

# Weekly Report

## Productivity in the Financial Sector: Brains are more important than Computers

*A conventional decomposition of the financial sector's gross value added growth into its various components indicates that investments in Information and Communication Technologies are highly important. However, a more comprehensive calculation reveals that growth is the result of—in particular—the increased deployment of medium-skilled labour, without whom the technological potential could not be fully realized. Further, productivity increases in the financial sector are also the result of value chains restructured in favour of external intermediate inputs. Case studies and microeconomic assumptions serve to confirm these relations.*

**G. Erber**  
gerber@diw.de

**R. Madlener**  
rmadlener@eonerc.nwth-aachen.de,  
rmadlener@diw.de

The comparative advantages of individual countries are to be found in the differences in their regulation of the labour market, restrictions on manpower mobility, government regulation or the lack of qualified management. In international comparison, Germany is at the vanguard.

In the project “Sectoral e-Businessw@tch”, DIW Berlin together with collaborative partners, has examined the impact of Information and Communication Technologies (ICT) on sectoral growth, productivity and employment development in the banking industry.<sup>1</sup> The starting point was provided by the EU-KLEMS database, which was compiled by the Groningen Growth and Development Centre, based on research commissioned by the EU Commission.<sup>2</sup>

This database, however, had substantial shortcomings with regard to the number of countries considered and the length of the time series as initially planned. This necessitated a limitation of the following study to 12 countries and to the period from 1995 to 2005. The business activities of the banking industry were defined according to NACE Rev. 1.1 (Box 1). In the following, on the basis of two competing methodical approaches, calculations are presented on the significance of the different influencing factors for productivity growth in the financial services industry.

**JEL Classification:**  
C23, E23, O57

**Keywords:**  
Financial service industries,  
Stochastic production  
possibility frontiers,  
Efficiency analysis,  
Growth accounting

<sup>1</sup> EU Commission: ICT and e-Business Impact in the Banking Industry. Study Report No. 6/2008, see also [www.ebusiness-watch.org](http://www.ebusiness-watch.org).

<sup>2</sup> Van Ark, B., O'Mahony, M., Ypma, G.: The EU KLEMS Productivity Report. Issue 1, March 2007, as well as [www.euklems.net/](http://www.euklems.net/).

Box 1

### Structural Classification of Economic Activities in the European Community NACE 1.1

NACE 1.1	Sector Classification	ISIC
<b>J</b>	<b>Financial intermediation, insurance and pension funding (except compulsory social security)</b>	
65	Monetary intermediation	
65.1	Central banking and monetary intermediation	651
65.11	Central banking	6511
65.12	Other monetary intermediation	6519
65.2	Other financial intermediation	659
65.21	Financial leasing	6591
65.22	Other credit granting	6592
65.23	Other financial intermediation n.e.c.	6599
<b>66</b>	<b>Insurance and pension funding (except compulsory social security)</b>	
66	Insurance and pension funding (except compulsory social security)	660
66.01	Life insurance	6601
66.02	Pension funding	6602
66.03	Non-life insurance	6603
<b>67</b>	<b>Activities auxiliary to financial intermediation</b>	
67.1	Activities auxiliary to financial intermediation	671
67.11	Administration of financial markets	6711
67.12	Security broking and fund management	6712
67.13	Activities auxiliary to financial intermediation n.e.c.	6719
67.2	Activities auxiliary to insurance and pension funding	672

Source: Eurostat.

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### The Conventional Way: Growth Accounting

On the basis of the Growth Accounting approach (Box 2), analysis of the average growth rates for the gross value added in the EU countries' financial sectors revealed the following: The deployment of ICT equipment capital has had a notably positive impact on the development of the gross value added (Figure 1). In addition, manpower quality improvements—measured by the employees' level of education—also contribute overall positively to growth.

There seems to be a strong positive correlation between the educational level and the ICT skills of an employee concerning the impact of productivity growth.<sup>3</sup> Since, in the EU-KLEMS database, the ICT skills are not specifically measured, we used the educational level as a proxy indicator. This seems

appropriate, because, for example, the percentage of Internet proficiency increases noticeably with the level of education, i.e. the general educational level and ICT skills are highly positively correlated.<sup>4</sup> The contributions of the other factors to the value-added growth in the individual countries are heterogeneous. On the whole, the findings of this approach suggest that increased use of ICT is a key determinant of value-added growth in the financial services industry.

