Productivity and Cost-Efficiency in the Danish Financial Sector

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1. INTRODUCTION AND SUMMARY

From a macro-economic point of view, an efficient financial sector is essential. This article will analyse the productivity and cost-efficiency of the financial sector.

From 1948 to 1980, labour productivity in the financial sector, measured by the ratio of domestic lending or financial assets to employment, was roughly unchanged, while substantial productivity advances have been achieved since 1980. But in recent years banks' domestic lending relative to employment has fallen.

Compared with the rest of the EU, Denmark is among the member states with the highest total assets or domestic lending per employee in the credit institution sector. This should, however, be viewed in the context of the large Danish mortgage banking sector. In terms of the cost-to-income ratio, Danish credit institutions are, on average, in the middle of the range.

For a number of years, the average labour earnings level in the Danish financial sector has been higher than in other segments of the economy. Most of the additional labour earnings in the financial sector reflect the education composition of employees, the complexity of job functions, geography, etc. Other factors may also provide for the relatively high earnings in the financial sector, for instance high productivity or high earnings capacity due to efficient utilisation of highly educated, specialised labour. Conversely, the ownership structure of the financial sector or the absence of strong potential foreign competition in financial services could dampen the pressure for efficient cost control and equalisation of additional earnings over time.

[1] The authors would like to thank the Danish Competition and Consumer Authority for valuable comments and suggestions in connection with the preparation of the analyses in this article. Any remaining errors in the article are solely the responsibility of the authors and the views and conclusions expressed in the article are those of the authors.

Comparisons with foreign studies indicate that estimated earnings differentials between the financial sector and other industries in Denmark are roughly in line with those abroad.

Since 1988, the Danish financial sector has been subject to a special payroll tax, currently accounting for 10.9 per cent of the payroll. Other things being equal, such payroll tax should contribute to relatively lower earnings in the financial sector than in other industries. Viewed in isolation, payroll tax provides an incentive for the financial sector to replace labour by capital (e.g. through automation of labour-intensive processes).

The productivity and cost-efficiency of individual banks can be compared based on key accounting figures for input (e.g. staff costs and administrative expenses) and output (e.g. total lending). An analysis shows that some Danish banks are fully able to match the efficiency of the most efficient foreign banks. However, in terms of efficiency, some Danish banks – primarily in the Danish Financial Supervisory Authority's groups 3 and 4 – are some distance away from the most efficient Danish banks. The consolidation in the Danish banking sector in recent years has helped to improve its average efficiency.

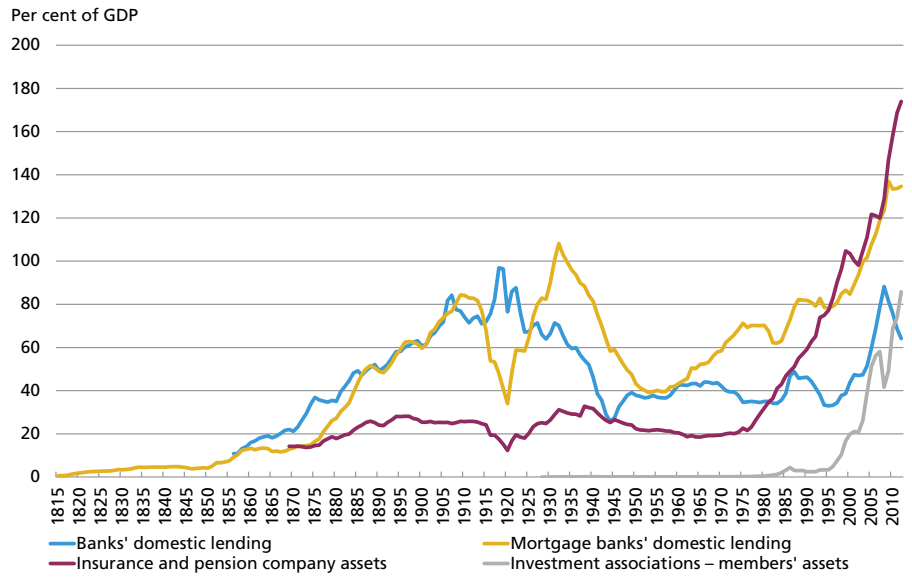
2. FINANCIAL SECTOR DEVELOPMENT AND THE ECONOMY

Viewed over a longer period of time, financial sector total assets as a percentage of the gross domestic product, GDP, have expanded considerably, cf. Chart 2.1. This trend has also been evidenced in other countries with high income levels, cf. Goldsmith (1969), King and Levine (1993), Levine (1997) and Andersen (2001).

Already at the end of the 19th century, the banking sector as well as the mortgage banking sectors played a key role as credit intermediaries in the Danish economy. Before World War I, banks' domestic lending accounted for 70-80 per cent of GDP, and mortgage-bank lending was of a similar magnitude. The interwar period seemed to mark a turning point, and in the mid-1950s both bank and mortgage-bank lending had declined to about 40 per cent of GDP. Since then the trend has reversed, but the level seen immediately before World War I has been reached only in recent decades.

Evidence from other countries has also indicated that the size of the financial sector has only reached its pre-World-War I level during the most recent decades characterised by financial market liberalisation and globalisation. The pre-World War I period was also characterised by financial market liberalisation and globalisation, cf. Rajan and Zingales (2003).

KEY ASSETS AND LIABILITIES OF THE FINANCIAL SECTOR Chart 2.1



Note: Domestic lending is exclusive of lending to MFIs.
Source: Abildgren (2008, 2012), Hansen and Svendsen (1968), Hansen (1969, 1983), Danmarks Nationalbank and Statistics Denmark.

Initially, the early introduction of a tax-funded old-age pension scheme in Denmark (1891) reduced the potential size of the private pension sector. But recent decades have seen the build-up of financed labour-market pensions[1], reflected in strong growth in the assets managed by life-insurance companies and pension funds. This development has also been boosted by tax allowances for private pension savings, cf. Kramp et al. (2012).

The lifting of restrictions on cross-border portfolio investments in the 1970s and 1980s produced an increase in the volume of assets managed by investment associations. However, the balance-sheet growth of investment associations did not really take off until the second half of the 1990s, cf. Abildgren et al. (2010). This growth reflected, in part, a global trend towards international diversification of investor portfolios. Moreover, institutional investors increasingly found it convenient to use investment associations as investment vehicles rather than purchasing securities directly, e.g. in relation to accounting and market research. This development should be seen not least in light of the ever more differentiated range of securities. Finally, other things being equal, the

[1] Both ATP pensions (the Danish Labour Market Supplementary Pension Scheme) and pensions based on collective agreements.

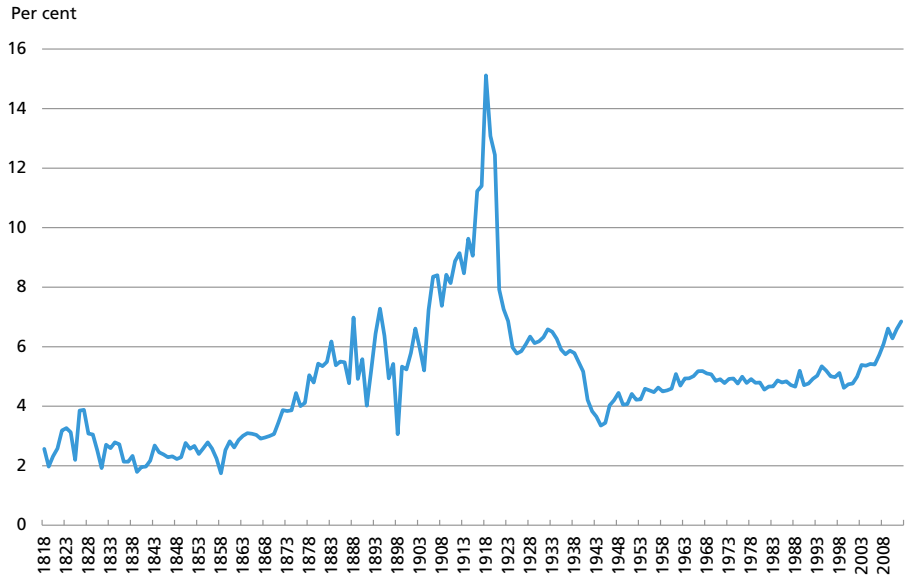
transaction costs of joint investment are, in principle, lower than the costs of direct purchase of securities.

It should be noted, however, that part of the increase in the ratio of assets of life-insurance companies, pension funds and investment associations to GDP is also attributable to a rise in real share prices, cf. Abildgren (2006).

Chart 2.2 illustrates the financial sector's share of gross value added, GVA, over the last 200 years. GVA indicates what is available for remuneration of the production factors, i.e. remuneration of employees and self-employed persons, return on capital and depreciation of the capital stock. The financial sector's share of GVA increased from 2-3 per cent to 7-8 per cent in the late 19th and early 20th century, peaking during World War I, which saw rapid growth in the money supply and in bank lending, cf. Johansen (1988) and Hansen (1996) The financial sector's share of GVA dropped sharply during the interwar period, but since World War II it has more or less recovered to its pre-World War I level.

The increase in the Danish financial sector's share of GVA since the end of World War II is very similar to that seen in a number of other European countries and the USA, cf. Philippon and Reshef (2013) and Greenwood and Scharfstein (2013). Long-term trends in the financial sector's share of GVA to a great extent match the development de-

FINANCIAL SECTOR SHARE OF GROSS VALUE ADDED (GVA) Chart 2.2



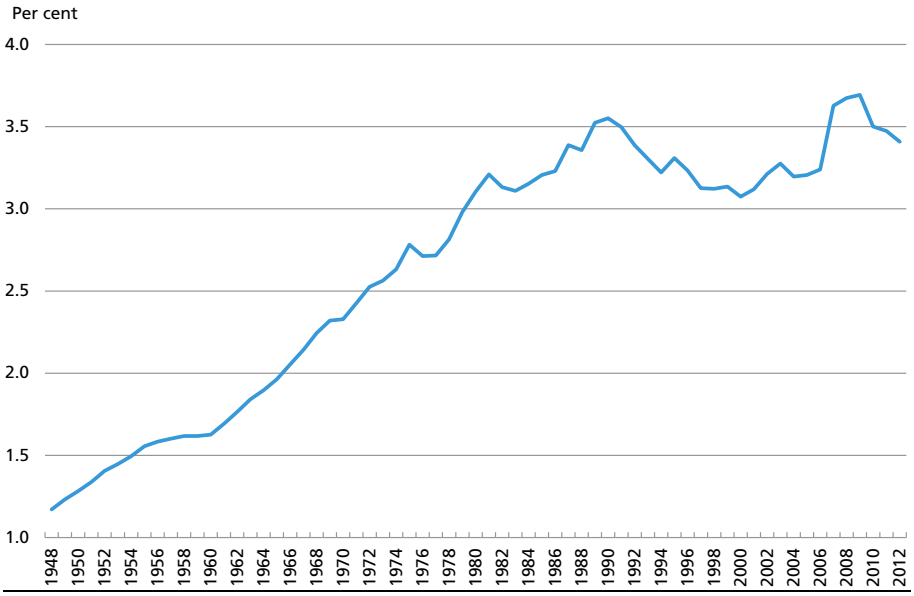
Note: Prices for the year.
Source: Hansen (1983) and Statistics Denmark.

monstrated earlier in the financial sector's assets and liabilities as a percentage of GDP, and thus the scope of credit intermediation and professional asset management.

Financial sector employment rose from just over 1 per cent of total employment in 1948 to about 3.5 per cent in 1990, cf. Chart 2.3. The cyclical reversal in the second half of the 1980s and the banking crises until the mid-1990s shifted the focus towards cost adjustment and adjustment of labour input, and the financial sector's share of total employment declined to approximately 3 per cent at the end of the 1990s. During the rapid lending expansion preceding the latest financial crisis, the share increased to 3.7 per cent in 2009. Since then, it has fallen back slightly again.

