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THE EFFECTS OF PRIVATIZATION AND CONSOLIDATION ON BANK PRODUCTIVITY: COMPARATIVE EVIDENCE FROM ITALY AND GERMANY

by E. Fiorentino[*], A. De Vincenzo[**], F. Heid[$], A. Karmann[$$] and M. Koetter[§]

Abstract

The Italian and German banking systems shared similar characteristics early in the 1990s but have evolved in different directions since then: Italy privatized its publicly-owned banks while Germany has maintained a large share of state-owned savings banks. Contemporaneously, banks in both markets engaged heavily in mergers and acquisitions. We analyze how these activities have affected banks' productivity in the period 1994-2004, differentiating between technical change, efficiency change and scale economies. We find that privatized banks experienced a significant increase in productivity, especially if they subsequently merged with other banks. German banks were still able to increase their productivity through consolidation.

JEL Classification: D24, G21, G28, L33.
Keywords: banking market integration, deregulation, total factor productivity, Italy, Germany.

Contents

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1 Introduction[1]

Banking industries throughout the world have changed dramatically over the last two decades. Technological progress and the globalization of financial services have exposed banks to increased competitive pressure and forced them to optimize their operations and productivity, often through mergers and acquisitions (Amel et al., 2004; Angelini and Cetorelli, 2003). The deregulation of the banking industry has also played an important role in this regard (Megginson, 2005; Barth et al., 1999).

In this study, we examine the Italian and German banking systems which, until the 1990s, shared similar characteristics, in particular with regard to the existence of a large public banking sector. With the beginning of the 1990s both banking systems started a profound process of consolidation which is still in progress. But while Italy privatized its public banking sector, Germany has maintained a large share of state-owned savings banks throughout. In Italy, mergers across different banking sectors became normal while in Germany mergers between savings banks and private banks are prohibited by law. We aim to to shed new light on the effects of consolidation and privatization by comparing the evolution of these two important European banking industries.

Two questions are at the center of our analysis: How did the productivity of German and Italian banks develop during the 1990s, and how was it affected by privatization and consolidation? What are the most important components of productivity growth: technical progress, efficiency gains, or the realization of scale economies? As privatization is said to remove some constraints in the efficient allocation of resources one might expect a positive sign on total factor productivity (TFP) changes for those banks affected, at least in the longer run when the privatization and related restructuring of the bank are completed. However, this hypothesis is only valid if one believes that public banks are indeed less productive than private banks. We also try to provide an answer to this question in our subsequent analysis. From a theoretical viewpoint, the effects of merger activities should have a positive effect on productivity, at least if they are motivated by scale economies. Since integration costs can be high, the benefits of mergers might be visible only in the longer term.

While there now exists an extensive body of literature on the effects of M&A, surprisingly little is known about the effects of bank privatization in developed countries (Megginson, 2005), in particular when it comes to cross-dependencies between merger and privatization effects. Furthermore, while a number of studies analyze individual productivity components for both banking markets, only few address all three components simultaneously. [2] We aim to fill this gap by analyzing how privatization and consolidation have affected banks' TFP changes and its components:

[1]We thank participants to the conference on public and private ownership hosted by the Center for Financial Studies (CFS), the Deutsche Bundesbank, and the Wharton Financial Institution Center (WFIC) in Frankfurt in November 2006 for their useful suggestions. We also thank participants of seminars at the Banca d'Italia in December 2007 and at the Deutsche Bundesbank in February 2008. We are particularly grateful to Steven Ongena for his very helpful comments. The paper represents the authors' personal opinions and does not necessarily reflect the views of the Banca d'Italia and the Deutsche Bundesbank. All errors are our own.

[2]For example, Lang and Welzel (1996), Altunbas et al. (2001), Maudos et al. (2002) or Casu et al. (2004).

(i) efficiency changes, (ii) scale economy changes and (iii) technical changes. To this end, we use a unique dataset provided by the central banks of Italy and Germany that includes information on M&A activities and ownership changes.

We structure the remainder of the paper as follows. In section 2 we review the relevant literature relating bank productivity to ownership changes and consolidation. In section 3 we briefly describe the Italian and German banking markets in terms of structural and regulatory peculiarities. In section 4 we present the productivity analysis of German and Italian banks. In particular, we discuss in section 4.1 how we estimate TFP changes based on industry cost functions, we describe our database in section 4.2, and we show the results of the productivity analysis in section 4.3. In section 5, we explain how we use regression techniques to analyze the effects of privatization and consolidation on TFP change and its components, and we discuss the results of the regression analysis in section 5.1. We conclude in section 6.

2 Bank Privatization, Consolidation, and Productivity

Ownership influences bank's behavior significantly. For instance, Berger et al. (2008) report that Indian firms with relations to state-owned banks tend to maintain fewer and less diversified ties to financial institutions compared to non-financial firms banking with foreign intermediaries. Whether government or privately owned banks also perform differently is another matter of long-standing debate. According to Megginson (2005), government ownership of banks can be justified on the basis of non-economic objectives, as a remedy to market failure, or a more efficient way to provide finance if contracts can either not be written completely or enforced. But managers of government owned banks also face fewer incentives to maximize revenue, are less well monitored, and most importantly are inefficient by design since they are constructed for the very purpose to serve politicians' objectives rather than pursuing value and welfare maximizing choices (Barth et al., 1999; La Porta et al., 2002).

A number of studies find accordingly that government owned banks are less efficient, see for example Bonin et al. (2005). But most studies concern less-developed or developing countries and yield fairly mixed results across countries. Bhattacharyya et al. (1997) analyze total factor productivity (TFP) growth of privatized Indian banks between 1970 and 1992. Despite an initial fall in productivity, potentially due to the new competitive market conditions, they find significant improvements in TFP (up to 7% at the end of the observation period) thereafter. In contrast, Kumbhakar and Sarkar (2003), who analyze the relationship between deregulation and TFP growth for Indian banks between 1985 and 1996, report the absence of any TFP improvements. In fact, according to their results, public sector banks do not respond well to deregulation. A number of country studies add to the ambiguity. Nakane and Weintraub (2005) (Brazil), Mohieldin and Nasr (2007) (Egypt), and Gilbert and Wilson (1998) (Korea) report positive performance development of privatized state-owned banks. On the other hand, Bonaccorsi di Patti and Hardy (2005) (Pakistan), Omran (2007) (Egypt) and Isik and Hassan (2003) (Turkey) find that efficiency gains are not sustained shortly after privatization or even that

privately-owned banks experienced slower TFP growth compared to government-owned institutions.

These contradicting findings may simply underpin that privatization is not a panacea to remedy slack in the banking industry (Megginson, 2005). Partly, they may also reflect three additional reasons that we seek to address in our study. First, bank privatization in developed countries is likely to have significantly different effects compared to developing countries usually studied (Barth et al., 1999; La Porta et al., 2002). But direct evidence on the effects of bank privatization in industrialized countries remains scant. One exception is Micco et al. (2007), who confirm a weak correlation between ownership and bank performance in industrial countries. Another test of the direct implications of bank ownership in industrialized countries is Sapienza (2004). She reports that Italian state-owned banks charged systematically lower interest rates on loans but prefer at the same time to lend to larger firms between 1991 and 1995. Overall, she concludes that state-ownership fosters inefficient capital allocation and may thus depress financial development, output, and productivity. Both studies, however, do not explicitly estimate the effect of privatization on productivity but accounting based measures of performance.

Second, most studies neglect the dynamic implications of the privatization process. According to Berger et al. (2005) and Bonin et al. (2005) this is important since both timing and the mode of privatization affect bank's performance. The former study shows that state-owned banks in Argentina exhibit poor long run performance but the most pronounced improvements after privatization. Related, Bonin et al. (2005) report for a sample of banks in six Eastern European countries that early cohorts of privatized banks are more efficient compared to banks privatized at later stages. Therefore, we account explicitly for the timing of privatization and the dynamic effects on TFP change. A closely related and important aspect that is often neglected in the literature concerns the interdependency between privatization and consolidation. There has been considerable research on the effects of M&As. But only few studies analyze the possible benefits for banks' TFP change. Most studies focus instead on consolidation effects on individual TFP components, for instance efficiency.[3] Furthermore, we are unaware of a study that compares mergers in a liberalized market to mergers in a market maintaining the status quo of state-owned banks. Our joint analysis of both privatization and mergers in both Germany and Italy allows us to compare merger effects following privatization to a control group of mergers without privatization. We can investigate if mergers yield a stronger effect in an environment with potentially more partners following deregulation and which components of TFP change benefit in particular, for instance cost or scale efficiencies.

Third, ambiguous results may partly reflect methodological differences. Many studies use Malmquist index to decompose productivity into different components.[4] However, non-parametric methods as the Malmquist index neglect the effects of random noise and are sensitive to outliers, which is why other studies use parametric models to estimate TFP growth or technological progress.[5] One parametric

[3]See Berger et al. (1999) for a comprehensive survey, Focarelli et al. (2002) and Resti (1998) for Italian and Lang and Welzel (1999) and Koetter (2008) for German banking system evidence.

[4]See, for example, Berg et al. (1992) (Norway), Alam (1998) (Turkey), Gilbert and Wilson (1998) (Korea), Wheelock and Wilson (1999) (U. S.) and Isik and Hassan (2003) (Turkey).

[5]See Casu et al. (2004) for a comparative analysis of parametrical and non-parametrical pro-

studies that investigates multiple components of TFP is Stiroh (2000). He reports positive overall productivity growth for a sample of U.S. bank holding companies in the 1990s, primarily due to positive changes in scale economies. But he also reports increased cost inefficiency as a result of deregulation. In contrast, Kumbhakar and Lozano-Vivas (2005) find that deregulation in the Spanish banking industry contributes univocally positive to TFP growth through both reductions of inefficiency and technical progress. In our analysis of privatization and consolidation, we therefore distinguish the respective effects on all three components of TFP change: scale effects, technical change, and efficiency developments.