### An Alternative Method: Stochastic Possibility Frontiers (SPF)

In addition to the widely used Growth Accounting approach, an econometric model estimation approach was carried out on the basis of an SPF. This enables a considerably more comprehensive examination and testing of the impact of ICT capital

<sup>3</sup> Erber, G., Hagemann, H.: The New Economy in a Growth Crisis. In: Hübnner, K. (Ed.): The Regional Divide, Promises and Realities of the New Economy in a Transatlantic Perspective. Routledge 2005.

<sup>4</sup> [www.pewinternet.org/trends/User\\_Demo\\_6.15.07htm](http://www.pewinternet.org/trends/User_Demo_6.15.07htm).

Box 2

**Growth Accounting**

Growth Accounting is the decomposition of an output factor's growth—in this case, the gross value added—into the contributions from individual input factors. Owing to the definitional aggregation, the resulting residual component is termed “total factor productivity” (TFP), since it cannot be attributed to any of the observed input factors. Critics of this approach refer to this variable as a residual as well as a “measure of ignorance”, i.e. ignorance of the underlying growth factors.

This analytical concept was extended by Jorgenson, Gollop and Fraumeni<sup>1</sup> via indicators of quality changes

<sup>1</sup> Jorgenson, D.W., Gollop, F.M., Fraumeni, B.M.: Productivity and U.S. Economic Growth, Harvard Economic Studies 159, Cambridge, Massachusetts, 1987.

in order to incorporate compositional changes in their particular qualities to the composition of the aggregate production factors. These indicators are meant to show internal structural shifts as proxy variables, e.g. in the composition of the employed manpower by age, sex, or educational level. However, these quality change indicators do not reflect the relation between these particular factor inputs, and their respective factor prices, and thus neglect the implicit economic allocation principle induced by relative price changes. Consequently, substitution processes resulting from relative price changes between the individual subcomponents are not measurable by this approach either.

on an output variable and a particular input factor on productivity in the financial services industry (Box 3).

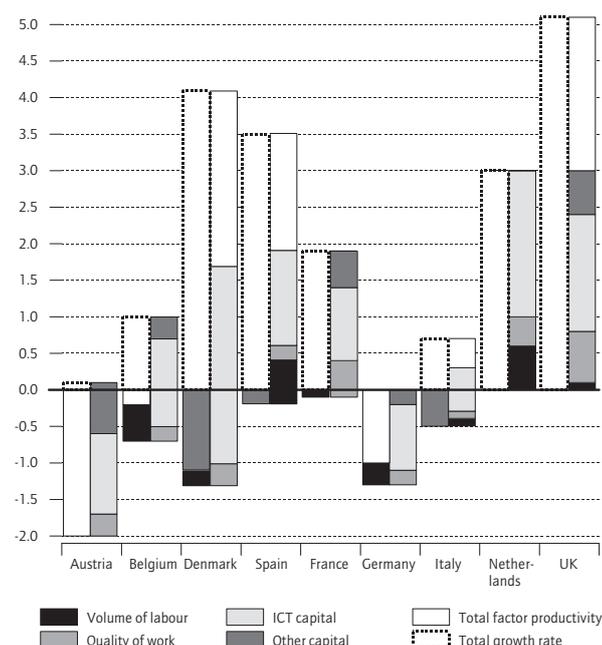
In contrast with Growth Accounting—a self-contained decomposition of components where the total factor productivity is the residual—the econometric estimation of an SPF enables statistical significance testing on the relevance of the individual input factors. In addition, the measurement of an increase in the more persistent productivity growth rate is not distorted by idiosyncratic random shocks. With Growth Accounting, these two components are lumped together under “total factor productivity” as a residual variable.