The financial sector in Denmark is relatively large compared with that of many other EU 15 member states, cf. Table 2.1. On a per capita basis, Denmark has a relatively high percentage of employees in the credit institution sector. Moreover, the Danish MFI sector is characterised by relatively large total assets and a high domestic lending-to-GDP ratio. The high ratio of domestic lending to some extent reflects large domestic savings in pension funds. Another aspect is a well-developed mortgage market with good opportunities for mortgage equity withdrawal.

FINANCIAL SECTOR EMPLOYMENT — Chart 2.3



Note: Employment in financial services and insurance as a percentage of total employment.
Source: Statistics Denmark.

INDICATORS OF FINANCIAL SECTOR SIZE IN SELECTED COUNTRIES Table 2.1

No.	No. of employees in credit institutions Persons per 1,000 inhabitants	MFI sector, total assets Per cent of GDP	MFI sector, domestic lending (excl. lending to MFIs) Per cent of GDP	Assets in insurance companies and pension funds Per cent of GDP
1.	LU: 50.6	LU: 2165	**DK: 209**	LU: 316
2.	AT: 9.2	IE: 714	NL: 175	NL: 246
3.	**DK: 8.1**	GB: 496	ES: 155	GB: 187
4.	DE: 8.1	**DK: 472**	PT: 152	IE: 182
5.	GB: 7.2	NL: 416	GB: 148	**DK: 177**
6.	IE: 6.9	FR: 397	LU: 148	FR: 102
7.	FR: 6.4	ES: 341	SE: 139	SE: 96
8.	NL: 6.2	PT: 337	IE: 139	BE: 74
9.	SE: 5.5	AT: 316	IT: 124	DE: 45
10.	PT: 5.4	FI: 312	GR: 119	PT: 41
11.	BE: 5.4	DE: 309	FR: 112	AT: 41
12.	IT: 5.2	SE: 297	AT: 107	IT: 36
13.	ES: 5.1	BE: 288	DE: 105	ES: 36
14.	GR: 5.0	IT: 270	FI: 102	FI: 32
15.	FI: 4.2	GR: 228	BE: 77	GR: 8

Note: BE = Belgium, DK = Denmark, FI = Finland, FR = France, GR = Greece, NL = Netherlands, IE = Ireland, IT = Italy, LU = Luxembourg, PT = Portugal, ES = Spain, GB = United Kingdom, SE = Sweden, DE = Germany, AT = Austria. All figures relate to 2012 except for domestic lending figures, which relate to June 2013. However, for Belgium, pension company assets are from 2011. The MFI sector has been calculated excl. the central bank and comprises banks (including mortgage banks), other credit institutions and money-market funds.
Source: ECB, Eurostat and Danmarks Nationalbank.

3. SUMMARY INDICATORS OF COST AND EFFICIENCY DEVELOPMENTS IN THE OVERALL FINANCIAL SECTOR

Several different definitions of financial sector activity can be applied – not least in the banking sector. A traditional distinction is between the production approach and the intermediation approach, cf. Colwell and Davis (1992). Under the production approach, banks are seen as producers of deposit and loan accounts, using labour and capital, while, under the intermediation approach, banks are seen as financial intermediaries, providing lending based on inputs in the form of labour, capital and deposits. However, the literature does not always agree on whether deposits should be considered as outputs from or inputs to the banking sector, cf. Hjalmarsson and Mlima (2002). Moreover, the banking sector also produces a number of other services related to payment systems, securities trading, etc.

Regardless of the definition applied, measuring productivity in the banking sector presents considerable challenges. As opposed to goods

manufacturing industries, output in the banking sector cannot be measured in homogeneous physical units that can be weighted using a set of prices from a given base year. This makes it anything but simple to identify the value of financial services produced by the financial sector. Therefore, it is difficult to make accurate calculations of, say, developments in labour productivity in the banking sector based on real value added and employment figures from the national accounts, cf. Box 3.1. This is also the reason why the output of the financial sector is not subject to normal VAT rules (instead a special payroll tax is payable).

Financial sector GVA is to cover the sector's remuneration of production factors in the form of labour and capital and depreciation of the capital stock. Disregarding intermediary consumption the financial sector's GVA to its assets or lending volumes thus provides a rough indicator for the development in unit cost in the financial sector, cf. Chart 3.2.

THE BANKING SECTOR IN THE NATIONAL ACCOUNTS Box 3.1

In the national accounts, gross value added (GVA) for a given corporate sector is usually calculated as the value of the sector's output less the value of its intermediate consumption, etc. Accordingly, GVA indicates what is available in the sector for remuneration of the production factors, i.e. remuneration of employees and self-employed contractors, return on capital and depreciation, if any, of the capital stock.

The national accounts are often used for determining labour productivity developments in various sectors based on the sector's real GVA and the number of employees (or the labour input measured in number of hours worked). The financial sector has experienced average annual productivity improvements of about 5 per cent since 1980 using growth in real GVA per hour worked as a measure of productivity, cf. Chart 3.1.

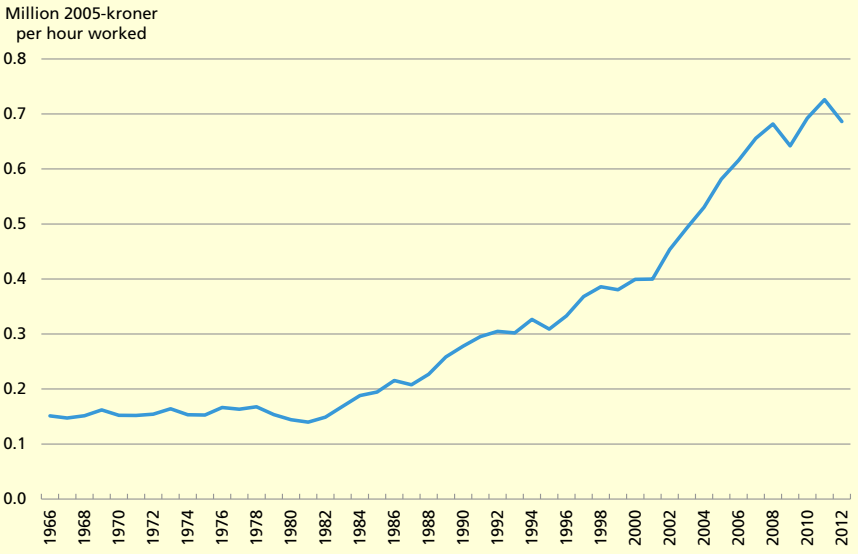
This type of productivity calculation is most relevant to the market economy. The reason is that value added in the non-market economy (e.g. public services) is calculated on a cost basis, entailing that the calculation of value added in this part of the economy is not determined independently of the labour input used, cf. Thage and Thomsen (2009). [1]

Difficulties also exist in terms of the financial sector. Often, services provided by banks are measured indirectly. Banks finance many of these services through the interest margin. In the national accounts, the output value of the banking sector is therefore calculated as the sum of financial intermediation services directly measured (fees, commissions and spreads in connection with securities and foreign exchange transactions) and net interest income (also referred to as financial intermediation services indirectly measured, FISIM). The calculation of net interest income at constant prices is based on interest margin information in a given base year and developments in banks' deposits and outstanding volume at constant prices. Bank services measured directly are deflated by a net price index for fees, cf. Statistics Denmark (2002).

[1] As of 2014, an output-based method will be used in the Danish national accounts for the calculation of public-sector output, cf. Deveci (2012).

CONTINUED Box 3.1

FINANCIAL SECTOR GROSS VALUE ADDED (GVA) RELATIVE TO THE NUMBER OF HOURS WORKED Chart 3.1



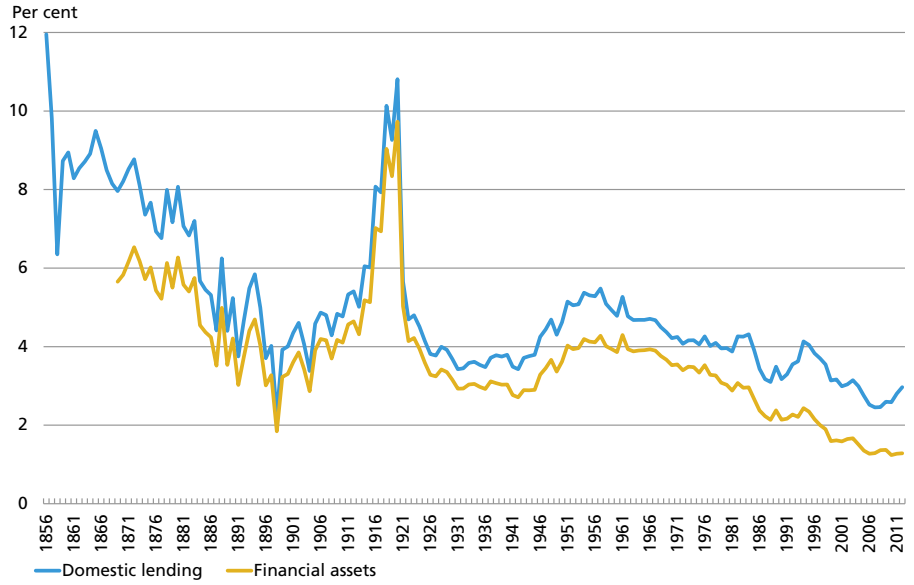
Source: Statistics Denmark.

Banks' net interest income, and thus a large percentage of the sector's output value, cannot be attributed to specific services provided by banks to their customers free of charge and no specific price has been recorded for these services. Therefore, it may be difficult to make accurate conventional calculations of productivity developments in the financial sector on the basis of the national accounts based e.g. on growth in real GVA and the number of employees.

The Danish Productivity Commission (2013) also points out the problems of calculating productivity in the financial sector based on value added in the national accounts at constant prices. For instance, for some parts of the financial sector, the deflation of output needs to be based on an earnings index. Since productivity increases are typically reflected in higher earnings, this entails the risk that, almost by definition, some of the productivity increases in the financial sector are eliminated. Subject to these caveats, the Productivity Commission finds that, during the period 1995-2010, hourly productivity in the financial sector (calculated as GVA at constant prices divided by the number of hours worked) increased more in Denmark than in the USA and the average of Sweden, the Netherlands and Germany. This applies both to the insurance and pension sector and to the rest of the financial sector.

FINANCIAL SECTOR GROSS VALUE ADDED (GVA) AS A PERCENTAGE OF FINANCIAL SECTOR DOMESTIC LENDING OR FINANCIAL ASSETS

Chart 3.2



Note.: Domestic lending comprises lending by banks (including mortgage banks). Financial assets comprise domestic lending by banks (including mortgage banks), members' assets in investment associations and financial assets of insurance and pension companies.