3 The Italian and German Banking Systems

At the end of the 1980s the Italian banking system consisted of private banks, public banks (both savings institutions and stated-owned banks), [6] and credit cooperatives. The system was highly fragmented, with a large number of relatively small institutions and a significant presence of state-owned banks (see table 1). At that time there were no universal banks and the institutions were classified according to the business specialization as commercial banks or as special credit institutions.[7] In addition, the regional network and business activities were strictly regulated.

In the course of the 1990s, this structure was radically altered. During the 1990s public banks were transformed into joint-stock companies and split into two separate entities, a "foundation" and a "stock corporation".[8] The foundation represented the original legal entity, conferred its banking division to the stock corporation and held the stock. The "stock corporation" (the bank) conducted banking business. In 1994 and 1999 tax incentives were introduced for foundations to disinvest themselves of their bank shares.[9] Together with the reform of the ownership structure of public banks, a set of other important reforms took place in the 1990s, in part as a consequence of the implementation of the Second Banking Directive (89/646/EEC). The mandatory specialization was gradually removed after 1990, so that, thanks to the new universal bank model, credit institutions could raise funds in any form and undertake any business activities (such as factoring, leasing, medium- and long-term lending, and merchant banking). Restrictions on geographical diversification were lifted and the concept of "a banking group" was introduced in the legislation.

As a consequence of this wave of reforms, the nature of the banking system changed substantially. The share of total assets controlled by public banks decreased considerably, from 59.6 to less than 10 percent, and the number of banks dropped

ductivity measurements.

[6] The state presence in the banking system dates back to the creation of IRI ("Istituto per la Ricostruzione Industriale") after the Great Depression. It was a publicly-owned holding company controlling the three largest public banks: Banca Commerciale Italiana, Credito Italiano, and Banca di Roma.

[7] Commercial banks were specialized in short-term business, i.e. shorter than 18 months, while special credit institutions were specialized in medium- and long-term business and often in one particular sector, such as agriculture, building, public enterprizes or industry (Carletti et al., 2005).

[8] Law No. 218 of 1990 (Amato-Carli Law): The restructuring and integration of the equity of public sector banks.

[9] Law No. 474 of 1994 (Dini Directive) and Law No. 461 of 1998 (Ciampi Law).

by 26.5 per cent to 784 (see table 1). These trends were accompanied by a process of mergers and acquisitions (M&As) among banks which, in terms of the number of institutions involved, reached its peak in the course of the 1990s. Between 1990 and 2004 a total of 620 M&As were recorded, involving more than half of the total assets of the Italian banking system. At the same time, thanks to the liberalization of branching, the number of bank offices increased by around 78 per cent and the availability of banking services improved. Furthermore, the average size of banks increased.[10]

The German banking system is a universal banking system. Like the Italian banking industry at the beginning of the 1990s, the banking industry in Germany is composed of public and private credit institutions, and of credit cooperatives ("three-pillar system"). However, in contrast to Italy, the German banking system did not undergo fundamental liberalization during the 1990s (Krahnen and Schmidt, 2004). Furthermore, regional and central savings banks in each state are governed by state law and cannot be taken over by an institution from another pillar (Brunner et al., 2004). However, the number of institutions dropped considerably in the last decade: from 4,589 in 1990 to 2,089 in 2004 (see table 1). At the same time, the average size of banks increased by almost 60 percent. Although the number of publicly-owned banks also declined steadily due to intra-pillar mergers rather than privatization, the asset share of public banks did not change significantly (35.1 percent in 1990 and 34.5 percent in 2004). [11]

Table 1: Privatization and Consolidation of Italian and German Banks (1990-2004)

Country	Banking Groups	No. of Banks		Asset Share	
		1990	2004	1990	2004
Italy	Public banks	93	-	59.6	-
	Private commercial banks	106	243	20.5	79.3
	Cooperative and mutual banks	823	475	18.5	14.9
	Branches of foreign banks	37	66	1.6	5.80
	Total	1064	784	100	100.00
Germany	Public banks	784	489	34.79	33.30
	Private commercial banks	305	168	27.45	31.99
	Cooperative and mutual banks	3416	1338	14.84	10.42
	Specialized institutions	73	68	21.54	23.00
	Branches of foreign banks	60	84	1.35	1.23
	Total	4638	2147	100	100.00

Source: Bundesbank and Banca d'Italia, Monthly reports.

[10]Tables 9 and 11 in the Appendix give further insight into the structure and performance of the Italian banking system during the period of analysis.

[11]Tables 10 and 12 in the Appendix give further insight into the structure and performance of the German banking system during the period of analysis.

4 Productivity Change of Italian and German Banks

In this section we analyze productivity growth in the German and Italian banking markets. We begin by presenting the method for determining productivity growth. Next, we discuss the data that we use to calculate bank individual growth rates. We then compare aggregate productivity changes in Italy and Germany over time. Finally, we test for σ convergence in productivity between Italian and German banks.

4.1 Methodology

Many studies use, in an input-output framework, deterministic index methods such as the Divisia Index, which measures productivity change as the difference between output and corresponding input index changes (Kumbhakar and Lovell, 2000). A disadvantage of such index methods is that they do not provide information about the *sources* of productivity changes.[12] For this reason, we follow the econometric approach suggested by Bauer (1990) and Kumbhakar and Lovell (2000). In particular, we derive TFP change – and its components – by estimating a cost frontier that also takes account of the multi-product nature of bank production.

While taking into account bank-specific effects (see below), we estimate a common frontier for both banking markets together rather than one for each country. However, our main objective is to compare the banking markets in Italy and Germany, whereas the latter approach would only allow for a comparison of banks *within* each country. When specifying a common frontier it is imperative to adequately account for systematic differences in the production function as well as in macroeconomic and regulatory conditions (Lozano-Vivas et al. (2002) and Dietsch and Lozano-Vivas (2000)). But we also note that Italian and German banks operated as universal banks in a common market for financial services[13] during the entire period under investigation and therefore had, at least in principle, access to the same production technology. We also take great care in harmonizing the national differences in the variables specified for the production function. However, we did not only include country specific-effects in the production function but went one step further and added (unobserved) *bank-specific effects* to the frontier equation.[14]

In particular, we assume that every bank k is subject to a technology constraint $T(\bullet)$, which is time-dependent. At any time t, and given an input price vector w, each bank k chooses an input vector x in order to produce an output vector y. An optimal cost frontier in logs is then:[15]

$$lnC_{kt} = \alpha_k + f(y_{kt}, w_{kt}, z_{kt}, t) + v_{kt} + u_{kt} \tag{1}$$

[12] Furthermore, since they do not account for random noise, non-parametric methods are also more sensitive to outliers (Coelli et al., 2005).

[13] The First Banking Directive (1977), the EU White Paper (1985) and the Second Banking Coordination Directive (1988) led to the establishment of the Single Market for Financial Services on January 1, 1993.

[14] An alternative to our approach is provided by Bos and Schmiedel (2007), who estimate single frontiers for a sample of European countries and then apply a meta-frontier.

[15] We assume that the function has a translog form and estimate it with the software Limdep. Estimated parameters for the cost function are provided in the Appendix on page 32.

where $f(y_{kt}, w_{kt}, z_{kt}, t)$ is the *kernel* of the optimal cost frontier, α_k is a vector of bank-specific fixed effect, z_{kt} is a vector of banks' observable characteristics and $\varepsilon_{kt} = v_{kt} + u_{kt}$ is the composite error term. In any year t, a bank can deviate from optimal costs due to random noise, v_{kt}, or inefficient management, u_{kt}. The random error term v_{kt} is assumed to be *i.i.d.* with $v_{kt} \sim N(0, \sigma_v^2)$ and independent of the explanatory variables. The inefficiency term is *i.i.d.* with $u_{kt} \sim N|(0, \sigma_u^2)|$ and independent of v_{kt} [16]. Bank-specific point estimates of efficiency are obtained as $E(u_{kt}|\varepsilon_{kt})$, i.e. the mean of u_{kt} given ε_{kt} (Jondrow et al., 1982). Parameter estimates of the cost frontier in equation (1) are depicted in table 13 in the Appendix. In table 13 the significance of λ, the ratio of the variance due to inefficiency and the variance due to random noise, shows the existence of inefficiency; a frontier is therefore preferred to an ordinary cost function.

From equation (1) we derive three components for TFP change: technological progress, the realization of scale economies and efficiency changes. The sum of the three components, as depicted in equation (2), is a measure of total productivity change:[17]

$$TFPC_{kt} = [1 - \frac{\partial \ln C_{kt}(y, w, z, t)}{\partial \ln y_{kt}}]\dot{y}_k + \frac{\partial \ln C_{kt}(y, w, z, t)}{\partial t} - \frac{\partial u_{kt}}{\partial t} \qquad (2)$$

The first expression on the right-hand side of equation (2) represents the component of TFP change resulting from banks' realization of scale economies (in the following SC), the second term describes technological change (in the following TC), and the last expression depicts the change in technical efficiency (in the following EFC). The component that describes the realization of scale economies depends on two effects: scale elasticities as captured by the term inside the brackets and the changes in output volume. Note that, if a bank exhibits constant or negative returns to scale, ($\partial \ln C_k(y, w, z, t)/\partial \ln y \geq 1$), a change in the level of output does not contribute positively to TFP growth. The second component of equation (2) depicts changes in technology. Under technological progress, a given volume of outputs can be produced – at the efficiency level – at lower costs. Many papers estimate technical changes by estimating separate frontiers per year and then disentangling cost changes due to changed parameters from those due to changing variables. In our view, the estimation of separate functions at each year is problematic for the same reasons that we mentioned above with regard to the estimation of separate frontiers for different countries. Instead, we follow Baltagi and Griffin (1988) and add a time trend t along with interaction terms of time and input prices as well as output quantities. This allows us to derive technical change as the sum of partial time derivatives. [18] The final component of equation (2) captures the contribution to productivity change of changes in the cost of technical inefficiency. Until very recently, econometric models of productivity by and large ignored the contribution

[16] We impose linear homogeneity restrictions by dividing prices and total cost by the price of one input.