Globalization of the financial markets coupled with the growing specialization of financial services inside this industry has led to a noticeable increase in the amount of intermediate inputs of the financial services industry—a structural change accommodated by our form of analysis by using the gross production value, i.e. the sum of gross value added and intermediate inputs, instead of the gross value added alone as an output factor. Simply taking the gross value added on its own—as so many Growth Accounting studies do—is to ignore this structural shift between intermediate inputs and gross value added, which play an important role in the development of productivity growth in the financial services industry.

A further improvement of the SPF method is that the total volume of labour inputs is differentiated into three different classes of educational qualification (high = university level, medium = schooling up

to university entrance or GCSE passes, low = no GCSE passes) (Figure 2). This enables an explicit attribution of the different educational qualification levels to developments in productivity and growth in this industry.

Figure 1  
**“Growth Accounting” of the Gross Value Added in the Financial Sectors of Selected Countries, 1995 – 2005**  
 Growth contributions of individual factors in percent



Sources: EU-KLEMS; Calculations by DIW Berlin.

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## Box 3

**Stochastic Production Possibility Frontier**

The Stochastic Possibility Frontier (SPF) was initially developed as a generalization of the production function to avoid the assumption of a persistent perfect instantaneous adjustment, i.e. efficient allocation of factor input utilization according to market conditions. From the perspective of business cycle theory in particular, it was obvious that production inefficiencies exist, since producers cannot permanently and immediately adjust their factor inputs to the respective market situation. Demand shocks often come unexpectedly, making time-consuming adjustment of production, i.e. supply side, necessary. There are, however, other problems involved apart from such temporary adjustment problems. These are problems linked to more sustainable differences in efficiency between companies and between individual countries on account of different abilities to attain best-practices. Impediments may be attributable to differences in management abilities or institutional frameworks. To take account of these stylized facts, the production function approach has been extended by a stochastic inefficiency variable in addition to the standard stochastic error

term. The underlying distribution assumption of these inefficiency variables had to be limited to a positive range. Common distribution assumptions are, for example, a positive half-normal distribution, such as used in this study. For the econometric estimation of the parameters of an SPF, the respective contribution of the inefficiency term is measured as the relative distance from what is the optimal production function or possibility frontier. Thus, efficiency comparisons between individual countries are possible using a multi-country panel dataset. The estimates for the specific distances from the common possibility frontier serve then as a benchmark for the relative positions between each other as well as their particular individual distance from the common efficiency frontier. These distances from the common frontier can be normalized to 100, i.e. 100 per cent.<sup>1</sup>

<sup>1</sup> Aigner, D. J., Knox Lovell, C. A., Schmidt, P.: Formulation and Estimation of Stochastic Production Frontier Models. *Journal of Econometrics*, 1997, 6, 21-37; and Battese, G. E., Coelli, T. J.: Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India, *Journal of Productivity Analysis*, 1992, 3(1-2), 153-169.

The basis of the SPF estimation is a multi-country panel, which was extracted out of the EU-KLEMS database. Using these data and applying the method developed by Battese and Coelli, the model parameters were thus estimated on the basis of a Cobb Douglas production function assuming constant economies of scale.

The obtained estimation results on the significance of the various input factors for productivity development diverge considerably from the results obtained using the Growth Accounting approach. The contribution of ICT capital showed up to be statistically insignificant at the 5% significance level.<sup>5</sup> The most important input factor for growth in labour productivity in the financial services industry is actually that of medium-skilled labour.

These SPF-based findings on the contribution of different input factors to labour productivity growth are more consistent with approaches based on endogenous growth theory, which attributes crucial importance to human capital for the long-term economic growth dynamics, rather than those based on

the traditional neoclassical growth model. From a growth theory perspective, the results obtained from Growth Accounting may not be taken as an empirical confirmation of a sustainable acceleration of productivity growth, owing this to the increased input of ICT capital. It is, then, not surprising that the increase in productivity growth based on a substantial expansion of ICT capital stock observed during this period was only temporary. In the meantime, this has also been conceded by proponents of the New Economy hypothesis.<sup>6</sup>

The SPF model has also been dynamized within the framework of the panel database, so that the development of the inefficiencies over time, i.e. the decrease, or increase of efficiency, may be empirically estimated for individual countries over a chosen time period on the basis of certain assumptions about an adjustment process to converge towards the efficiency frontier.