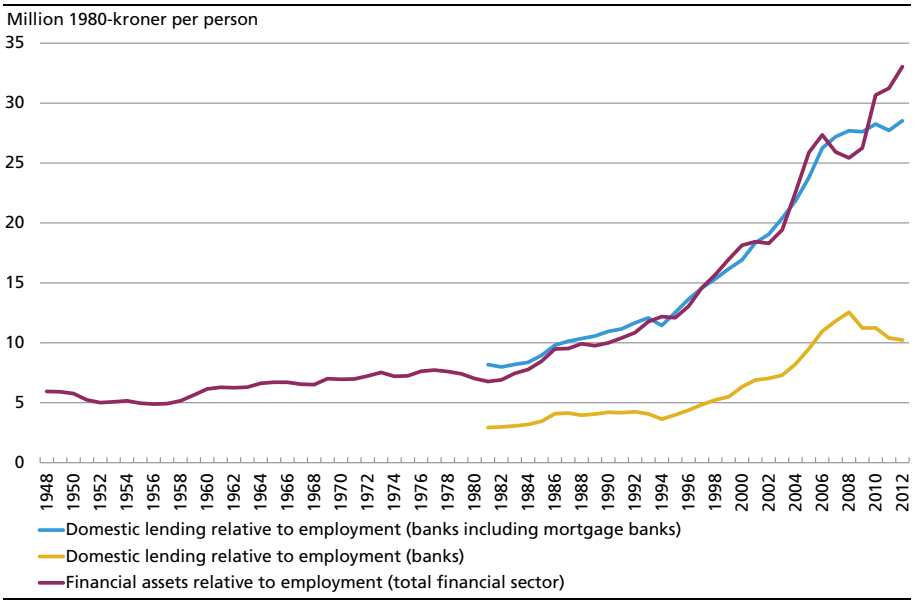
Source: Abildgren (2008, 2012), Hansen and Svendsen (1968), Hansen (1969, 1983), Danmarks Nationalbank and Statistics Denmark.

Measured by these indicators, there seems to have been a long-term decline in the unit costs of financial intermediation. It should be noted that part of the rise in financial sector assets since 1980 is attributable to an increase in real share prices, cf. section 2. However, long-term trends in unit cost performance of financial intermediation remain unchanged, regardless of whether total assets or lending volumes are used as outputs.

For the post-1950 period, Philippon and Reshef (2013) find similar developments in France, Germany, Italy and Japan. In the USA, on the other hand, the ratio of financial sector GVA to financial sector lending has increased since the early 1970s. Philippon and Reshef (2013) mention that a possible explanation for the increase in the cost of financial intermediation in the USA in the post-1980 period could be monopolistic trends resulting from the increased concentration in the US financial sector. To this should be added increased volumes of securities-related services with high margins targeting small investors (households).

DOMESTIC LENDING AND FINANCIAL ASSETS RELATIVE TO FINANCIAL SECTOR EMPLOYMENT

Chart 3.3



Note.: Deflated by the consumer price index. Financial assets comprise lending by banks (including mortgage banks), members' assets in investment associations and financial assets of insurance and pension companies.

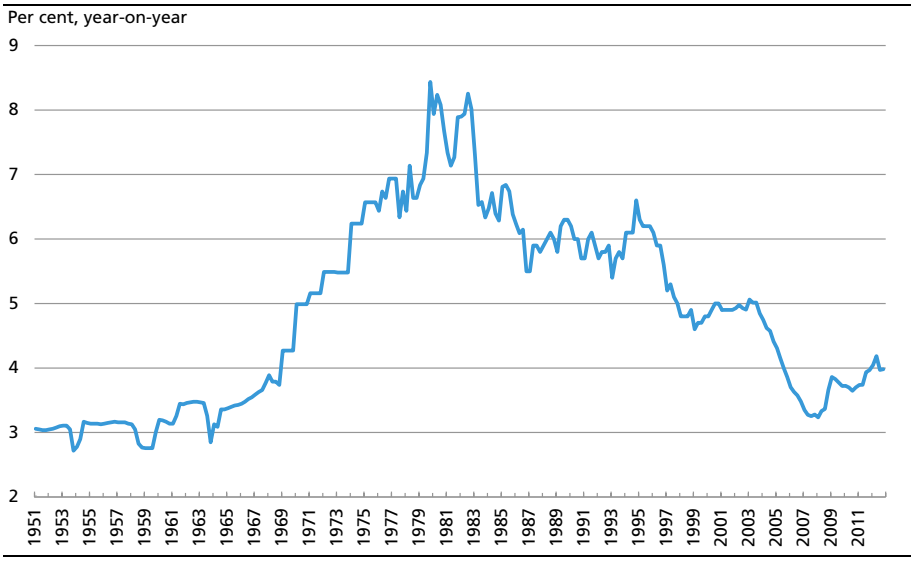
Source: Abildgren (2008, 2012), Abildgren et al. (2010), Hansen and Svendsen (1968), Hansen (1969, 1983), Danmarks Nationalbank, Danish Financial Supervisory Authority and Association of Danish Mortgage Banks.

A rough indicator of developments in labour productivity in the financial sector can be obtained by looking at domestic lending (or financial assets) adjusted for general price developments relative to employment, cf. Chart 3.3. Calculated in this way, labour productivity was more or less unchanged from 1948 to 1980, while annual growth rates have averaged some 4-5 per cent since 1980. Although banks have tended to increase the use of fees and charges in recent decades, there is hardly any doubt that the rise in the sector's labour productivity is reflected in the narrowing of bank interest margins seen since the early 1980s, cf. Chart 3.4.

The post-1980 period has been characterised by increased market orientation in the financial sector following liberalisation and internationalisation. Conversely, in the pre-1980 period, quantitative credit restrictions (such as lending limits for banks and mortgage banks, etc.) and foreign-exchange control were key economic policy instruments.

Lifting of restrictions on cross-border capital flows and deregulation of the financial sector in Denmark during the 1980s produced considerable welfare gains, cf. Economic Council (1994) and the recent "Rangvid

BANK INTEREST MARGINS Chart 3.4



Note. Quarterly observations. The interest margin is the difference between banks' average lending and deposit rates. The average interest rates used are weighted averages of interest rates on outstanding loans to or deposits from the sectors general government, non-financial corporations and households. Wherever possible, adjustments have been made for various data breaks.
Source: Abildgren (2012) and Danmarks Nationalbank.

report" (Ministry of Business and Growth, 2013). These gains were the result of lower prices (e.g. reflected in the narrowing of the spread between lending and deposit rates mentioned earlier) and a wider range of financial products (such as options, futures and several money-market products) as a result of increased competition and higher labour productivity in the financial sector. Moreover, the lifting of restrictions gave households and firms better opportunities for planning savings, consumption and investment.

In recent years, the ratio of domestic lending to employment for banks (including mortgage banks) has been stagnant or shown a weak trend compared with previously. This reflects that the ratio of domestic lending to employment has actually fallen in case of banks (excluding mortgage banks).

It should be noted, however, that simple measures such as financial assets or lending per employee are very summary in nature and highly incomplete indicators of productivity. For instance, under outputs, the "quality" involved is not taken into account.

As a case in point, it may be debated whether lending of different credit quality should be given the same weight. For example, if the

banking sector goes through a period of strong growth in lending of increasingly poor credit quality, causing systemic risks to build up in the financial sector, the real lending volume per employee is not the most appropriate indicator of the efficiency of the banking system.

Furthermore, these indicators are very summary in nature, based on financial sector total assets (statement holdings), which do not include e.g. the volume of financial transactions (number of payment transfers, number of securities transactions, etc.) or securities trading advice, etc.

Table 3.1 shows a number of summary indicators of productivity and cost-efficiency in the Danish credit institution sector compared with credit institutions in the other EU 15 member states.

Disregarding countries known as international financial centres (Luxembourg and Ireland), Denmark is among the group of countries with the highest total assets per employee in the credit institution sector. The same applies to domestic lending per employee. However, the high Danish levels of total assets and domestic lending per employee should be seen in the context of high domestic savings in pension funds and a well-developed mortgage system with good opportunities for mortgage equity withdrawal.

Denmark is among the group of countries with the largest number of inhabitants per ATM. Other things being equal, a large number of inhabitants per ATM indicates less use of cash, which is cost-intensive for the banking system compared with electronic payment solutions. By international standards, consumers in Denmark and the other Nordic countries make relatively few cash payments, cf. Payments Council (2013).

In terms of the ratio of total accounting costs to income or payment transactions per employee, Denmark tends to be in the middle of the range. The same more or less applies to the number of local branches. Other things being equal, a high number of inhabitants per local branch indicates that few human resources are dedicated to customer service.

In terms of payment transactions per employee, it should be mentioned, however, that a few large banks represent a substantial portion of the Danish banking sector and that credit transfers within the same bank are not included in the Danish figures, while, in principle, they are included in the figures of other countries.

As regards the cost-to-income ratio, a high cost ratio usually provides an indication of potential savings options in a competitive market for financial services. In less competitive markets, low cost ratios are also obtainable if high prices can be charged for services that do not reflect a correspondingly high product quality, etc.

INDICATORS OF CREDIT INSTITUTION PRODUCTIVITY AND COST-EFFICIENCY IN SELECTED COUNTRIES

Table 3.1

No.	Total assets per employee Million euro	Domestic lending per employee Million euro	Domestic deposits per employee Million euro	Payment transactions per employee No. of transactions	Cost-to-income ratio Per cent	No. of inhabitants per local branch Persons	No. of inhabitants per ATMs Persons
1.	IE: 35.4	**DK: 11.4**	NL: 8.2	FI: 107,856	ES: 48	NL: 6,784	SE: 2,773
2.	LU: 32.7	SE: 10.9	BE: 7.4	SE: 64,121	FI: 52	GB: 5,418	FI: 2,444
3.	FI: 26.5	NL: 10.1	ES: 6.5	NL: 56,589	LU: 53	SE: 5,049	NL: 2,210
4.	**DK: 25.8**	FI: 8.7	LU: 6.5	LU: 43,763	SE: 56	IE: 4,307	**DK: 2,057**
5.	NL: 24.1	IE: 7.2	GB: 6.3	FR: 43,390	PT: 58	**DK: 3,967**	IE: 1,498
6.	SE: 23.2	ES: 6.9	IE: 6.1	BE: 41,885	GR: 61	FI: 3,847	GR: 1,357
7.	GB: 21.0	IT: 6.3	FI: 5.6	GB: 40,713	GB: 61	GR: 3,111	LU: 1,193
8.	FR: 18.5	GB: 6.3	SE: 5.2	**DK: 39,345**	**DK: 63**	BE: 2,904	IT: 1,170
9.	BE: 18.1	FR: 5.5	IT: 5.0	AT: 31,340	IT: 63	LU: 2,585	FR: 1,116
10.	ES: 15.3	BE: 4.8	DE: 4.8	PT: 30,865	AT: 68	DE: 2,258	AT: 1,011
11.	IT: 13.6	PT: 4.4	FR: 4.6	DE: 27,639	FR: 69	AT: 1,893	DE: 991
12.	AT: 12.5	DE: 4.3	AT: 3.9	ES: 24,797	BE: 73	IT: 1,826	GB: 960
13.	DE: 12.5	AT: 4.2	**DK: 3.8**	IE: 21,842	DE: 73	FR: 1,703	ES: 821
14.	PT: 9.7	GR: 4.0	PT: 3.8	IT: 13,999	NL: 89	PT: 1,685	BE: 708
15.	GR: 7.7	LU: 2.5	GR: 3.1	GR: 3,255	IE: 126	ES: 1,211	PT: 635

Note: BE = Belgium, DK = Denmark, FI = Finland, FR = France, GR = Greece, NL = Netherlands, IE = Ireland, IT = Italy, LU = Luxembourg, PT = Portugal, ES = Spain, GB = United Kingdom, SE = Sweden, DE = Germany, AT = Austria. Total assets of credit institutions have been calculated as total assets at year-end 2012 in the MFI sector, excl. central banks and certificates issued by money-market funds (held by residents in the currency area). Domestic lending and deposits have been calculated at end-June 2013 and are excl. of outstanding balances with MFIs. Payment transactions relate to transactions in 2012, involving non-MFIs. As far as Denmark is concerned, payment transactions comprise credit transfers (giro, in-payment forms and credit transfers between banks – credit transfers within the same bank are not included), direct debit (Betalingsservice and Leverandørservice), cheques and card payments (Dankort and international payment cards). The cost-to-income ratio has been calculated as an average over the years 2008-2012 and based on consolidated statistics in which foreign branches and subsidiaries are included in figures.

Source: ECB and Danmarks Nationalbank.