[17] We assume the input mix is allocative efficient. Therefore, the additional component of TFP growth that captures the impact of deviation of actual input cost shares from efficient input cost shares and the component caused by allocative inefficiency are not included in the decomposition of TFP change we consider here. For more details see Kumbhakar and Lovell (2000).

[18] For an application to European banking, see Altunbas et al. (1999).

of efficiency. However, if inefficiency exists, its change provides an independent contribution to productivity. To measure these changes, it is important to specify the frontier in such a way that it allows for time-varying inefficiency. In contrast to many other studies that have analyzed the evolution of efficiency, we do not impose any functional form for the change in efficiency, which provides greater flexibility in modelling its dynamics.

4.2 Data

In our analysis, we consider all universal banks with the exception of the head institutions of German credit cooperatives (DZ bank and WGZ bank) and savings banks (the Landesbanks), which, given their specialist nature, do not appear to be comparable with the other market participants (Altunbas et al., 1999). Balance sheet data and P&L accounts were provided by the Deutsche Bundesbank and the Banca d'Italia. The time period under consideration covers the years from 1994 to 2004. Earlier years have been excluded because they were either missing or not completely available.[19]

Table 2: Bank Production Data for Italian and German Banks (1994-2004)

Country	Variable		Mean	SD	Min	Max	N
Italy	Interbank Loans	**y1**	212.432	1,117.340	0.004	22,396.290	6362
	Customer Loans	**y2**	974.752	4,437.375	0.601	94,681.380	6362
	Securities	**y3**	250.871	835.180	0.008	13,160.680	6362
	Price of Fixed Assets	**w1**	5.890	2.455	1.993	19.671	6362
	Price of Labor	**w2**	48.476	5.818	30.573	80.694	6362
	Price of Funds	**w3**	3.697	1.936	1.010	15.689	6362
	Equity	**z1**	136.722	561.552	0.558	11,677.200	6362
	Non-performing Loan Share	**z2**	8.907	6.752	0.008	38.181	6362
	Total Cost	**C**	110.015	486.868	0.569	9,280.111	6362
Germany	Interbank Loans	**y1**	127.124	1,869.644	0.001	103,324.500	27736
	Customer Loans	**y2**	478.666	3,818.360	1.129	204,335.800	27736
	Securities	**y3**	185.887	1,667.635	0.002	99,729.890	27736
	Price of Fixed Assets	**w1**	14.532	8.033	5.135	74.130	27736
	Price of Labor	**w2**	48.530	7.352	28.386	92.741	27736
	Price of Funds	**w3**	3.515	0.651	1.868	5.475	27736
	Equity	**z1**	35.798	290.488	0.245	14,052.140	27736
	Non-performing Loan Share	**z2**	5.788	4.483	0.000	31.614	27736
	Total Cost	**C**	46.129	396.123	0.356	21,705.730	27736

Notes: Outputs, equity and total cost are expressed in millions of euro.
Price of funds, price of fixed assets and non-performing loans share are expressed in percent.
Price of labor is expressed in thousands of euro.

We follow the intermediation approach of Sealey and Lindley (1977) and define three input and output categories. Input quantities are: fixed assets x1, such as branches and administrative buildings; labor x2, measured as full-time equivalents (FTE); and borrowed funds x3, measured as the volume of deposits and bonds. As outputs we define the volume of interbank loans y1, customer loans y2, and investments in stocks and bonds y3. According to our definition, interbank activities are considered as an output when they sit on the left hand side of the balance sheet

[19]Data are available for Italian banks back to 1986 but only back to 1993 for German institutions. This is mainly because East German banks were not included in the statistics prior to 1993. Furthermore, the German database presents for the year 1993 a large number of missing values.

(interbank loans, y1) and as an input when they sit on the right hand side (borrowed funds, x3). It has been noted in the literature on bank efficiency that it is important to include a measure of risk in the regression equation (Mester, 1993). Therefore we include equity z_1 and non-performing loans z_2 as control variables in the cost function.

Table 2 displays the variables considered here and their respective mean, standard deviation, minimum and maximum. All currency variables are expressed in euro and are adjusted for inflation.[20] The Italian sample amounts to 6,362 observations and the German sample to 27,736. We have adjusted the initial database for outliers in three steps. First, we dropped all observations belonging to the first and 99th percentile. Then, as the translog function cannot handle zeros or, equally, missing values or negative values we confined the sample to those banks that have strictly positive inputs and outputs. Finally, having calculated the components of TFP change, we dropped all observations with implausible rates of output changes.[21] Here, we use the method suggested by Hadi (1992) and Hadi (1994) for the identification of multiple outliers in multivariate databases.

4.3 Results of the Productivity Analysis

The results of the productivity analysis are shown in table 3. We report TFP change measures ($TFPC$) and its components technical change (TC), efficiency change (EFC) and change in scale economies (SC). The change in scale economies, in turn, is the product of scale elasticities (SE) and the change in output volume ($\dot{Y}$).

We also show TFP changes according to the traditional Divisia Index method (Hulten, 2000). We calculate the Divisia Index as the change in the ratio of total costs (C) to total output (Y). It is a well-known fact that the Divisia method will usually deliver results that deviate from parametric methods; the gap between the two can sometimes be significant (Kumbhakar and Lozano-Vivas, 2005). One reason for the deviation is that the Divisia method necessarily also includes price changes that are usually not considered in parametric analysis. In our sample, the Divisia method reports significantly larger values than the parametric method. It is reassuring, however, and supports the stability of our findings, that the *ranking* of TFP changes – between countries and by and large also between banking groups – is the same. Since only the parametric but not the Divisia approach allows for a breakdown of TFP change into its components, we will henceforth only consider the former.

According to the parametric estimates, productivity increased, on average, by 3.2 percent in Italy and 1.2 percent in Germany over the observation period. Likewise, with the exception of efficiency change, all TFP components also exhibit higher rates of change in Italy than in Germany. At the same time, the relative importance of the individual components differs between Italy and Germany. Technological progress, for example, has had much greater importance in Italy than in Germany: Technological progress led *ceteris paribus* to a downward shift of the cost frontier and thus to an improvement in productivity of 2.3 percent in Italy but of only 0.4 percent in

[20] Data are converted into 1995 prices using own country GDP deflators.

[21] Some banks have implausible rates of higher than 1000 points.

Table 3: Average productivity growth of Italian and German banks (1994-2004)

Country/Bank Type	Divisia[2)]	$TFPC$ =	TC +	EFC +	SC	(SE ×	$\dot{Y}$)	N
Germany Total	0.027	0.012	0.004	0.001	0.008	0.139	0.055	21620
Saving banks	0.028	0.013	0.004	0.002	0.007	0.135	0.053	4843
Private banks	0.017	0.008	-0.007	0.001	0.015	0.184	0.072	575
Cooperatives	0.027	0.012	0.004	0.001	0.008	0.138	0.054	16202
Italy Total	0.074	0.032	0.023	-0.003	0.012	0.129	0.098	4604
Formerly State owned[1)]	0.069	0.022	0.020	-0.002	0.003	0.201	0.019	58
Formerly Saving banks[1)]	0.071	0.027	0.020	-0.007	0.014	0.177	0.073	548
Private banks	0.049	0.027	0.026	-0.011	0.012	0.141	0.085	349
Cooperatives	0.062	0.022	0.021	-0.012	0.013	0.149	0.091	554
Mutual banks	0.079	0.036	0.024	0.0001	0.012	0.114	0.107	3095

Notes: $TFPC$= Total Factor Productivity Change, TC= Technical Change, EFC= Efficiency Change, SC= Change in Scale Economies, SE= Scale Elasticities, $\dot{Y}$= Output Change. [1)] Privatized during the sample period. [2)] For comparability reasons we consider here the negative of the Divisia Index. We tested the statistical significance of the differences in the values of TFPC and its components using a t-test for unpaired samples. Differences between Italy and Germany are significant at the 1% level, while differences between banking groups are only in part statistically significant. For more details see table 15, table 16 and table 17 in the appendix

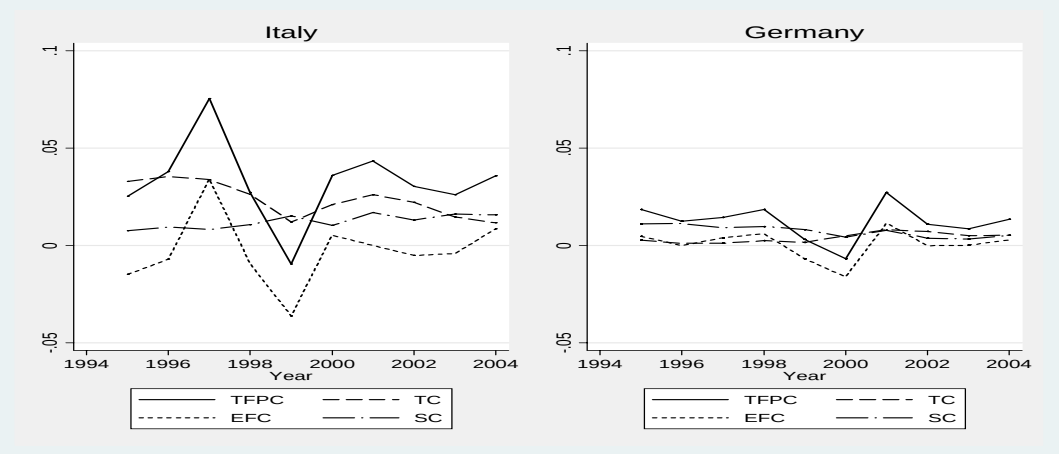
Germany. These results are, in the case of Italian banks, in line with OECD (2000) and Amel et al. (2004) which identify rapid technological advances as one main reason for the increase in competition and productivity. Both banking markets benefited from the presence of positive returns to scale and increasing credit demand. In Germany, about 67 percent of the productivity growth is explained by gains in scale economies while in Italy it explains only 37 percent of the overall growth. Still, the scope for scale economies was larger in Italy, where credit demand also increased more strongly. With regard to efficiency changes, our results show that productivity growth arising from higher efficiency is negligible, or, in the case of Italy, even slightly negative.