Extensive micro-econometric analyses based on company data, together with case studies on the isolated impact of ICT equipment on the efficiency of companies, have likewise come to the conclusion

<sup>5</sup> Detailed results may be found in the study commissioned by the EU Commission: ICT and e-Business Impact in the Banking Industry. Study report No. 6/2008, 88.

<sup>6</sup> Jorgenson, D. W., Ho, M. S., Stiroh, K. J.: A Retrospective Look at the U.S. Productivity Growth Resurgence. 29 January 2007, mimeo.

that the thesis that ICT inputs alone could have the dominant positive productivity impact is a rather myopic perception. In fact, there is a lot of evidence that it is a combination of ICT equipment, the increased employment of corresponding skilled labour and organisational restructuring in companies that actually led to significant efficiency increases, and thus an acceleration of productivity growth.<sup>7</sup>

ICT process restructuring through outsourcing together with the utilization of cost advantages and other locational advantages offered by global value chains through offshore outsourcing, opens up further opportunities to sustainably enhance the efficiency of an entire sector of the economy, such as the financial services industry.<sup>8</sup> The study's findings for the SPF estimations, in which the intermediate inputs serve as an indicator for the decomposition of value chains, also confirm this: the corresponding coefficient value estimate is the second highest after that for medium-skilled labour.

Apart from this, the input of highly qualified manpower and non-ICT capital provides statistically significant—albeit notably smaller—contributions to labour productivity growth in the financial sector. The contribution of the “autonomous” technological progress to productivity growth is shown by this analysis, too, to be a yearly average growth rate of 1.4%.

**Efficiency Comparison of Factor Input**

While the Growth Accounting analysis assumes different, country-specific production technologies, the Stochastic Possibility Frontier (SPF) approach initially assumes that all countries have equal opportunity to access those technologies with regard to efficient factor use. In this context, the term “common possibility frontier” or just “common frontier” is often used.<sup>9</sup> When all countries have the same access to the factors of production, national differences in productivity are not so much the result of technological opportunities but more of institutional and organizational barriers, such as differently regulated

<sup>7</sup> Brynjolfsson, E., Hitt, L.: Paradox Lost? Firm-level Evidence on the Returns to Information Systems Spending. *Management Science*, 1996, 42(4), 541-558; Brynjolfsson, E., Hitt, L.: Beyond Computation: Information Technology, Organizational Transformation and Business Performance. *Journal of Economic Perspectives*, 2000, 14 (4), 23-48; Brynjolfsson, E.: VII Pillars of Productivity. *Optimize*, Issue 22, May 2005.

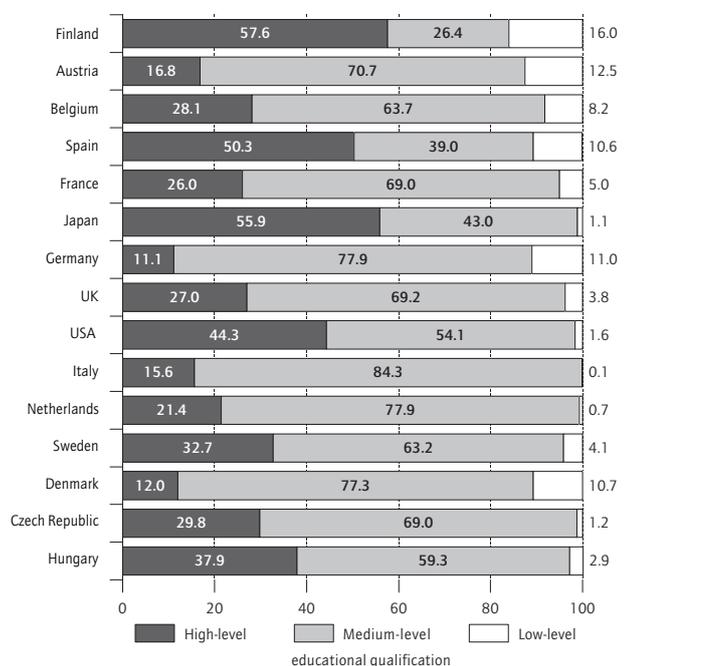
<sup>8</sup> Erber, G., Sayed Ahmed, A.: Offshore Outsourcing—A Global Shift in the Present IT Industry. *Intereconomics*, 40 (2) 2005, 100-112.