4. COSTS OF PAYMENT SYSTEMS

Much of the time of banking employees is spent performing activities related to payment systems, including cash handling, customer services at the counter in branches and processing of customer inquiries on entries, payment cards, etc. Banks also have other costs that are directly attributable to payment systems, e.g. payment for services provided by data processing centres, depreciation of ATMs and costs of producing payment cards. Moreover, it may be relevant to include a proportion of general bank costs to get an impression of their total costs of payment systems.

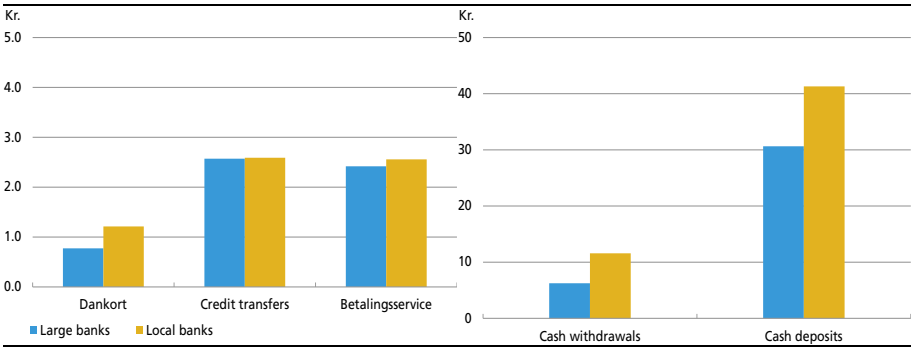
Costs of payment systems may subsequently be allocated to the various payment services provided by banks. For example cash withdrawals or deposits, payments by debit or credit cards, i.e. cards where funds are debited to the customer's account immediately or after a period of time, respectively, transfers and collections. Such allocation of costs can be subject to some uncertainty, especially as regards general costs where allocation keys must be used. Finally, costs may be based on the number of transactions to determine the cost-to-service ratio.

Assessment of economies of scale

Danmarks Nationalbank has conducted a study of the social costs of payments in Denmark, including bank costs, cf. Danmarks Nationalbank (2011). Nine banks participated in the study: the four largest Danish banks and five local banks. The study collected data on bank costs of cash withdrawals and deposits, various types of card payments, including Dankort payments, online transfers or transfers at the counter of a branch and Betalingsservice (direct debit). The study covered only payments from consumers to businesses and only payments in Denmark in Danish kroner.

Chart 4.1 shows the average costs per transaction for selected services, broken down by the largest banks and the five local banks. The chart indicates that the provision of payment services offers some economies of scale, given that the costs per transaction are generally lower for large banks. However, this does not apply to transfers, for which unit costs are the same for large and small banks. These types of payments are usually online transfers, which are automated and, in practice, performed by banks' data processing centres, which are able to achieve economies of scale. Banks' Betalingsservice costs also show only a moderate difference.

DANISH BANK COSTS OF SELECTED PAYMENT SERVICES Chart 4.1



Note: Large banks are Danske Bank, Nordea Bank Danmark, Sydbank and Jyske bank, while local banks are Sparekassen Sjælland, Vestjysk Bank, Sammenslutningen af Danske Andelskasser, Nørresundby Bank and Sparekassen Kronjylland.
Source: Danmarks Nationalbank (2011).

Given that payment systems involve fixed costs (overheads), unit costs decrease with the number of transactions. According to a breakdown of bank costs of payment systems, about 60 per cent of costs can be classified as fixed costs, cf. Jacobsen (2012). Consequently, these costs tend to have some natural economies of scale. If unit costs are calculated based only on variable costs, small banks have lower costs than their large counterparts for some payment services.

Danish banks versus foreign banks

In addition to Danmarks Nationalbank, a number of other central banks have conducted studies of bank costs of payments. Table 4.1 summarises the findings of some of these studies for payments using debit and credit cards, transfers and direct debits. Several of these studies, including the one conducted by Danmarks Nationalbank, are derived from a European study coordinated by the European Central Bank (ECB). The use of a common cost calculation method facilitated comparability of results across countries. As regards the other studies used, deviations between countries may, to a greater extent, be explained by methodological differences.

In general, bank costs of payment systems in individual countries vary considerably. This may be due to differences in cost levels, but may also reflect variations in the volume of payments with fixed costs that are important to the unit costs calculated. For instance, costs per debit card

BANK UNIT COSTS OF SELECTED PAYMENT SERVICES IN EUROPEAN COUNTRIES

Table 4.1

Kr.	Year	Payment by debit card	Payment by credit card	Transfer	Collection
Denmark*	**2009**	**1.33**	**19.66**	**5.19**	**4.13**
Finland*	2009	0.95	12.85	3.77	2.13
Italy*	2009	4.65	8.84	7.03	1.86
Latvia*	2009	3.65	5.63	3.47	3.12
Lithuania	2011	3.15	21.92	2.87	3.13
Norway	2007	2.35	29.69	3.30	2.26
Portugal	2007	1.71	18.18	2.09	0.67
Sweden*	2009	1.82	8.30	2.84	0.55
Hungary*	2009	4.35	20.19	4.06	2.21

Note: Studies marked by * were conducted as part of a pan-European study of costs of payments, coordinated by the European Central Bank. The costs of other countries have been converted into Danish kroner using the average annual exchange rate.

Source: Banco de Portugal (2007), Turján et al. (2011), Banca d'Italia (2012), Lietuvos Bankas (2012), Latvijas Banka (2013), Segendorf and Jansson (2012), Nyandoto (2011), Danmarks Nationalbank (2011), Gresvik and Haare (2009).

payment in Denmark are relatively low, which should be seen in light of the popularity of the Dankort (debit card). On the other hand, bank costs per credit card payment are considerably higher in Denmark than in, say, Sweden. Part of this difference is, no doubt, attributable to the higher prevalence of credit cards in Sweden than in Denmark.

Another explanation for the difference in bank costs in Table 4.1 could be that payment services are not identical across countries. For example, high collection costs in Denmark may, in part, be explained by the sophistication of Betalingsservice relative to similar direct debit products in other countries, cf. Danish Competition and Consumer Authority (2011). Similarly, bank transfer costs depend on the proportion of online transfers relative to transfers at the counter in branches.

5. FINANCIAL SECTOR EARNINGS COSTS

Previously, analyses have been conducted of the earnings level in the Danish financial sector, cf. Ministry of Finance (1997), Economic Council (2005), Danish Bankers Association (2008), Schaarup (2009) and various editions of the former Danish Competition Authority's "Competition Reports". These analyses show that, since the early 1980s, "raw" average earnings in the financial sector have tended to be higher than in the rest of the economy. However, some of the analyses indicate that a substantial portion of the earnings differential can be attributed to factors such

as differences in education levels, job functions, job experience and geography.

This section conducts a microeconometric analysis of the earnings level in the financial sector relative to that of other industries.

Data and descriptive statistics

Below, analyses are conducted with two different measures of hourly earnings. Some of these analyses use the hourly earnings variable from the Statistics Denmark IDA database. This makes it possible to illustrate the development in financial sector earnings over a long span of years (the period 1980-2010). Analyses are also performed based on earnings per hour worked from the Services Register of the Earnings Statistics. Reliable data from this register is available only for the period 2000-2010, but the data quality and degree of detail are better than in the IDA database. Box 5.1 provides a description of the data used and the delineation of data.

DATA DESCRIPTION — Box 5.1

The data used in the analysis below is the result of correlation of various Statistics Denmark registers. Hourly earnings data is derived from the IDA database (Integrated Database for Labour Market Research) and from the Services Register of the Earnings Statistics. In general, the population consists of all employees aged 15-66. To minimise the effects of major measuring errors, only observations for which hourly earnings range between the 0.1 and 99.9 percentiles for each year in each industry are included.

The IDA database

The IDA database has been used in a number of previous analyses of earnings in Denmark. The hourly earnings variable from the IDA database has been calculated based on reporting to Skat (Danish tax authorities) and ATP data (Danish Labour Market Supplementary Pension Fund), and the focus is only on observations for which the quality of the hourly earnings calculation has been rated "usable" by Statistics Denmark. Pension contributions are not included in this calculation of hourly earnings.

The advantage of using calculated hourly earnings from this database is that it is possible to examine earnings trends from 1980 until today. The drawback is that, according to Statistics Denmark, the calculation of hourly earnings has some element of estimate when it comes to the number of hours worked during the year. The calculation of hours worked is based on payments to ATP, resulting in uncertainty, in particular as regards employees with low weekly working hours. As from 2011, Statistics Denmark no longer calculates hourly earnings using the IDA database.

Industries are grouped into 111 sub-groups such as Banks, Mortgage Banks etc., Insurance (including Pension) and Financial Services.

CONTINUED Box 5.1

Services Register of the Earnings Statistics

In the fairly new register, Services Register of the Earnings Statistics, the main earnings concept is earnings per hour worked. This earnings concept is substantially better for comparing earnings across labour-market groups and although some uncertainty still persists as to the reporting of the number of hours worked, its quality must be considered to be higher than that of IDA hourly earnings. Moreover, it is possible to break down total hourly earnings into a number of sub-components, such as holiday pay, pension contributions, etc., facilitating decomposition of estimated additional earnings. Therefore, earnings data from this register is used for most of the analyses below. The drawback of the register is that reliable data exists only from 2000 onwards.

The register contains information on employees employed by firms with 10 or more full-time equivalent employees, who have been employed for at least one month and have average weekly working hours exceeding eight hours. The register does not include employees in agriculture and fisheries. Another requirement is that employees are employed under "normal conditions", entailing e.g. that employees who are paid exceptionally low earnings rates due to disability, etc., and employees who are not taxed under ordinary tax conditions in Denmark are not included. The register includes all employment relationships for each individual during the year, but the analysis below focuses exclusively on the employment relationship with the most hours worked during the year. This means that the population differs significantly from the IDA population, which includes only employment in November, but, on the other hand, comprises employees in firms with fewer than 10 full-time equivalent employees.

Industries are grouped into 127 sub-groups such as Banks, Mortgage banks etc., Insurance and Pension and Financial Services, between them making up the main group: Financing and Insurance. Mortgage banks etc. comprise e.g. mortgage banks, investment associations and financial leasing. Banks do not include Danmarks Nationalbank, while Financial Services include, inter alia, securities brokers.

Background variables

The analysis also includes a number of observable background variables, all of which must be expected to affect earnings made. In particular, adjustment is made for the following factors:

- Educational background (completion only of primary and lower secondary education, upper secondary education, vocational education, short-cycle, medium-cycle or long-cycle education.
- Job function[1] (top management, work at a high level of competency, work at a medium level of competency, office work, sales and service work, work in agriculture and horticulture, process and machine operator work, other work).

[1] In the analysis using the Services Register for the Earnings Statistics, the variables for job function have been generated based on the DISCO earnings codes. However, over time, there have been inconsistencies in the reporting of financial sector employees across the nine main groups, resulting in unrealistic fluctuations from one year to the next. Consequently, it is regarded necessary to integrate three main groups, Work at a high level of competency, Work at a medium level of competency and office work into one, since changes in additional earnings over time could otherwise represent arbitrary changes in the job functions reported. Similar considerations apply to the analysis using the IDA database. Also note the data breaks in the data basis of the job function variables in the IDA analysis in 1996 and 2002, and for both the Services Register for the Earnings Statistics and the IDA database in 2010.

CONTINUED Box 5.1

- Other personal characteristics, i.e. gender, age, age squared, job experience, job experience squared, annual unemployment rate (proportion of the year spent unemployed), immigrant background (from 1986 onwards), children living at home, marital status, residence in the Greater Copenhagen area, unemployment insurance.
- Moreover, adjustment is made for general developments using time dummies.

When, in the remainder of this section, results are presented that cover the entire period since 1980, calculations are based on the IDA database. Calculations relating only to the period 2000-2010 are based on the Services Register of the Earnings Statistics.