As differences in productivity growth between Italian and German banks might be driven by specific institutions, we report average results by banking groups. Indeed, the results highlight great differences between German private banks, on the one hand, and savings and cooperative banks, on the other. While the latter improved their productivity by 1.2 percent, the former saw TFP growth of only 0.8 percent. The difference is even bigger for technical change alone. This is a surprising result since the sector of private banks includes the big and internationally active banks which are said to operate in a highly competitive environment. However, the sector of private banks in Germany is very heterogeneous as it contains, apart from the big banks, many small and specialized credit institutions. Furthermore, the difference might also just reflect the fact that German private banks were already operating at a higher productivity level and that the other two bank groups were converging to this higher level. We will discuss convergence issues in more detail below.

Due to the liberalization in Italy, formerly state-owned banks and formerly private banks all operate as private and universal banks without regional restrictions. Indeed, the results show that productivity gains in Italy do not differ substantially across banking groups. With the only exception of mutual banks, which had the

highest improvement in productivity, the banking groups exhibit fairly homogeneous productivity growth. Formerly saving banks (now private commercial) as well as commercial banks grow on average by 2.7 percent, and formerly state owned (now private commercial) and cooperative banks by 2.2 percent. Furthermore, the larger TFP growth of mutual banks indicates that small banks experienced above-average productivity growth during the 1990s, possibly as a result of higher competitive pressure (Amel et al., 2004). Private banks profited most from technical change, which represents the most important factor for TFP growth in Italy. Interestingly, efficiency change was negative for all banking groups in Italy, with the exception of mutual banks. Potentially small banks, as mutual banks, react to stiffer competition by becoming more cost-efficient.

Figure 1: Trends in productivity change

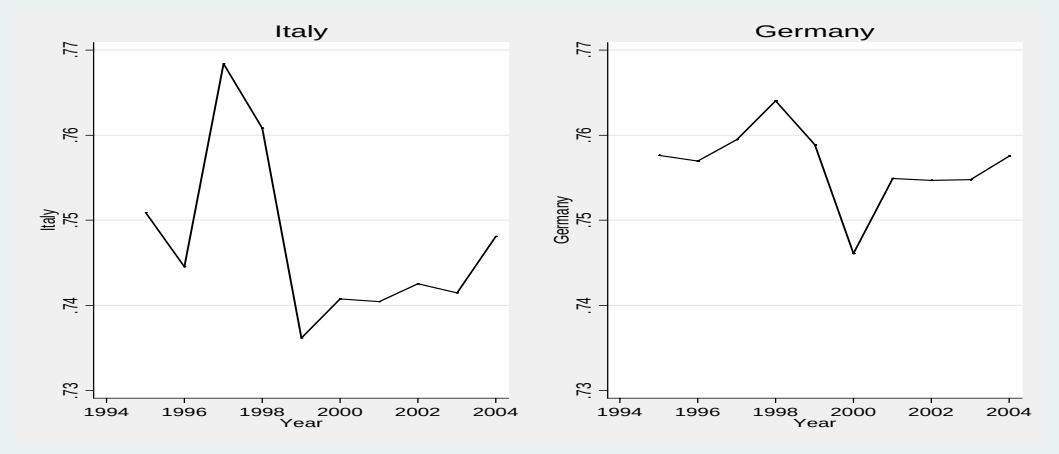


In general, the trend in TFP change and its components over time is more homogenous in Germany than in Italy (figure 1). TFP change in Germany varies between -0.006 and 0.02 while, in Italy, it ranges between -0.009 and 0.75. Moreover, the pattern of TFP change in Italy seems to follow the development of the privatization process: After the Dini Directive of 1994 and the Ciampi legislation of 1999, productivity improved substantially, as can be seen by the positive peaks in 1996 and 2001.

As we already noted above, efficiency changes (EFC) of Italian and German banks are, on average, of minor importance for TFP growth (table 3). Nevertheless the evolution of efficiency change over time reveals two spikes in 1996 and 1999 that had an impact on overall TFP change (figure 1). To better understand these trends, in figure 2 we report cost efficiency in terms of levels.

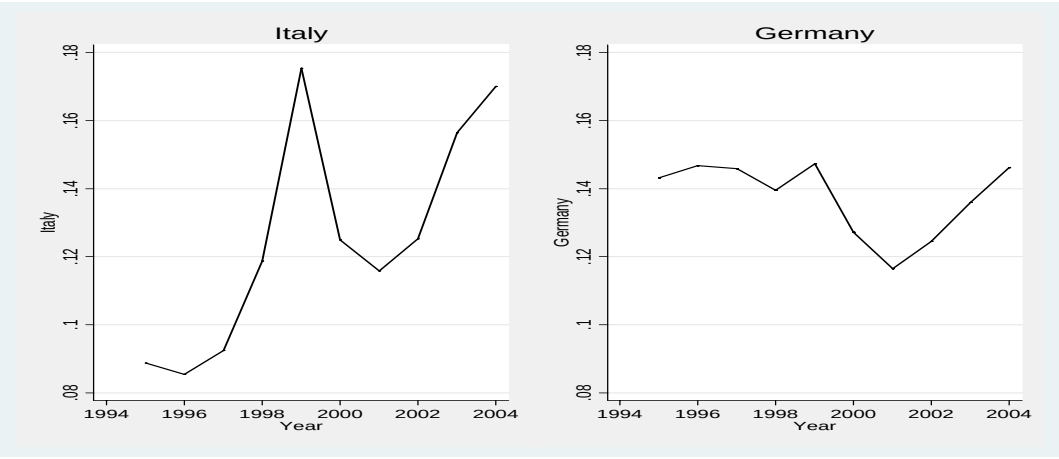
In the run-up to 1999 (Ciampi legislation and introduction of the euro) banks managed to improve their efficiency. One potential reason might be that fiercer competition forced banks to operate more efficiently. The deterioration in efficiency in both the Italian and the German market around 1999 might reflects bankers' lack of cost-consciousness when financial markets were soaring and the contemporaneous costs of labor and borrowed funds decreased. Only after the stock market crashed did the necessity to keep costs in check regain prominence, and cost efficiency improved since 1999/2000, albeit in small measure. Another reason for the trough in 1999

Figure 2: Trends in Cost Efficiency in Terms of Level



might be high reorganization costs due to an increase in M&As. In fact, in Italy the percentage of total assets involved in M&As averaged 3.2 percent in the periods 1995-1997 and 2000-2004 and peaked at 14.02 percent between 1998-1999. The same holds for Germany, as the majority of M&A took place between 1997 and 2000.

Figure 3: Trends in Economies of Scale in Terms of Level



The development of scale economies SC over time supports the evidence found by Cavallo and Rossi (2001) that the optimal bank size increased in the wake of ongoing deregulation. As can be seen in figure 3, the evolution of scale economies of Italian banks had a distinct pattern, but was the reverse of the evolution of efficiency, as it peaked in 1999.

Regarding the evolution of technical progress , TC (dashed line), figure 1 highlights three important characteristics. First, German banks have had a relatively constant rate of change in technology while in Italy technical change fluctuated to a larger extent during the period under investigation. Technical change in Italy increased until 1999 and decreased over the remainder of the sample period. Thus, we observe a downward shift in the cost function, *ceteris paribus*, from 1995 to 1999 for

Italian banks. This shift might be attributed to both the decrease in labor cost until 1998 and the decrease in the interest rate on borrowed funds until 1999. Second, while technical change is the most important contributor to productivity gains in Italy, the scope for further improvement seems to be diminishing.

Table 4: Convergence in Productivity Change of Italian and German Banks (1994-2004)

Sample	**Productivity Measures**	**Mean**		**SD**		**Min**		**Max**	
		1995	2004	1995	2004	1995	2004	1995	2004
Pooled									
	$TFPC$	0.020	0.019	0.051	0.052	-0.387	-0.267	0.311	0.742
	TC	0.007	0.007	0.014	0.009	-0.038	-0.033	0.088	0.086
	EFC	0.002	0.004	0.048	0.046	-0.353	-0.269	0.291	0.651
	SC	0.011	0.008	0.012	0.013	-0.037	-0.038	0.128	0.105
	C/Y	0.075	0.051	0.015	0.008	0.039	0.030	0.235	0.152
Italy									
	$TFPC$	0.025	0.036	0.059	0.068	-0.153	-0.132	0.240	0.742
	TC	0.033	0.011	0.011	0.011	0.006	-0.021	0.088	0.086
	EFC	-0.015	0.009	0.055	0.060	-0.175	-0.159	0.202	0.651
	SC	0.008	0.016	0.014	0.015	-0.037	-0.028	0.079	0.105
	C/Y	0.106	0.046	0.013	0.009	0.068	0.031	0.235	0.152
Germany									
	$TFPC$	0.019	0.014	0.049	0.045	-0.387	-0.267	0.311	0.281
	TC	0.003	0.005	0.009	0.008	-0.038	-0.033	0.038	0.037
	EFC	0.005	0.003	0.046	0.041	-0.353	-0.269	0.291	0.285
	SC	0.011	0.005	0.012	0.011	-0.030	-0.038	0.128	0.097
	C/Y	0.070	0.052	0.008	0.008	0.039	0.030	0.161	0.147

Notes: $TFPC$= Total Factor Productivity Change, TC= Technical Change, EFC= Efficiency Change, SC= Change in Scale Economies, C/Y= Divisia Index Productivity Change.