<sup>9</sup> The hypothesis was tested that a common SPF exists with no country-specific fixed effects, cf. Erber, G., Madlener, R.: Impact of ICT and Human Skills on the European Financial Intermediation Sector. Contribution to The European Money and Finance Forum Conference (SUERF): Productivity in the Financial Services Sector. Banque Centrale du Luxembourg, 11 – 12 November 2008, Luxembourg, conference proceedings forthcoming; also FCN Working Paper No. 5/2008, E.ON Energy Research Center, RWTH Aachen University, September 2008.

Figure 2

**Volume of Labour 2005 in the Financial Sector According to Educational Qualification in Selected Countries**

In percent



Sources: EU-KLEMS, Calculations by DIW Berlin.

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labour markets, restrictions on workforce mobility, government regulations or the dearth of important resources, such as highly qualified management.

On the basis of the parameter estimations for the SPF, the different degrees of average efficiency or inefficiency benchmarking with regard to the common frontier can be shown for the financial services industries of the individual countries. A comparison of the 12 EU member states together with the USA and Japan over the period of 1995 to 2005 also confirms that the differences between the countries are not very pronounced. Two northern states, Denmark and Finland, are at the vanguard with 99 and 98 percent respectively, along with Italy at 98 percent. Germany, the USA and Japan follow with 97 percent each. This is followed by the UK (96 percent) and Spain (94 percent). The Czech Republic achieves 90 percent. The other countries fall below this level (Figure 3).

**Unsolved Problems Regarding the Measurement of Value Added in the Financial Sector**

Quite apart from the question of which factors generate growth of value added and productivity growth

in the financial services industry, the ascertaining of what actually constitutes value added in this sector poses a particular hurdle. The problem has become even more pronounced due to the current global financial crisis. In national accounts, value added is currently determined via the “financial intermediation services indirectly measured” (FISIM) method.<sup>10</sup> This indirect calculation means that actual market valuations of equity in the balance sheets of banks and other financial service institutions is not appropriately reflected in national accounts, although it would have a significant impact on individual economic units, leading to bankruptcies such as in the case of Lehman Brothers last year. Thus, this approach has considerable shortcomings when it comes to precisely defining the relation between the profits and losses of financial intermediaries as declared in their corporate financial balance sheets, and as represented in the financial services sector of national accounts by FISIM.

FISIM assumes a risk-free business model for capital market activities, such as credits given to non-bank institutions, so that, for instance, the credit volume, with its nominal value as reference value, finds its way unadjusted into the calculations of the value added. At the moment, there is therefore a strong divergence between the corporate profitability corrected by the actual credit losses of increased credit default risks on the one side, and the valuation methods applied in the national accounts ignoring these valuation problems in output measurement on the other side. In such a situation, national accounts are bound to reflect a significantly distorted value added for the financial sector service industries.<sup>11</sup>

Hence the European Central Bank has, therefore, already commissioned a research group to make a proposal for correcting the calculation of value added in the banking industry in Europe. These revised methods take into consideration the differentiated and changing-over-time risk structure of all financial services sector assets.<sup>12</sup> Further corrections will however be required, since risks also exist in the form of leverage effects from transactions outside the balance sheets of banks (off-balance-sheet

<sup>10</sup> Eichmann, W.: Finanzserviceleistung, indirekte Messung (FISIM). In: *Wirtschaft und Statistik*, Heft 7/2005, Statistisches Bundesamt, Wiesbaden, 710-716.