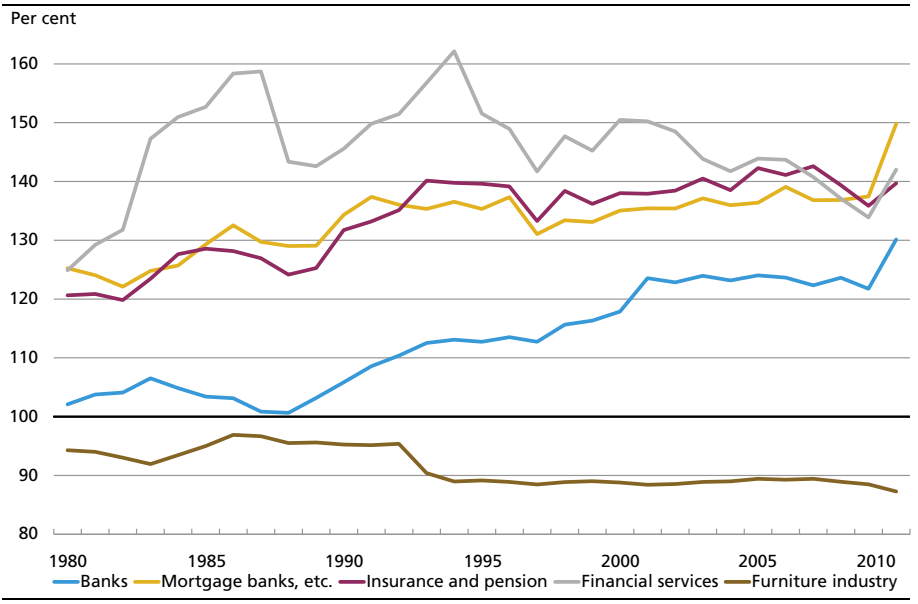
Previous Danish studies calculate additional earnings in the financial sector relative to a specific industry (usually the furniture industry, which was used as a benchmark e.g. by the former Danish Competition Authority and the Economic Council). This study, on the other hand, prefers to calculate the earnings differential in the financial sector relative to a weighted average of all other industries, the weights being determined by the size of the industry, since the furniture industry is not really comparable with the financial sector. Average earnings in the furniture industry are between 5 and 20 per cent lower than average earnings across all industries, cf. Charts 5.1 and 5.2.

For all sub-industries of the financial sector, average hourly earnings calculated based on the IDA database were higher than average earnings across all industries throughout the period 1980-2010, cf. Chart 5.1. It should be noted, however, that additional earnings of bank employees exceed average earnings by more than 10 per cent only from the early 1990s. Year-on-year fluctuations are higher for financial services, but this sub-industry has relatively few employees – especially at the beginning of the period. Financial services comprise e.g. securities brokers, cf. Box 5.1. In general, raw additional earnings in the financial sector were rising during the period from 1980 until 2010.

A similar pattern is seen for earnings per hour worked from the Services Register of the Earnings Statistics, cf. Chart 5.2. For this hourly earnings variable, raw additional earnings were also between 20 and 50 per cent in the period 2000-10.

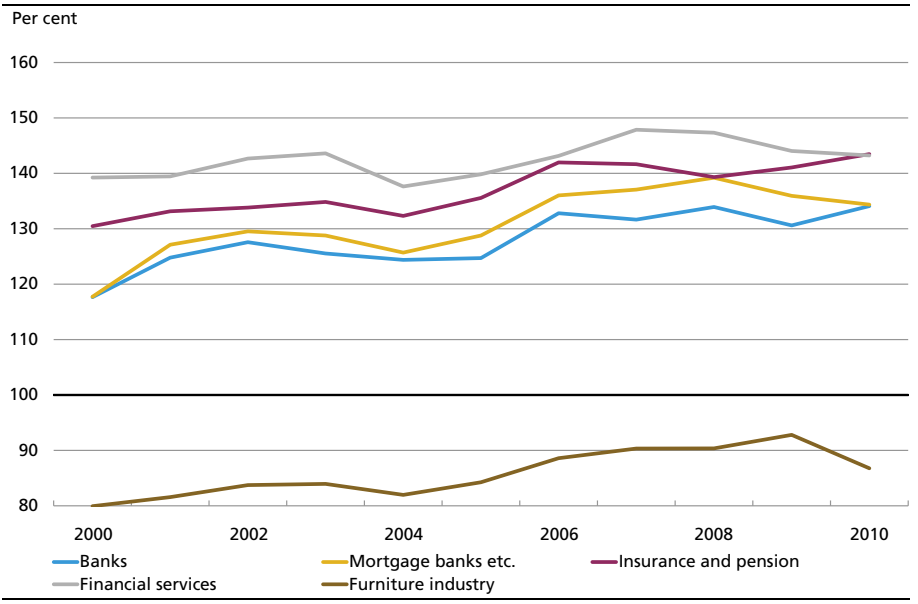
Higher average earnings per hour worked are not explained exclusively by a few employees with very high earnings. The entire earnings distribution for each sub-industry in the financial sector has shifted towards

HOURLY EARNINGS IN SELECTED INDUSTRIES 1980-2010 COMPARED WITH AVERAGE EARNINGS ACROSS ALL INDUSTRIES (= INDEX 100) Chart 5.1



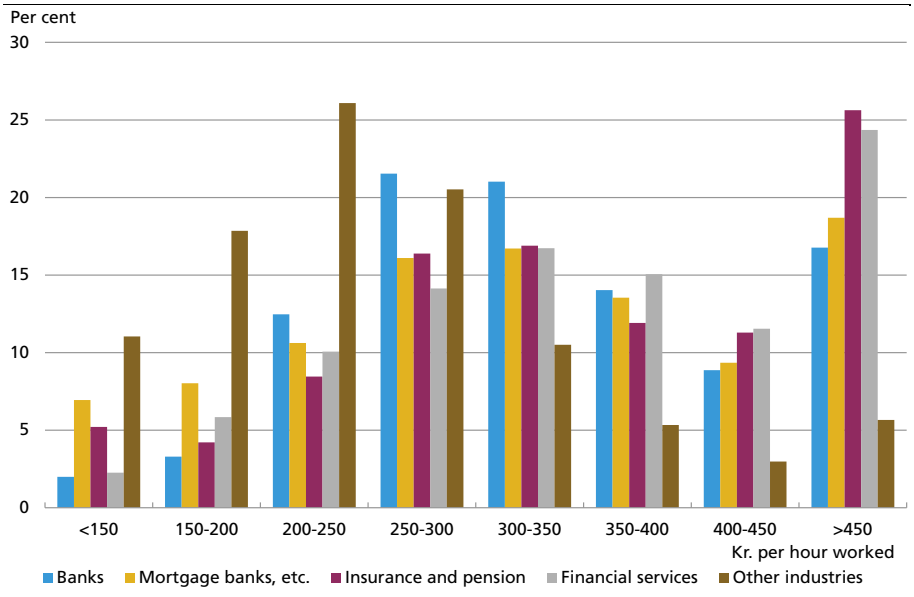
Note: Calculated hourly earnings are derived from the IDA database; for 2010, hourly earnings have been calculated based on BfL (Employment Statistics for Employees) in the eIncome register, resulting in a data break.
Source: Statistics Denmark and own calculations.

TOTAL EARNINGS PER HOUR WORKED IN 2000-2010 COMPARED WITH AVERAGE EARNINGS ACROSS ALL INDUSTRIES (= INDEX 100) Chart 5.2



Note: Total earnings per hour worked are derived from the Services Register of the Earnings Statistics.
Source: Statistics Denmark and own calculations.

BREAKDOWN OF TOTAL EARNINGS PER HOUR WORKED IN 2010 Chart 5.3



Source: Statistics Denmark and own calculations.

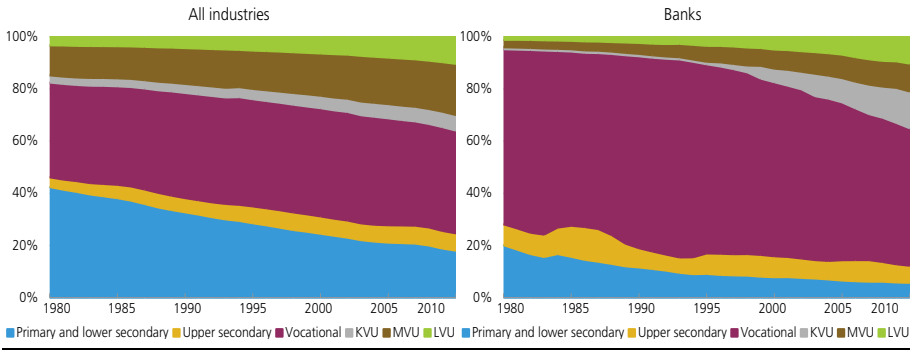
the right relative to the earnings distribution across all other industries, cf. Chart 5.3.

The charts above cannot be seen as an indication that earnings in the financial sector are too high. For instance, the differential in hourly earnings could be due to observable differences in education levels, job functions, etc.

Education levels across all industries rose from 1980 until 2010, cf. Chart 5.4. The same pattern is evidenced in banks where the percentage of employees with vocational training, e.g. banking training, decreased from 67 per cent in 1980 to 53 per cent in 2010. On the other hand, the percentage of employees with higher education – especially short-cycle higher education, such as an Academy Profession Degree in Financial Management – has increased sharply since the late 1990s. Other sub-industries in the financial sector have seen the same trend. Accordingly, the average education level in the financial sector has risen more than in other industries, which may reflect the deregulation of the financial sector and the need for more advanced risk management.

Geographical differences also exist between the Danish financial sector and other Danish industries. A relatively higher percentage of financial sector employees live in the Greater Copenhagen area, cf. Chart 5.5, where living costs are generally higher than in the rest of the country.

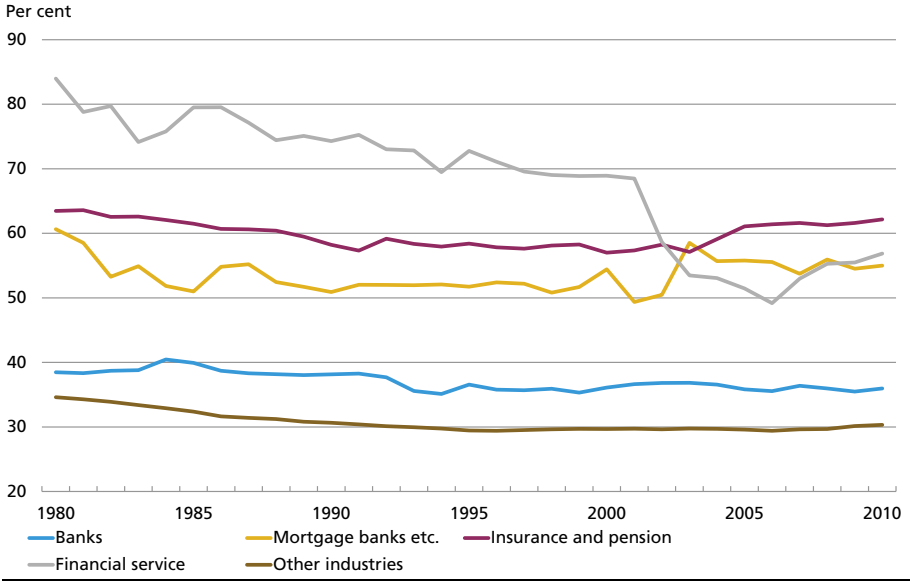
EDUCATIONAL COMPOSITION Chart 5.4



Note: This sample is also used below in the IDA analysis, i.e. using the delineation of data described in Box 5.1. The Danish abbreviations KVU, MVU and LVU indicate short-cycle, medium-cycle and long-cycle higher education.
Source: Statistics Denmark and own calculations.