Technical change, financial deregulation and increased competition are often said to have led to more financial integration and convergence between European countries. Our trend analysis above does not support this hypothesis at least with regard to average TFP growth in Italy and Germany. To study convergence in more detail we also looked at σ *convergence* of TFP change and its components. [22] Table 4 reports the summary statistics, and in particular the standard deviation of TFP change and its components. If the two banking systems had converged over time, we would expect a decrease in the spread of productivity change. However, this is not the case, as the standard deviation for bank-specific TFP growth is even higher in 2004 than in 1994. On the other hand, it is still possible that, while divergence in *growth rates* can be observed, banks' productivity converges in *levels*.

To test this hypothesis, we look at the the ratio of total costs to total output (C/Y). We noted above that this is often a poor measure of productivity but we use it here nevertheless in the absence of a better alternative.[23] As we can see in Table 4 the standard deviation of C/Y indeed diminishes over time, confirming the converge in productivity *levels* between Italian and German banks in general and Italian institutions in particular.

In sum, our results show that banks' productivity improved in both countries. Italian banks productivity, however, improved substantially faster. The decomposi-

[22]See Barro and Sala-i Martin (1995), Sala-i Martin (1996).

[23]Recall that the Divisia Index is calculated as the change in the ratio of total costs to total output. Reassuringly, the Divisia Index leads to similar results as our parametric measure of TFP changes.

tion of TFP growth highlights the fact that most of the gains in productivity are attributable to technical change in Italy and the realization of economies of scale in Germany. We also find evidence for convergence in productivity between Italian and German banks.

5 Impact of Privatization and Consolidation on Productivity

The differences in productivity growth between German and Italian banks and between different banking groups within the respective countries give rise to the question of whether these differences can be explained by different approaches to consolidation and privatization and by differences in ownership. We therefore now turn the analysis of how privatization and consolidation affected individual banks. In doing so, we aim to shed more light on the extent to which these strategies were successful in boosting individual banks' productivity growth. We wish to note from the outset, however, that if these strategies were indeed successful, they are likely to have had an even wider effect that is not restricted to the affected banks. In fact, by improving the productivity of a particular group of banks, other banks might equally strive to enhance their productivity due to higher competitive pressure. Therefore, the overall productivity gains of the banking sector *in total* that have been analyzed in the previous sections may be also the result of "spill-over" effects from one banking group to other banks. These second-round effects, though potentially important, are not the subject of our subsequent analysis. Nevertheless, restricting our analysis to actually privatized or merged banks will enable us to detect any "direct" effect of these strategies on the affected banks.

As we have explained in the introduction there are theoretical reasons to expect that private banks are more productive than public banks. But rather than analyzing *levels* of productivity, which are difficult to calculate for the aforementioned reasons, we will look at productivity *growth* instead. Therefore the hypothesis that we will analyze in the following can be stated as follows:

Hypothesis 1: The privatization of banks will boost their productivity growth.

With respect to the consolidation of the banking sector, it has been noted in the literature that the banking industry is likely to be subject to decreasing returns to scale. Therefore, the main reason for a bank to engage in M&As probably lies in benefitting from scale economies. Our second hypothesis is therefore as follows:

Hypothesis 2: Mergers and acquisitions enhance banks' productivity growth mainly by helping them to reap the benefits of scale economies.

As Wheelock and Wilson (2000) have shown, apart form productivity enhancement, distress resolution is another important motive for mergers. Therefore, hypothesis 2 refers only to *voluntary* mergers. These have to be distinguished from *distress* mergers, i.e. those where one of the merging banks is on the brink of insolvency.

5.1 Empirical Specification

In order to test our hypotheses 1 to 2, we employ panel estimation techniques and analyze the effects of privatization on consolidation at single-entity level. The principal structure of the underlying regression equation is as follows:[24]

$$\begin{aligned} g_{k,t} = \quad & \delta_1 \cdot < \text{PRIVATIZATION} >_{k,t} + \delta_2 \cdot < \text{M\&AS} >_{k,t} + \delta_3 \cdot < \text{PUBLIC} >_{k,t-1} \\ & + \delta_4 \cdot < \text{CONTROLS} >_{k,t} + \sum_j \delta_j \, \text{D}(j) + u_k + \varepsilon_{k,t} \end{aligned} \tag{3}$$

Here g_{it} is either the TFP change or one of its components.

In the above specification, public ownership or public control is indicated by a dummy variable (PUBLIC). In line with the classification of the Banca d'Italia, we consider a bank to be public if the foundation owns more than 50% of the bank's shares. We also use a dummy variable to proxy the immediate privatization effects, which takes the value 1 if a public bank becomes private in the current period (PRIVATIZED). In order to measure long-term effects, we include a dummy variable that takes the value of 1 if the bank is now private but was public three years ago. This variable enters into the regression equation with lag 1 (in order to avoid double counting of current effects). Merger and acquisitions are proxied in a similar fashion (M&AS). In this context it is important to distinguish between voluntary and distressed mergers. While it can be assumed that most banks engage in voluntary mergers in order to enhance their productivity, distressed mergers are arranged to avoid outright default. In fact, because of this, the incidence of the latter is extremely rare.

In this analysis we use prudential information provided by the Bundesbank and the Bank d'Italia, which collect information on banks considered under distress and which have therefore merged with another bank. Therefore, if one of the merging banks was under distress, we use a dummy variable called DISTRESS. [25] In order to measure longer-term effects, we also include lagged variables.

It is important to note that contemporaneous privatization and consolidation variables need to be considered as endogenous variables in the above regression equation. Since the decision to privatize or to merge is likely to depend on the past performance of the particular bank, we include a set of control variables in the regression equation. More specifically, we calculate the change in the cost-to-income ratio (CH_CI) and also include the logarithm of total assets as a measure for the bank's size (SIZE). All bank-specific variables are then either treated as endogenous or pre-determined variables. We then apply GMM techniques and use all lags of the respective bank-specific variables as instruments. In this regard we follow Blundell

[24] A full description of the variables can be found in table 14 in the Appendix.

[25] In case of Italian banks, the dummy DISTRESS takes the value of one when the last supevisory rating (CAMEL) assigned to the bank involved in a merger as target belongs to the range classified as "unfavourable" (in a ranking that contemplates the classes "favourable", "in-between", and "unfavourable"). In case of German banks, the dummy DISTRESS takes the value of one when a bank has losses amounting to 25% of liable capital or a negative operating result in excess of 25% of liable capital.

and Bond (1998) and use all available lags of the endogenous variables dated $t-2$ and earlier as instruments in the difference equation, and first differences dated $t-1$ and earlier in the level equation. We control for the macroeconomic developments and other time effects by including year dummies for each year in the observation period.

5.2 Results of the Regression Analysis

We first estimate equation (3) for TFPC as the dependent variable and then run separate regressions for Germany and Italy (Model A in table 5). With regard to Italy, the results show that public banks have experienced slower TFP growth than their private peers. Consistent with this observation, the privatization of banks has increased their productivity and the improvement is remarkably significant not only statistically but also in economic terms, although some of the improvement seems to be reversed in the longer run. This result is in line with Kumbhakar et al. (2001) and Kumbhakar and Lozano-Vivas (2005) who report increasing bank productivity after deregulation. With regard to consolidation in the Italian banking sector, voluntary mergers have an immediate and positive effect on productivity.[26]

In Germany, we cannot measure any privatization effects, simply because no public bank was privatized in the observation period. It is remarkable, though, that the ownership variable shows a positive sign, in contrast to the Italian case. In other words, contrary to the experience in Italy, public banks showed a higher TFP growth than other banks in Germany. The voluntary merger variable has the expected positive sign but is statistically insignificant. The short-term effect of distressed mergers is statistically insignificant as well, while a small negative effect is visible in the longer run.[27]

Part of the success of the privatization process in Italy might be due to the fact that it also fostered consolidation in the banking sector. Indeed, when a public bank turns private, it might subsequently be taken over by another private bank. In fact, the privatization of public banks and their subsequent consolidation with banks coming from other (private) pillars led to the creation of Italian banking groups. In order to test this hypothesis, we include in Model B an interaction term of the privatization and the merger variable. In order to avoid the problem of collinearity, and because longer-term effects turned out to be largely economically insignificant anyway in Model A, we exclude these in Model B. In fact, the privatization variable now becomes statistically insignificant, while the interaction term is not. This gives support to the hypothesis that the privatization of banks in Italy has broadened the basis for mergers in the banking sector and, thus, the potential for productivity improvements.

We now turn to the analysis of the components of TFP change, i.e. technical change, scale economies, and efficiency change. As regards technical change, the ownership variable has again different signs in Italy and Germany, indicating that

[26] Note that since we measure productivity *gains*, a one-time increase here has a permanent effect on productivity *levels*.