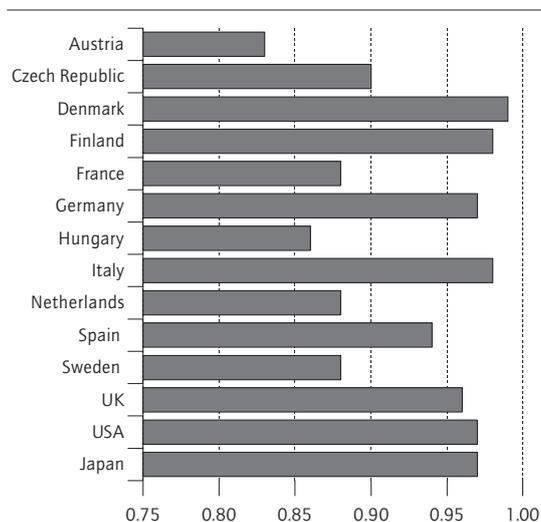
<sup>11</sup> To give an idea about the magnitude of the distortion one should be aware that the financial service institutions included in the S&P 500 had to account a loss of 126 billion US Dollar in the fourth quarter of 2008 after the collapse of Lehman Brothers according to GAAP-accounting standards. This huge loss caused by revaluations and write-offs is completely ignored in the System of National Accounts framework (SNA) using FISIM. Here the financial service industry in the US would still show up to have healthy profitability for the same quarter. See FTD: Und es gibt doch noch Gewinne, In: *Financial Times Deutschland*, March 18, 2009.

<sup>12</sup> Inklaar, R. J., Wang, C.: Not Your Grandfather's Bank Anymore? Consistent Measurement of Non-Traditional Bank Output. Paper presented at the SUERF Conference, loc.cit.

Figure 3

### Efficiency of the Financial Sector in Selected Countries

Mean values 1995-2005



Sources: EU-KLEMS; Calculations by DIW Berlin.

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operations) through conduits or special purpose vehicles (SPFs), who are the major agents in the securitization markets.<sup>13</sup> Previous studies indicate that the financial sector's value added, such as it is reported in national accounts, is exaggerated.<sup>14</sup> Since the shrinking value added finds its way into the macroeconomic aggregates, the future bias and its consequences on the effective real output are likely to be substantial following the outbreak of the global financial market crisis.

### Conclusions

The findings from the analysis of the impact of ICT investments on gross value-added growth and productivity growth in the financial services industry depend significantly on the methodological approach chosen for the analysis. Whilst Growth Accounting accords ICT capital great significance with regard to the growth of gross value added, the Stochastic Possibility Frontier approach does not. In contrast, the SPF shows that the dominating role with regard to productivity growth in the financial services industry is played by the increased deployment of medium-skilled labour coupled with the

<sup>13</sup> Erber, G.: *Verbriefungen: Eine Finanzinnovation und ihre fatalen Folgen*. Wochenbericht des DIW Berlin Nr. 43/2008

<sup>14</sup> With regard to the U.S., Basu, Inklaar and Wang, using their “value-at-risk” method to measure service output came to the conclusion that between 1997 and 2007 the value added—measured by the FISIM—was upwardly biased by 21%. This led to an error of 0.3 percent for the total GDP. Basu, S., Inklaar, R., Wang, C.: *The Value of Risk: Measuring the Service Output of U.S. Commercial Banks*. Working Paper 4/2008 of the Federal Reserve Bank of Boston.

increasing number of external intermediate inputs in the course of value chain restructuring. In fact, the SPF arrives at the perhaps rather surprising conclusion that ICT capital on the whole does not make any statistically significant contribution to productivity growth in the financial services industry.

Case studies and microeconomic assumptions also indicate that ICT equipment has no impact on productivity as long as complementary, additional skilled manpower and necessary organizational adjustments are lacking. ICT implementation is only successful in a framework of the whole financial system context. When all countries have the same access to the factors of production, national differences in productivity are not the result of technological opportunities alone but are much more attributable to institutional and organizational barriers, such as e.g. differently regulated labour markets, restrictions on workforce mobility, government regulations or the dearth of important resources, such as highly qualified management. Furthermore, this study finds that there is no compelling evidence that individual countries held a permanent comparative advantage over the observed period.

DIW Berlin  
Mohrenstraße 58  
10117 Berlin

Tel. +49-30-897 89-0  
Fax +49-30-897 89-200

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