An advantage of using the hourly earnings variable from the Services Register of the Earnings Statistics is the possibility of decomposing total earnings into a number of sub-components. Total earnings per hour worked can be decomposed as follows:

PERCENTAGE RESIDING IN THE GREATER COPENHAGEN AREA Chart 5.5



Note: This sample is also used below in the IDA analysis, i.e. using the delineation of data described in Box 5.1.
Source: Statistics Denmark and own calculations.

Total earnings = Remuneration + Nuisance bonus + Sickness absence pay, etc. + Holiday pay, etc. + Pension contributions + Fringe benefits [1] + Other [2]

where all components are calculated per hour worked.

The composition of total earnings per hour worked, broken down into various sub-components, is illustrated in Chart 5.6. Remuneration – i.e. the concept that is closest to actual hourly earnings (although including irregular payments such as bonuses and profit sharing) – accounts for the largest share by far of total earnings. To this should be added pension contributions and holiday pay, etc. The same applies to banking employees.

It should be noted that higher earnings in banks relative to other industries are attributable both to higher remuneration, larger pension contributions and higher holiday pay. The same pattern is seen in other sub-industries of the financial sector.

Regression results

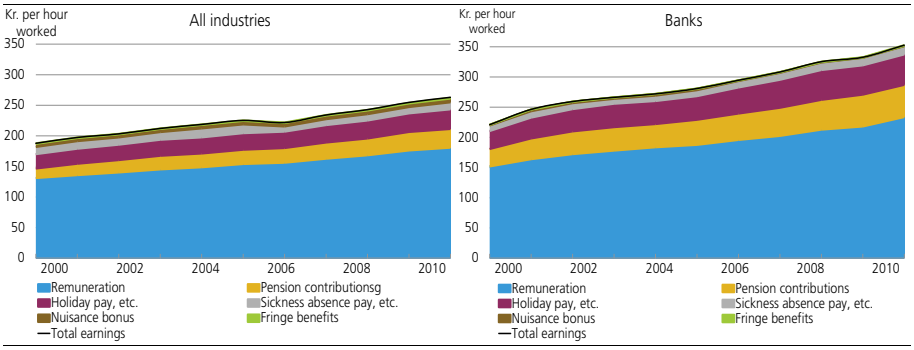
The charts of the previous section show that average earnings in the financial sector are higher than in other industries. The charts also indicate that part of this earnings differential can be attributed to differences in education levels and geography, but other observable differences between financial sector employees and employees in other industries are also feasible, e.g. job experience or job functions. In this section, a number of formal empirical analyses are conducted to further examine this issue. Box 5.2 contains a description of OLS, the method used.

Chart 5.7 shows additional earnings estimates from OLS regressions for each individual year. The chart shows that, adjusted for a number of background variables, financial sector earnings were relatively high throughout the period. In recent years, earnings levels have been between 15 and 30 per cent higher than the average across all industries, regardless of which of the two hourly earnings concepts is chosen. For the vast majority of years, additional earnings in the financial sector are higher within insurance and pension as well as in financial services.

[1] Fringe benefits cover only fringe benefits subject to income tax (class A tax), such as free car and free board and lodging. The Services Register of the Earnings Statistics, on the other hand, has no information on fringe benefits subject to tax on income not collected at source (class B tax), share-based incentive schemes, etc.

[2] Other covers, inter alia, the 'Free Choice Scheme' (from 2008 onwards). Unfortunately, 'Other' is not part of the Services Register of the Earnings Statistics, entailing that decompositions are incomplete, although deviations are marginal.

EARNINGS PER HOUR WORKED BROKEN DOWN INTO SUB-COMPONENTS Chart 5.6



Note: This sample is also used below in Service Register of the Earnings Statistics, i.e. using the delineation of data described in Box 5.1.
Source: Statistics Denmark and own calculations.

A comparison of the regression results from Chart 5.7 with the raw earnings differentials in Charts 5.1 and 5.2 indicates that, when various background variables are taken into account, the impression of additional earnings in the financial sector is reduced.

Table 5.1 illustrates the effect of gradually including various background variables in a Pooled OLS regression for the period 2000-2010. The table shows that – especially when adjustment is made for personal characteristics, such as age, job experience, etc. and job function – additional earnings in the financial sector decline. But even after taking these factors into account, additional earnings in the financial sector exceed 15 per cent.

In the analyses conducted so far, it cannot be ruled out that additional earnings in the financial sector – adjusted for observable characteristics – are due to systematic, but unobservable differences between financial sector employees and employees in other industries[1], for example in

METHOD — SIMPLE OLS (METHOD OF LEAST SQUARES) Box 5.2

The following linear regression model is constructed

$$y_{it} = \boldsymbol{x}_{it}\boldsymbol{\beta} + \boldsymbol{d}_{it}\boldsymbol{\gamma} + \boldsymbol{\epsilon}_{it}$$

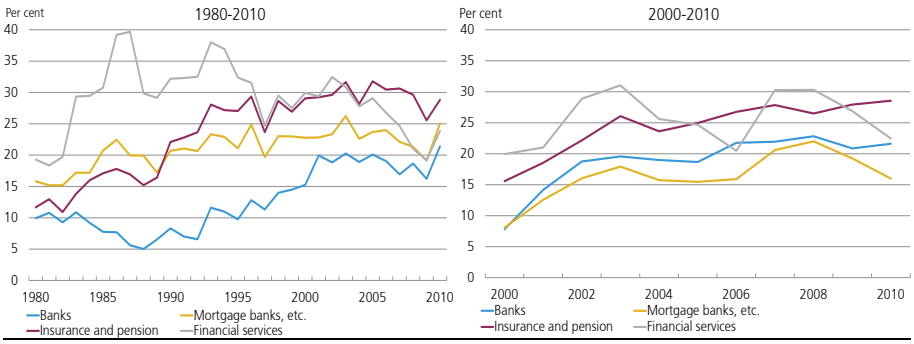
where y_{it} is the natural logarithm of hourly earnings, $\boldsymbol{x}_{it}$ is a vector of observable characteristics, and $\boldsymbol{d}_{it}$ is a vector of industry dummies.

The estimation may be performed for each individual year or overall as a *Pooled OLS*. In the latter case, cluster-robust standard errors are calculated, i.e. clustered standard errors to allow for the correlation between the error terms across years for each individual.

[1] By conducting an Abowd, Kramarz and Margolis (1999) decomposition of Danish IDA data, Sørensen and Vejlin (2014) find that 40 per cent of the earnings variation can be explained by unobservable (time-invariant) differences among employees.

ESTIMATED ADDITIONAL EARNINGS USING OLS REGRESSION FOR EACH INDIVIDUAL YEAR

Chart 5.7



Note: The left-hand chart presents estimates using hourly earnings from the IDA database, while the right-hand chart presents estimates using total earnings per hour worked from the Services Register of the Earnings Statistics. Additional earnings, calculated relative to those of an average employee across all industries outside the financial sector, have been achieved by OLS regressions with the natural logarithm of hourly earnings on the left-hand side and a number of additional explanatory variables, cf. Box 5.1. The parameter estimates, γ, have been converted into additional earnings in per cent of $100[exp(\gamma) - 1]$. All additional earnings are statistically significant at a significance level of 1 per cent.

Source: Statistics Denmark and own calculations.

SIGNIFICANCE OF BACKGROUND VARIABLES FOR ESTIMATED ADDITIONAL EARNINGS, POOLED OLS ESTIMATION FOR 2000-2010

Table 5.1

Parameter estimate	(1)	(2)	(3)	(4)	(5)
Bank employee	0.282	0.212	0.216	0.166	0.172
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mortgage bank, etc. employee	0.266	0.214	0.187	0.143	0.153
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Insurance and pension employee	0.334	0.263	0.265	0.218	0.220
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Financial service employee	0.407	0.317	0.295	0.248	0.232
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Background variables included					
Personal characteristics	–	+	+	+	+
Level of education	–	–	+	+	+
Job function	–	–	–	+	+
Time dummies	–	–	–	–	+
Number of observations (thousands)	18,687	18,111	17,902	17,902	17,902

Note: The left-hand-side variable is the natural logarithm for earnings per hour worked from the Services Register of the Earnings Statistics. Standard errors are clustered at individual level in parentheses. Personal characteristics include gender, age, age squared, job experience, job experience squared, annual unemployment rate and dummies for immigrant background, have children living at home, are married or cohabiting, live in the Greater Copenhagen area, have unemployment insurance. A "+" next to background variables included denotes that the variable has been included.

Source: Statistics Denmark and own calculations.

METHOD – PANEL DATA ESTIMATION WITH INDIVIDUAL FIXED EFFECTS Box 5.3

By exploiting the fact that the same individual is observed several times (in different years), unobservable (but time-invariant) heterogeneity is allowed

$$y_{it} = \boldsymbol{x}_{it}\boldsymbol{\beta} + \boldsymbol{d}_{it}\boldsymbol{\gamma} + \alpha_i + \boldsymbol{\epsilon}_{it}$$

where α_i is unobservable, time-invariant characteristics. Performing a "within transformation" gives the result

$$\tilde{y}_{it} = \tilde{\boldsymbol{x}}_{it}\boldsymbol{\beta} + \tilde{\boldsymbol{d}}_{it}\boldsymbol{\gamma} + \tilde{\alpha}_i + \tilde{\boldsymbol{\epsilon}}_{it}$$

where a tilde (~) denotes a deviation from the time average, i.e. $\tilde{z}_{it} = z_{it} - T^{-1}\sum_{t=1}^{T} z_{it}$. Thus, by definition, we have $\tilde{\alpha}_i = 0$, while $\tilde{\boldsymbol{x}}$ now contains only observable characteristics that vary over time.

To identify $\boldsymbol{\gamma}$ in this panel data estimation, some individuals need to change industry during the period observed. In the sample for 2000-2010, 50.3 per cent of the individuals observed changed industry during the period.

terms of the degree of motivation or skills. Below, wherever possible, some allowance has been made for these factors by using panel data methods (individual fixed effects), cf. Box 5.3. These methods e.g. allow some employees to have a number of (unobservable) characteristics that enable them to obtain high earnings, regardless of their industry of employment.

When allowance is made for unobservable, time-invariant heterogeneity, estimated additional earnings in the financial sector relative to other industries fall from around 16.5 and 26.1 per cent to between 5.2 and 10.5 per cent, cf. Table 5.2.[1] At the same time, the dispersion of additional earnings across the four sub-industries is reduced. Accordingly, much of the earnings differential can be attributed to systematic differences between employees inside and outside the financial sector.

At first glance, differences across the private and public sectors may seem large, e.g. paid lunch breaks, etc., making comparisons difficult. But estimated additional earnings in the financial sector are not due to the fact that financial sector employees are compared with employees across all industries – in the public as well as private sectors. Additional earnings in the financial sector are between 5 and 10 per cent, even if only private-sector employees are included in the analysis, cf. Table 5.3.

Additional earnings in the financial sector are attributable primarily to higher remuneration, pension contributions and holiday pay than in other industries, cf. Table 5.4.

[1] Parameter estimates, γ, have been converted to per cent by $100[\exp(\gamma) - 1]$, i.e. $100[\exp(0.153) - 1] \approx 16.5$, etc.

COMPARISON OF POOLED OLS AND FIXED EFFECTS FOR 2000-2010 Table 5.2

Parameter estimate	Pooled OLS	Fixed Effects
Bank employee	0.172 (0.001)	0.100 (0.002)
Mortgage bank, etc. employee	0.153 (0.002)	0.051 (0.001)
Insurance and pension employee	0.220 (0.002)	0.093 (0.002)
Financial service employee	0.232 (0.003)	0.069 (0.003)
Number of observations (thousands)	17,902	17,902

Note: The left-hand-side variable is the natural logarithm for earnings per hour worked from the Services Register of the Earnings Statistics and regressions include a number of additional explanatory variables, cf. Box 5.1, not including, however, gender and immigrant background for fixed effects. For Pooled OLS, standard errors have been clustered at individual level in parentheses, while, for fixed effects, robust standard errors are reported in parentheses.
Source: Statistics Denmark and own calculations.