[27] A note on the Sargan test on over identifying restrictions: For Germany the low p-values point to some misspecification in the regression equation. In fact, as we will show below, there are partly opposing effects on the components of TFPC, i.e. on TC, EFC, and SC.

public banks in Italy benefited less from technical change than other Italian banks, while in Germany they benefited more. There is also a positive, albeit small effect of mergers on technical change in Italy. While in Germany the respective signs are negative, they are also statistically insignificant.

Turning to our hypothesis 2, the results show that in both countries banks benefited from increasing returns to scale when they engaged in voluntary mergers, which is in line with previous findings (Cavallo and Rossi, 2001). In both countries, public banks benefited less from scale economies than private or cooperative banks. To exclude any size effects here, we included size as a control variable (as we did in the other regression equation). Again, the privatization of banks has a positive impact, which indicates that privatization has helped banks to grow. It is worth noting, that it is not the group of privatized banks that has been subsequently merged with another bank (PRIVATIZED×M&AS) that is driving this effect, but instead the "pure" privatization effect alone.

It has been argued in the literature that the liberalization of markets helps banks to reorganize their businesses and cut their costs. In fact, efficiency enhancements seem to play an important role in the productivity gains of privatized banks. It is worth noting that this effect mainly comes from those banks that merged with another bank after it had been privatized. Taken this into consideration, the "pure" privatization effect is even negative, pointing to restructuring costs in the immediate period after the merger. Also, mergers as such have only a small effect (in the case of Italy), or none whatsoever, on efficiency change.

In sum, our results show that, in Italy, the privatization and consolidation processes have positively influenced productivity growth, as did the consolidation process in the German banking market.

Table 5: The Effect of Privatization and Mergers on TFP Change

	Model A		Model B	
	Italy	Germany	Italy	Germany
PRIVATIZED	0.148***		-0.004	
	[9.47]		[0.29]	
PRIVATIZED×M&AS			0.144***	
			[7.84]	
M&AS	0.026***	0.016	0.016**	0.032***
	[5.02]	[1.17]	[2.51]	[2.68]
DISTRESS	-0.054***	0.030**	-0.070***	0.044***
	[2.67]	[2.41]	[7.19]	[3.50]
M&AS_LR	0.005	-0.005		
	[1.05]	[1.63]		
DISTRESS_LR		-0.012***		
		[3.40]		
PRIVATIZED_LR	-0.017***			
	[5.86]			
L.PUBLIC	-0.064***	0.019**	-0.021***	0.018**
	[7.20]	[2.53]	[2.84]	[2.47]
L.SIZE	-0.002	0.009***	-0.007***	0.006***
	[1.49]	[5.02]	[8.13]	[3.55]
L.CH_CI	-0.056***	0.076***	-0.079***	0.065***
	[3.05]	[5.48]	[4.42]	[5.01]
Test for AR(1) in first differences (p-value):				
	0.00	0.00	0.00	0.00
Test for AR(2) in first differences (p-value):				
	0.21	0.02	0.82	0.03
Sargan test of overid. restrictions (p-value):				
	0.80	0.00	0.97	0.00

Notes: Absolute value of z-statistics in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The year dummies coefficient estimates are excluded for the sake of brevity. *Privatized* and *Privatized_LR* are dummies variables indicating bank privatization in the current year and within the last four years excluding the current; *M&As* and *M&As_LR* are dummies variables indicating bank M&As in the current year and within the last four years excluding the current; *Distress* and *Distress_LR* are dummies variables indicating bank distress mergers in the current year and within the last four years excluding the current; *Privatized×M&As* is a dummy variable indicating contemporarily bank privatization and merger in the current year; *Public* is a dummy variable indicating public ownership; *Size* corresponds to bank total asset and *CH_CI* to cost to income ratio.

Table 6: The Effect of Privatization and Mergers on Technical Change

	Model A		Model B	
	Italy	Germany	Italy	Germany
Privatized	-0.004		-0.003	
	[1.34]		[1.36]	
Privatized×M&As			-0.001	
			[0.12]	
M&As	0.004***	-0.003	0.004***	-0.005
	[2.83]	[1.09]**	[6.41]	[1.63]
Distress	-0.010**	0.005	0.011***	0.003
	[2.01]	[2.12]	[3.32]	[0.89]
M&As_LR	0.002***	0.000		
	[8.29]	[0.53]		
Distress_LR		0.000		
		[0.15]		
Privatized_LR	-0.002***			
	[7.07]			
L.Public	-0.003	0.007***	-0.003**	0.007***
	[1.50]	[5.09]	[2.42]	[5.51]
L.Size	-0.002***	-0.002***	-0.001***	-0.003***
	[5.71]	[8.72]	[4.91]	[9.75]
L.CH_CI	0.017***	-0.009	0.026***	-0.016
	[5.02]	[0.84]	[11.70]	[1.44]
Test for AR(1) in first differences (p-value):				
	0.00	0.00	0.00	0.00
Test for AR(2) in first differences (p-value):				
	0.02	0.14	0.07	0.10
Sargan test of overid. restrictions (p-value):				
	0.84	0.36	0.84	0.88

Notes: Absolute value of z-statistics in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The year dummies coefficient estimates are excluded for the sake of brevity. *Privatized* and *Privatized_LR* are dummies variables indicating bank privatization in the current year and within the last four years excluding the current; *M&As* and *M&As_LR* are dummies variables indicating bank M&As in the current year and within the last four years excluding the current; *Distress* and *Distress_LR* are dummies variables indicating bank distress mergers in the current year and within the last four years excluding the current; *Privatized×M&As* is a dummy variable indicating contemporarily bank privatization and merger in the current year; *Public* is a dummy variable indicating public ownership; *Size* corresponds to bank total asset and *CH_CI* to cost to income ratio.

Table 7: The Effect of Privatization and Mergers on Scale Economies

	Model A		Model B	
	Italy	Germany	Italy	Germany
PRIVATIZED	0.009***		0.019***	
	[2.69]		[7.51]	
PRIVATIZED×M&AS			-0.007	
			[1.25]	
M&AS	0.008***	0.020***	0.004***	0.021***
	[7.59]	[6.23]	[3.55]	[6.49]
DISTRESS	0.005	0.023***	0.001	0.028***
	[1.53]	[5.98]	[0.46]	[7.57]
M&AS_LR	-0.005***	-0.001		
	[12.21]	[0.80]		
DISTRESS_LR		0.001		0.001*
		[1.48]		[1.87]
PRIVATIZED_LR	-0.005***			
	[7.19]			
L.PUBLIC	-0.005***	0.014*	-0.004***	0.014*
	[3.64]	[1.78]	[2.76]	[1.76]
L.SIZE	0.000*	0.001	-0.001***	0.001
	[1.93]	[0.62]	[6.04]	[0.63]
L.CH_CI	-0.022***	-0.003	-0.012***	-0.003
	[7.22]***	[0.91]	[3.88]	[1.18]
Test for AR(1) in first differences (p-value):				
	0.00	0.00	0.00	0.00
Test for AR(2) in first differences (p-value):				
	0.76	0.30	0.35	0.22
Sargan test of overid. restrictions (p-value):				
	0.20	0.00	0.79	0.00

Notes: Absolute value of z-statistics in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The year dummies coefficient estimates are excluded for the sake of brevity. *Privatized* and *Privatized_LR* are dummies variables indicating bank privatization in the current year and within the last four years excluding the current; *M&As* and *M&As_LR* are dummies variables indicating bank M&As in the current year and within the last four years excluding the current; *Distress* and *Distress_LR* are dummies variables indicating bank distress mergers in the current year and within the last four years excluding the current; *Privatized×M&As* is a dummy variable indicating contemporarily bank privatization and merger in the current year; *Public* is a dummy variable indicating public ownership; *Size* corresponds to bank total asset and *CH_CI* to cost to income ratio.

Table 8: The Effect of Privatization and Mergers on Efficiency Change

	Model A		Model B	
	Italy	Germany	Italy	Germany
PRIVATIZED	0.108***		-0.021*	
	[7.59]		[1.84]	
PRIVATIZED×M&AS			0.148***	
			[6.99]	
M&AS	0.010*	-0.009	0.008*	0.000
	[1.84]	[0.47]	[1.84]	[0.02]
DISTRESS	-0.04***	0.003	-0.075***	0.003
	[2.69]	[0.17]	[9.61]	[0.16]
M&AS_LR	-0.002	-0.002		
	[0.45]	[0.80]		
DISTRESS_LR		-0.014***		
		[3.29]		
PRIVATIZED_LR	-0.011***			
	[5.86]			
L.PUBLIC	-0.046***	0.006	-0.025***	0.015***
	[6.67]	[1.04]	[3.94]	[3.10]
L.SIZE	0.000	0.005***	-0.003***	0.005***
	[0.05]	[3.20]	[4.29]	[3.35]
L.CH_CI	-0.038**	0.060	-0.053***	0.022***
	[2.27]	[0.73]	[3.73]	[0.29]
Test for AR(1) in first differences (p-value):				
	0.00	0.00	0.00	0.00
Test for AR(2) in first differences (p-value):				
	0.14	0.04	0.88	0.06
Sargan test of overid. restrictions (p-value):				
	0.69	0.20	0.97	0.13

Notes: Absolute value of z-statistics in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The year dummies coefficient estimates are excluded for the sake of brevity. *Privatized* and *Privatized_LR* are dummies variables indicating bank privatization in the current year and within the last four years excluding the current; *M&As* and *M&As_LR* are dummies variables indicating bank M&As in the current year and within the last four years excluding the current; *Distress* and *Distress_LR* are dummies variables indicating bank distress mergers in the current year and within the last four years excluding the current; *Privatized×M&As* is a dummy variable indicating contemporarily bank privatization and merger in the current year; *Public* is a dummy variable indicating public ownership; *Size* corresponds to bank total asset and *CH_CI* to cost to income ratio.

