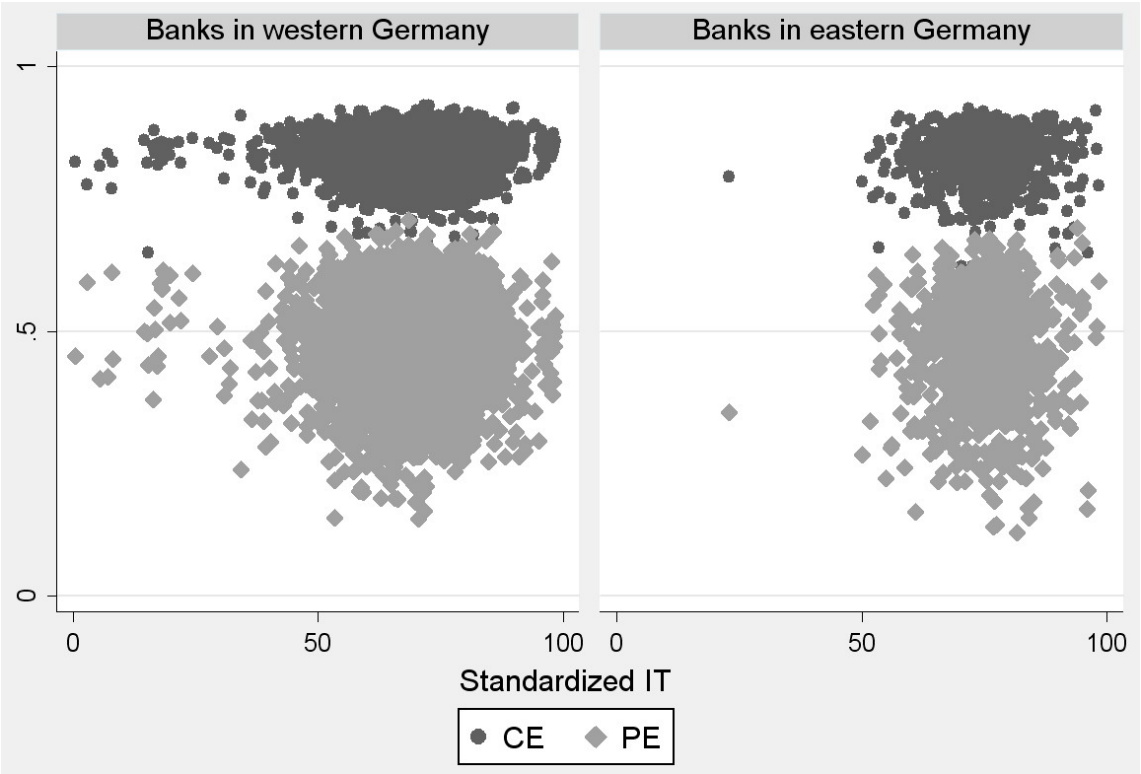


Figure 2: Level of IT standardization for eastern and western German savings banks

Figure 2 shows the relation of cost and profit efficiencies and the level of IT standardization for western and eastern German savings banks respectively. The y-axis depicts the degree of cost and profit efficiency while the x-axis shows the normalized (0-100) degree of IT standardization.



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