An interesting question is whether additional earnings in the financial sector are distributed evenly across all employees, or whether higher average hourly earnings are obtained only by the highest earners. To that end, quantile regressions are performed below, cf. Box 5.4, whereby the effect of being employed in the financial sector is estimated at different points of the earnings distribution.

COMPARISON OF POOLED OLS AND FIXED EFFECTS FOR 2000-2010 – PRIVATE-SECTOR EMPLOYEES ONLY Table 5.3

Parameter estimate	Pooled OLS	Fixed effects
Bank employee	0.162 (0.001)	0.092 (0.002)
Mortgage bank, etc. employee	0.136 (0.002)	0.049 (0.001)
Insurance and pension employee	0.206 (0.002)	0.093 (0.002)
Financial service employee	0.215 (0.003)	0.067 (0.002)
Number of observations (thousands)	10,532	10,532

Note: The left-hand-side variable is the natural logarithm for earnings per hour worked from the Services Register of the Earnings Statistics and regressions include a number of additional explanatory variables, cf. Box 5.1, not including, however, gender and immigrant background for fixed effects. For Pooled OLS, standard errors have been clustered at individual level in parentheses, while, for fixed effects, robust standard errors are reported in parentheses.
Source: Statistics Denmark and own calculations.

DECOMPOSITION OF ADDITIONAL EARNINGS, FIXED EFFECTS FOR 2000-2010 Table 5.4

Left-hand-side variable (kr. per hour worked)	Total earnings	Remuneration	Nuisance bonus	Sickness absence pay	Holiday pay	Pension contributions	Fringe benefits
Bank employee	24.42	5.00	-0.59	2.44	7.24	11.05	-0.58
	(0.48)	(0.30)	(0.05)	(0.13)	(0.08)	(0.11)	(0.03)
Mortgage bank, etc. employee	12.31	4.85	-0.54	0.35	3.84	4.01	-0.17
	(0.48)	(0.31)	(0.04)	(0.12)	(0.08)	(0.14)	(0.04)
Insurance and pension employee	26.41	12.92	-1.07	0.72	5.19	8.62	0.20
	(0.62)	(0.38)	(0.05)	(0.18)	(0.10)	(0.15)	(0.05)
Financial service employee	20.90	8.91	-0.52	-0.04	5.87	6.77	0.13
	(1.35)	(0.55)	(0.11)	(0.79)	(0.20)	(0.25)	(0.08)

Note: The left-hand-side variables (all of which from the Services Register of the Earnings Statistics) are level, i.e. allowance has not been made for the natural logarithm of these variables, and regressions include a number of additional explanatory variables, cf. Box 5.1, not including, however, gender and immigrant background. Robust standard errors are reported in parentheses. All regressions include 17,901,564 observations.

Source: Statistics Denmark and own calculations.

QUANTILE REGRESSION Box 5.4

Quantile Regression is a widely used alternative to a simple OLS estimation.[1] Instead of estimating the effect on the conditional mean value, the effect on the conditional quantile is estimated. This is particularly relevant in cases where heterogeneous effects play a role, i.e. the effect on the mean value is not very representative of the effect on, say, the lower quantile of the distribution.

The advantage of quantile regression is that the effect (e.g. of being employed in the financial sector) can be calculated for the lower, middle and upper quantiles of the distribution (e.g. earnings distribution), while, in the case of OLS estimations, the focus is exclusively on a single estimate, viz. the effect on the conditional mean value.

Another advantage is that extreme observations have no significance in the computation of conditional quantiles, while the conditional mean value will be affected by these observations. Consequently, in a quantile regression, it makes no difference whether the additional earnings of the highest earner in the financial sector is 100 per cent or, for example, 200 per cent, which is not the case for an OLS estimation.

Quantile regression requires that a linear programming problem be solved, since there is no closed solution as in the case of OLS. Therefore, this method is very computation-intensive, especially when the sample size and the number of explanatory variables are as large as in this study. For the same reason, individual fixed effects are not included in the quantile regressions in this section; moreover, inclusion of fixed effects in quantile regressions involves a number of methodological difficulties, cf. Bache et al. (2013).

For a relatively easy introduction to quantile regression, cf. Koenker and Hallock (2001).

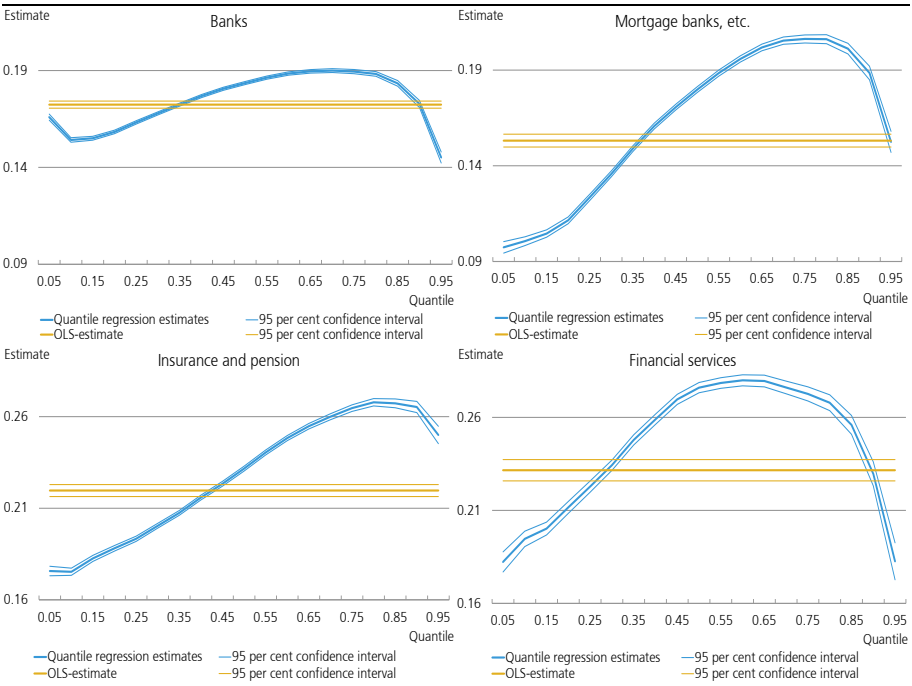
[1] The median, i.e. the observation where exactly half of the observations are above the median and the other half are below, is an example of a quantile (i.e. the 0.50 quantile).

When adjustment is made for a number of observable characteristics, it turns out that additional earnings in the financial sector are obtained not only by the highest earners, but also by the lower and middle ranges of the earnings distribution, cf. Chart 5.8. Moreover, additional earnings tend to be higher at the range between the median and the 0.75 quantile, while they are slightly lower at the top and bottom of the earnings distribution.

When regression analyses are conducted separately for various professional groups, it is confirmed that estimated additional earnings in the financial sector are not due only to high earnings among highly-educated specialists, cf. Table 5.5. The group of vocationally trained employees is particularly relevant, since it accounts for by far the largest professional group in the financial sector, especially in the banks as already illustrated in Chart 5.4.

Looking at the financial sector as a whole, there are no immediate signs that the sector's additional earnings are important in terms of job mobility in and out of the sector, cf. Box 5.5. However, a more detailed industry breakdown indicates that, for banks, job mobility is lower than in other industries both inside and outside the financial sector.

QUANTILE REGRESSIONS, 2000-2010 Chart 5.8



Note: The charts show the results of quantile regressions for each of the quantiles 0.05 ; 0.10 ; ... ; 0.95. Regressions include a number of additional explanatory variables, cf. Box 5.1.

Source: Statistics Denmark and own calculations.

ADDITIONAL EARNINGS FOR VARIOUS PROFESSIONAL GROUPS – COMPARISON OF POOLED OLS AND FIXED EFFECTS FOR 2000-2010 Table 5.5

	Low-skilled employees		Vocationally trained employees		Highly educated employees	
Parameter estimate	OLS	FE	OLS	FE	OLS	FE
Bank employee	0.124	0.068	0.182	0.125	0.194	0.127
	(0.003)	(0.003)	(0.001)	(0.003)	(0.002)	(0.003)
Mortgage bank, etc. employee	0.113	0.044	0.183	0.075	0.163	0.049
	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Insurance and pension	0.219	0.081	0.242	0.127	0.219	0.092
Employee	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)
Financial service employee	0.251	0.063	0.280	0.075	0.192	0.078
	(0.006)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
No. of obs. (thousands)	5,426	5,426	6,607	6,607	5,869	5,869

Note: OLS is Pooled OLS estimations, while FE is fixed-effects estimations. Low-skilled employees are persons who have completed only primary and lower secondary or upper secondary education, while highly educated employees have completed short-cycle, medium-cycle or long-cycle education programmes. The left-hand-side variable is the natural logarithm for earnings per hour worked from the Services Register of the Earnings Statistics and regressions include a number of additional explanatory variables, cf. Box 5.1, not including, however, gender and immigrant background for fixed effects. For Pooled OLS, standard errors have been clustered at individual level in parentheses, while, for fixed effects, robust standard errors are reported in parentheses.

Source: Statistics Denmark and own calculations.

CHANGE OF INDUSTRY AND JOB MOBILITY Box 5.5

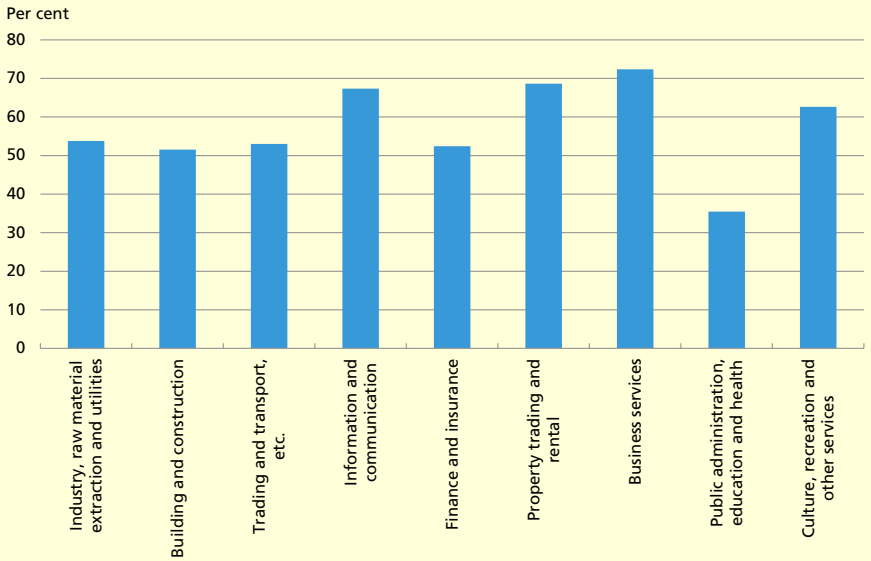
An interesting question is whether additional earnings in the financial sector have any bearing on job mobility. For instance, additional earnings might provide a disincentive for financial sector employees to move to other industries. On the other hand, additional earnings could also reflect that financial sector employees are highly mobile and move to high-earnings locations, putting upward pressure on earnings levels.

When industries are divided into 10 overall main groups, about half of the finance and insurance employees during the period 2000-2010 changed industries – either from another industry to finance and insurance or from finance and insurance to another industry altogether, cf. Chart 5.9.