6 Conclusions

In this study, we compare productivity growth in the Italian and German banking markets, two systems that shared similar characteristics at the beginning of the 1990s with regard to their large number of institutions and the existence of publicly-owned savings banks. Over the last decade both countries have undergone a profound process of consolidation; However, whereas Germany kept its "three-pillar" system of private banks, cooperative banks and publicly-owned banks, the Italian banking system witnessed a profound privatization of its public banks.

We used a unique database provided by the central banks of Italy and Germany to determine total factor productivity change in both countries. In calculating a common production frontier – while allowing for differences in production sets through bank-specific effects – we established a uniform yardstick against which to measure bank's performance. In doing so, we avoided the fallacy of comparing performance measures derived from different production frontiers. On the aggregate level, our results show that the productivity of Italian banks grew by 3.2% per year during the period 1994-2004 and that of German banks by 1.2%. As a result, with Italian banks starting from lower levels, aggregate productivity levels of both countries converged. It is noteworthy that productivity levels in Italy also converge on a bank-specific basis. At the same time, productivity growth rates do not converge, indicating that the evolution of productivity is not yet at its steady state.

In a second step, we took a closer look and analyzed how consolidation and privatization affected banks individually. We found that banks that had been privatized saw a strong immediate positive effect on their productivity growth. More precisely, this effect seems to be driven by those banks that had also been involved in a merger after they had been privatized. This gives rise to the hypothesis that it is not privatization *per se* that fosters greater productivity but the wider range of consolidation options that comes with it. Further support for this hypothesis is provided by the fact that mergers do seem to improve productivity in general. This said, the results also suggest that there is a direct positive privatization effect on cost efficiency, indicating that liberalization in Italy has helped banks to cut their production costs.

When it comes to the generalization of the effect of public ownership on banks productivity growth, some caution is requested. In fact, an important result of our analysis is that public control over banks had opposite effects on TFP change in Italy and Germany. The view that state-owned banks are less efficient, because they maximize social objectives rather than profit and managers experience low effort on keeping cost in check, seems to be supported by the Italian data but not by the German ones. This shows that it is difficult to judge public ownership on a general level without taking into account country-specific circumstances. There is evidence that low productivity of Italian public banks in the early 1990s may have been caused by social interference which liberalization might have helped to eradicate. In contrast, German savings banks are likely to enjoy greater independence, which might explains their relatively good performance in the past.

In the period in which we were finalizing this paper, a deep and profound financial crisis has hit the international banking system worldwide. As a result, in order to preserve the functioning of the banking system and the crucial role that banks play

in the economy the Governments of many countries have taken significant steps to recapitalize banks through interventions funded with taxpayers' money. Even if Governments have clearly stated that public interventions in the banking systems are to be considered on a strictly temporary basis, at the moment nobody can actually foresee what the international financial system will look like five, ten or fifteen years from now. Once the financial system has recovered from the deep crisis started in the summer of 2007 (soon, hopefully), we hope that the results of our analysis can contribute to the (new) debate on the consequences of public- vs private-ownership of banking systems.

Appendix

Table 9: Structure of the Italian Banking System in 1990 and 2004

	1990					2004			
	No. of Banks	No. of Branches	Assets, million EUR [1]	Assets, share in %		No. of Banks	No. of Branches	Assets, million EUR [1]	Assets, share in %
Public-Sector Banks	6	2,449	134,664	20.1	Commercial Banks	243	24,045	1,879,945	79.3
Banks of National Interest	3	1,459	86,466	12.9					
Savings Banks	84	4,695	162,427	24.2					
Private Commercial Banks	106	3,981	137,362	20.5					
Cooperative Banks	108	3,290	95,004	14.2		36	3,745	228,532	9.6
Mutual Banks	715	1,792	29,096	4.3	Mutual Banks [2]	439	3,603	126,369	5.3
Group central institutions	5	5	15,875	2.4		—	—		
Branches of Foreign Banks	37	50	10.475	1.6		66	108	137,063	5.8
Total	1,064	17,721	671,409	100		784	31,501	2,371,909	100

Source: Banca d'Italia

2. "banche di credito cooperativo"

Public-sector banks ("Istituti di diritto pubblico"), Banks of national interest ("Banche di interesse nazionale"), Savings banks ("Casse di risparmio" and "Monti di credito"), Private commercial banks ("Banche di credito ordinario"), Cooperative banks ("Banche popolari"), Mutual banks ("Casse rurali e artigiane"), Group central institutions ("Istituti centrali di categoria").

Table 10: Structure of the German Banking System in 1990 and 2004

	1990					2004			
	No. of Banks	No. of Branches	Assets, million EUR	Assets, share in %		No. of Banks	No. of Branches	Assets, million EUR	Assets, share in %
Commercial Banks[1]	305	6,699	1,500.34	27.45		168	14,667	2,408.53	31.99
Savings Banks	772	19,288	1,069.94	19.57		477	14,292	1,002.02	13.31
Regional Giro Institutions	12	389	831.99	15.22	Land Banks	12	549	1,505.13	19.99
Credit Cooperatives	3,410	17,689	583.03	10.66		1,336	12,967	576.45	7.63
Regional Institutions of Credit Cooperatives	6	33	228.59	4.18		2	11	210.66	2.79
Specialized Banks[2]	73	225	1,177.25	21.54		68	2,922	1,731.59	23
Branches of Foreign Banks	60	34	74.04	1.35		84	83	93.34	1.23
Total	4,638	44,357	5,465.18	100		2,147	45,491	7,527.69	100

Source: Bundesbank, Monthly report.

1. 1990 includes: big banks, regional. 2004 includes: big banks and regional. 2. Mortgage banks, building and loan associations, and special purpose banks.

Table 11: Banking Performance Indicators - Italy

Year	Average Total Assets (1) (2)	Net-Interest Income (3)	Non-Interest Income (3)	Operating Costs (3)	Profit Before Tax (3)	Non-Interest Income / Total Income	Operating Costs/ Total Income	Staff costs/ Operating Costs	ROE
1994	100.0	2.48	0.91	2.36	0.30	26.9	69.5	47.4	1.1
1995	107.3	2.77	0.88	2.44	0.43	24.1	66.9	44.9	2.0
1996	119.2	2.63	1.06	2.43	0.60	28.6	65.8	45.2	5.1
1997	130.9	2.41	1.12	2.35	0.42	31.7	66.7	44.6	1.9
1998	137.8	2.33	1.51	2.30	0.93	39.2	60.0	39.1	9.2
1999	157.4	2.12	1.58	2.23	0.91	42.7	60.3	39.0	11.0
2000	180.7	2.21	1.74	2.27	1.16	44.1	57.5	36.4	13.3
2001	193.8	2.18	1.47	2.16	0.79	40.3	59.0	37.4	9.1
2002	199.0	2.25	1.30	2.15	0.67	36.7	60.7	38.8	6.5
2003	206.7	2.19	1.41	2.12	0.70	39.1	59.0	38.2	6.7
2004	210.7	2.15	1.37	2.05	0.97	38.9	58.2	38.3	10.7

Source: Banca d'Italia
(1) Total banking system's assets divided by the total number of banks.
(2)Index numbers 1994=100.
(3)Ratios to total assets.

Table 12: Banking Performance Indicators - Germany

Year	Average Total Assets (1) (2)	Net-Interest Income (3)	Non-Interest Income (3)	Operating Costs (3)	Profit Before Tax (3)	Non-Interest Income / Total Income	Operating Costs/ Total Income	Staff Costs/ Operating Costs	ROE
1994	100.0	1.91	0.43	1.43	0.50	18.5	60.9	57.7	6.8
1995	105.9	1.72	0.43	1.38	0.50	19.8	64.1	57.9	6.6
1996	112.6	1.63	0.41	1.30	0.46	20.0	64.0	56.5	6.0
1997	121.7	1.46	0.42	1.19	0.45	22.2	63.3	55.9	6.7
1998	124.6	1.34	0.46	1.15	0.62	25.6	63.7	55.5	9.4
1999	130.9	1.23	0.49	1.14	0.37	28.5	66.2	54.2	5.9
2000	142.3	1.13	0.58	1.17	0.34	34.0	67.9	53.4	6.1
2001	171.6	1.10	0.51	1.15	0.24	31.6	71.0	52.3	4.4
2002	161.7	1.20	0.48	1.14	0.20	28.4	67.7	52.4	2.2
2003	155.8	1.15	0.54	1.13	0.10	31.7	66.9	53.0	-1.7
2004	158.0	1.15	0.47	1.07	0.20	29.0	66.0	53.5	1.8

Source: Deutsche Bundesbank
(1) Total banking system's assets divided by the total number of banks.
(2)Index numbers 1994=100.
(3)Ratios to total assets.

Table 13: Stochastic Frontier Model - Estimated Parameters

Variable	Coefficient	P[|Z|>z]	Variable	Coefficient	P[|Z|>z]	Variable	Coefficient	P[|Z|>z]
$ln\omega_1$	0.3241	0.000	$ln\omega_1 lny_1$	0.0200	0.000	t	-0.1045	0.000
$ln\omega_2$	0.2668	0.000	$ln\omega_1 lny_2$	-0.0311	0.000	t^2	-0.0008	0.000
lny_1	0.2835	0.000	$ln\omega_2 lny_1$	-0.0420	0.000	$lny_1 t$	0.0019	0.000
lny_2	0.5769	0.000	$ln\omega_2 lny_2$	-0.0677	0.000	$lny_2 t$	0.0202	0.000
lny_3	0.4261	0.000	$ln\omega_3 lny_1$	0.0360	0.000	$lny_3 t$	-0.0004	0.2728
lnz_1	-0.3131	0.000	$ln\omega_3 lny_2$	-0.0757	0.000	$ln\omega_1 t$	0.0149	0.000
lnz_2	0.1060	0.000	$lny_1 lnz_1$	0.0215	0.000	$ln\omega_2 t$	0.0132	0.000
$ln\omega_1 ln\omega_1$	0.0112	0.0006	$lny_1 lnz_2$	0.0070	0.000	$lnz_1 t$	-0.0229	0.000
$ln\omega_1 ln\omega_2$	-0.1132	0.000	$lny_2 lnz_1$	0.0244	0.000	$lnz_1 t$	0.0036	0.000
$ln\omega_2 ln\omega_2$	0.1468	0.000	$lny_1 lnz_2$	-0.0193	0.000			
$lny_1 lny_1$	0.0368	0.000	$lny_{13} lnz_1$	0.0042	0.0009			
$lny_1 lny_2$	-0.0445	0.000	$lny_1 lnz_2$	0.0171	0.000			
$lny_1 lny_3$	-0.0201	0.000	$ln\omega_1 lnz_1$	-0.0285	0.000	σ	0.43549635	0.000
$lny_2 lny_2$	0.0696	0.000	$ln\omega_1 lnz_2$	0.0065	0.000	λ	3.80702776	0.000
$lny_2 lny_3$	-0.0480	0.000	$ln\omega_2 lnz_1$	0.1990	0.000			
$lny_3 lny_3$	0.0595	0.000	$ln\omega_2 lnz_2$	-0.0391	0.000			
$lnz_1 lnz_1$	-0.0522	0.000						
$lnz_2 lnz_2$	0.0077	0.000						

y_1: Interbank loans; y_2: Customer loans; y_3: Securities;
w_1: Price of fixed asset; w_2: Price of labor; z_1: Equity; z_2: Non-performing loans.
Observations 34076; Log likelihood function: 14374.79; Iterations completed: 6.

Table 14: Regression Variables

Variable	Acronym	Definition
Privatization	Privatized	Dummy variable that takes the value of 1 if the bank was a publicly owned bank in year t and is private in t+1.
	Privatized_LR	Dummy variable that takes the value of 1 if the bank was privatized within the last four years, excluding the current year.
Public Ownership	Public	Dummy variable that takes the value of 1 if the bank was publicly owned in year t-1.
Consolidation	Merger	Dummy variable that takes the value of 1 if the bank was involved in a merger in year t.
	Merger_LR	Dummy variable that takes the value of 1 if the bank was involved in a merger in year t-3.
	Distress	Dummy variable that takes the value of 1 if the bank was involved in a distressed merger in year t.
	Distress_LR	Dummy variable that takes the value of 1 if the bank was involved in a distressed merger in year t-3.
Privat. - Consol.	Privatized×Merger	Dummy variable that takes the value of 1 if the bank was privatized and contemporaneously involved in a merger in year t.

Table 15: Productivity Change and its Components - Significance Test Italy versus Germany -

Country	**Italy**	**Germany**	**Difference**	**Obs.**
Divisia	0.074	0.027	0.047***	26224
$TFPC$	0.032	0.012	0.020***	26224
TEC	0.023	0.004	0.019***	26224
EFC	-0.003	0.001	-0.004***	26224
SC	0.012	0.008	0.004***	26224
SE	0.129	0.139	-0.010***	26224
$\dot{Y}$	0.098	0.055	0.044***	26224

Notes:
$TFPC$= Total Factor Productivity Change, TC= Technical Change, EFC= Efficiency Change, SC= Change in Scale Economies, SE= Scale Elasticities, $\dot{Y}$= Output Change. We tested the statistical significance of the differences in the values of TFPC and its components using a t-test for unpaired samples. *** indicates differences are significant at the 1% level.

Table 16: Productivity Change and its Components - Significance Test Germany

Bank Type	**Private**	**Savings**	**Difference**	**Obs.**	**Private**	**Cooperatives**	**Difference**	**Obs.**	**Savings**	**Cooperatives**	**Difference**	**Obs.**
Divisia	0.018	0.029	-0.011	5418	0.018	0.027	-0.009	16777	0.029	0.027	0.001	21045
$TFPC$	0.008	0.013	-0.005	5418	0.008	0.012	-0.004	16777	0.013	0.012	0.001	21045
TEC	-0.007	0.004	-0.011***	5418	-0.007	0.004	-0.011***	16777	0.004	0.004	0.000***	21045
EFC	0.001	0.002	-0.001	5418	0.001	0.001	0.000	16777	0.002	0.001	0.001	21045
SC	0.015	0.007	0.007***	5418	0.015	0.008	0.007***	16777	0.007	0.008	0.000***	21045
SE	0.184	0.135	0.050***	5418	0.184	0.138	0.046***	16777	0.135	0.138	-0.004***	21045
$\dot{Y}$	0.072	0.053	0.019***	5418	0.072	0.054	0.018 ***	16777	0.053	0.054	-0.001	21045

Notes:

$TFPC$= Total Factor Productivity Change, TC= Technical Change, EFC= Efficiency Change, SC= Change in Scale Economies, SE= Scale Elasticities, $\dot{Y}$= Output Change. We tested the statistical significance of the differences in the values of TFPC and its components using a t-test for unpaired samples. *** indicates differences are significant at the 1% level.

Table 17: Productivity Change and its Components - Significance Test Italy

Bank Type	**Public**	**Cooperatives**	**Difference**	**Obs.**	**Public**	**Savings**	**Difference**	**Obs.**	**Public**	**Mutuals**	**Difference**	**Obs.**
Divisia	0.069	0.063	0.006	612	0.069	0.071	-0.002	606	0.069	0.080	-0.010	3153
$TFPC$	0.022	0.022	-0.001	612	0.022	0.027	-0.005	606	0.022	0.036	-0.014***	3153
TEC	0.020	0.021	0.000	612	0.020	0.020	0.001	606	0.020	0.024	-0.003	3153
EFC	-0.002	-0.012	0.009	612	-0.002	-0.007	0.005	606	-0.002	0.000	-0.002	3153
SC	0.003	0.013	-0.010***	612	0.003	0.014	-0.010***	606	0.003	0.012	-0.009***	3153
SE	0.201	0.149	0.051***	612	0.201	0.177	0.023***	606	0.201	0.114	0.087***	3153
$\dot{Y}$	0.019	0.091	-0.071***	612	0.019	0.073	-0.054***	606	0.019	0.107	-0.088***	3153
Bank Type	**Private**	**Cooperatives**	**Difference**	**Obs.**	**Private**	**Savings**	**Difference**	**Obs.**	**Private**	**Mutuals**	**Difference**	**Obs.**
Divisia	0.050	0.063	-0.013	903	0.050	0.071	-0.021***	897	0.050	0.080	-0.030***	3444
$TFPC$	0.027	0.022	0.004	903	0.027	0.027	0.000	897	0.027	0.036	-0.009	3444
TEC	0.026	0.021	0.005***	903	0.026	0.020	0.006***	897	0.026	0.024	0.002	3444
EFC	-0.011	-0.012	0.001	903	-0.011	-0.007	-0.004	897	-0.011	0.000	-0.011	3444
SC	0.012	0.013	-0.001	903	0.012	0.014	-0.002	897	0.012	0.012	0.000	3444
SE	0.141	0.149	-0.008	903	0.141	0.177	-0.036***	897	0.141	0.114	0.027***	3444
$\dot{Y}$	0.085	0.091	-0.006	903	0.085	0.073	0.012	897	0.085	0.107	-0.023***	3444
Bank Type	**Cooperatives**	**Savings**	**Difference**	**Obs.**	**Cooperatives**	**Mutuals**	**Difference**	**Obs.**	**Savings**	**Mutuals**	**Difference**	**Obs.**
Divisia	0.063	0.071	-0.008	1102	0.063	0.080	-0.017***	3649	0.071	0.080	-0.008	3643
$TFPC$	0.022	0.027	-0.004	1102	0.022	0.036	-0.014***	3649	0.027	0.036	-0.009***	3643
TEC	0.021	0.020	0.001	1102	0.021	0.024	-0.003***	3649	0.020	0.024	-0.004***	3643
EFC	-0.012	-0.007	-0.005	1102	-0.012	0.000	-0.012 ***	3649	-0.007	0.000	-0.007***	3643
SC	0.013	0.014	-0.001	1102	0.013	0.012	0.001	3649	0.014	0.012	0.002	3643
SE	0.149	0.177	-0.028***	1102	0.149	0.114	0.036***	3649	0.177	0.114	0.064***	3643
$\dot{Y}$	0.091	0.073	0.018***	1102	0.091	0.107	-0.017***	3649	0.073	0.107	-0.034***	3643
Bank Type	**Public**	**Private**	**Difference**	**Obs.**								
Divisia	0.069	0.050	0.020	407								
$TFPC$	0.022	0.027	-0.005	407								
TEC	0.020	0.026	-0.005***	407								
EFC	-0.002	-0.011	0.009***	407								
SC	0.003	0.012	-0.009	407								
SE	0.201	0.141	0.059***	407								
$\dot{Y}$	0.019	0.085	-0.065***	407								

Notes:

$TFPC$= Total Factor Productivity Change, TC= Technical Change, EFC= Efficiency Change, SC= Change in Scale Economies, SE= Scale Elasticities, $\dot{Y}$= Output Change. We tested the statistical significance of the differences in the values of TFPC and its components using a t-test for unpaired samples. *** indicates differences are significant at the 1% level.

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