A more detailed breakdown of industries, i.e. 127 sub-groups as in the analyses so far, reveals relatively large differences between the various sub-industries of the financial sector. There are certain indications that bank employees have less job mobility, since relatively few bank employees were also employed in another industry in the period 2000-2010, cf. Table 5.6. About 18 per cent of employees changing jobs from a bank to another industry change to credit institutions, etc., while approximately 72 per cent change to industries outside the financial sector. Moregage banks, etc. employees, on the other hand, show signs of relatively extensive job mobility, while the rest of the financial sector is more or less in line with other industries – both in terms of additions and departures.

CONTINUED Box 5.5

PERCENTAGE CHANGING INDUSTRIES DURING THE PERIOD 2000-2010 – INDUSTRIES HAVE BEEN BROKEN DOWN INTO 10 MAIN GROUPS Chart 5.9



Note: The chart is based on the data basis for 2000-2010 and, for each main group, shows the percentage of employees who were employed in an industry in this main group, who were also employed in an industry in another main group during the period. Industries are broken down into 10 main groups, only nine of which are displayed, however, since employees in agriculture and fisheries are not included in the Services Register of the Earnings Statistics, cf. Box 5.1. Note that a change of industry is captured only for changes to and from firms, both of which are included in the Services Register of the Earnings Statistics.

Source: Statistics Denmark and own calculations.

PERCENTAGE DISTRIBUTION OF JOB CHANGERS ACROSS INDUSTRIES Table 5.6

	From				
To	Banks	Mortgage banks, etc.	Insurance and pension	Financial services	Other industries
Banks		17.6	7.9	11.9	1.2
Mortgage banks, etc.	18.3		22.3	24.3	1.2
Insurance and pension	6.4	11.9		16.1	0.8
Financial services	3.8	5.1	8.6		0.4
Other industries	71.5	65.4	61.2	47.7	96.4
Total	100.0	100.0	100.0	100.0	100.0
Memo:					
Percentage changing from	25.4	67.5	41.2	46.4	49.4
Percentage changing to	33.5	62.0	49.3	75.3	49.2

Note: The table is based on the data basis for the period 2000-2010. Industries are broken down into 127 subgroups. The lower two rows show the percentage of employees who were employed in the industry during the period who changed from or to, respectively, the industry during the period. Note that a change of industry is captured only for changes to and from firms, both of which are included in the Services Register of the Earnings Statistics.

Source: Statistics Denmark and own calculations.

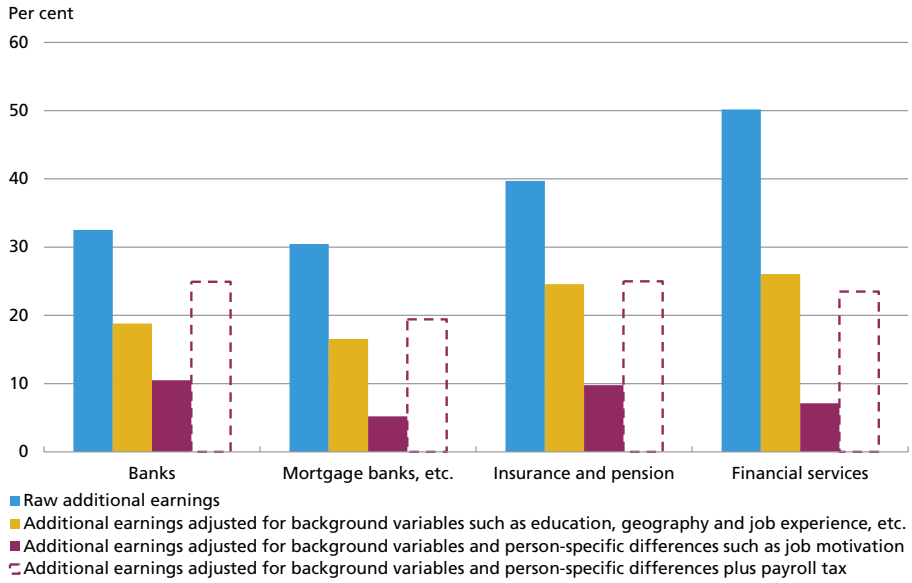
What do additional earnings in the financial sector reflect?

Raw earnings levels show that, since the early 1980s, average earnings in the financial sector have tended to be higher than in the rest of the economy.

The analysis above shows, in summary, that a substantial portion of the earnings differential can be attributed to factors such as differences in education levels, job functions, job experience and geography. For instance, a relatively high percentage of financial sector employees live in the Greater Copenhagen area, where living costs are generally higher than in the rest of the country. The analysis above also indicates that part of the earnings differential is due to other person-specific differences between financial sector employees and employees in other industries, e.g. job motivation.

Allowing for these factors, the earnings level in the Danish financial sector is approximately 5-10 per cent higher than in other industries, cf. Chart 5.10.

FINANCIAL SECTOR ADDITIONAL EARNINGS DURING THE PERIOD 2000-2010 Chart 5.10



Note: Estimates of raw additional earnings are derived from column 1 in Table 5.1. Additional earnings adjusted for background variables are derived from column 5 in Table 5.1, while additional earnings adjusted for background variables and unobservable differences are derived from column 2 in Table 5.2, i.e. incl. individual fixed effects. Parameter estimates, γ, have been converted to per cent as $100[exp(\gamma) - 1]$. Payroll tax has been calculated simplified based on the 2013 level, i.e. 10.9 per cent of the total payroll, shown in the chart as a percentage of earnings per hour worked for an average employee outside the financial sector. Thus the chart disregards that, to some extent, payroll tax is also paid in some industries outside the financial sector.

Source: Statistics Denmark and own calculations.

Since 1988, the Danish financial sector[1] has been subject to a special payroll tax, currently accounting for 10.9 per cent of the payroll. Other things being equal, such payroll tax should contribute to relatively lower earnings in the financial sector than in other industries. Viewed in isolation, the payroll tax provides an incentive for the financial sector to replace labour by, for instance, capital (e.g. through automation of labour-intensive processes).

It should be noted that in the calculations underlying Chart 5.10, only the highest completed, formal public-sector education has been included – not double education degrees or private-sector continuing education. The latter is particularly prevalent in the financial sector, cf. Danish Employers' Association for the Financial Sector (2011). An analysis conducted by the Danish Insurance Association (2008) shows that part of the earnings differential can be attributed to private-sector continuing education in the financial sector.

If job insecurity is higher in the financial sector than in other industries, financial sector employees must, in principle, be expected to demand additional earnings. But, as illustrated by Chart 5.11, the financial sector is not marked by greater fluctuations in employment than most other industries. If both addition and departure numbers are high, small changes in total employment could cover a high employee turnover ratio. There are, however, no indications that employee turnover, measured by additions and departures, is higher in the financial sector than in, say, the sectors covered by agreements with the Confederation of Danish Employers as a whole, cf. Danish Employers' Association for the Financial Sector (2012) and Confederation of Danish Industry (2012). Moreover, on average, unemployment rates for financial sector employees are lower than for employees in other industries.[2]

Unpaid overtime could be another explanation. If employees performed more unpaid overtime work than employees in other industries, calculated relative hourly earnings in the financial sector would be overestimated – at least if such work was not reported to Statistics Denmark. However, no evidence has been found that unpaid overtime is especially prevalent in the financial sector.

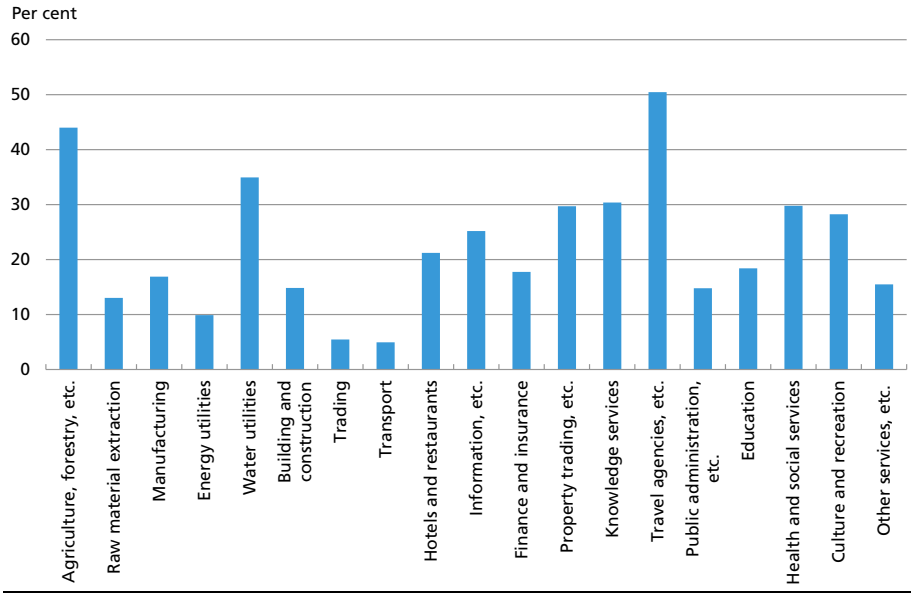
Furthermore, financial sector employees could, for instance, have obtained higher marks in their qualifying examinations, which some indications seem to support, cf. Danish Bankers Association (2008). But when adjustment is made for time-invariant individual heterogeneity, this

[1] Few other countries have similar taxes. For many years, France has had *taxe sur les salaires*, while the UK introduced a kind of payroll tax in 2010, but only on bonuses of some size.

[2] The annual average unemployment rate for financial sector employees was between 0.6 and 1.1 per cent in the period 2000-2010 compared with an average of 2.3 per cent across all industries.

THE COEFFICIENT OF VARIATION FOR TOTAL EMPLOYMENT 1966-2012 ACROSS INDUSTRIES

Chart 5.11



Note: The coefficient of variation shows the relationship between the standard deviation and the mean value.
Source: Statistics Denmark and own calculations.

explanation is partly disproved, since the marks obtained are constant over time, unless the individual engages in continuing education.

However, other factors point in the opposite direction. For instance, the hourly earnings variables used in the analysis do not include fringe benefits that are prevalent in the financial sector, such as attractive staff loans, etc.

In general, a relatively high level of earnings should be based on relatively high productivity and earnings capacity. Box 5.6 examines the relationship between earnings and the income-to-cost ratio of Danish banks. The analysis shows that additional earnings are higher in banks with a high income-to-cost ratio. This indicates that part of the additional earnings in the banking sector is due to (unobservable) differences between banks.[1] For example, some banks may be better than others at promoting cooperation and synergies between employees, which is reflected in a better bottom line. Ultimately, this is also to the benefit of employees through higher labour earnings.

Potential competition is important as a mechanism for ensuring that additional earnings that are not based on higher corporate earnings and productivity are ironed out over time.

[1] Sørensen and Vejlin (2014) find that 14 per cent of the earnings variation in Denmark is due to unobservable (time-invariant) differences between firms.

RELATIONSHIP BETWEEN EARNINGS AND COST-EFFICIENCY Box 5.6

This box examines whether, for banks, a relationship exists between cost-efficiency (measured by the income-to-cost ratio) and employee earnings.

Data for this sub-analysis has been derived by integrating data from Statistics Denmark's registers, cf. Box 5.1, with bank financial ratios, published by the Danish Financial Supervisory Authority for the period 2002-2010.

The period saw a statistically significant positive relationship between employee hourly earnings and bank income-to-cost ratios, both adjusted for observable differences and for individual heterogeneity, cf. Table 5.7. Hence additional earnings are higher in banks with high income-to-cost ratios. This indicates that part of the additional earnings is due to unobservable heterogeneity both among employees and among banks – heterogeneity that is not eliminated by inclusion of individual fixed effects.

RELATIONSHIP BETWEEN EARNINGS AND INCOME-TO-COST RATIO 2002-2010 Table 5.7

Parameter estimate	Pooled OLS	Fixed effects
Income-to-cost ratio	0.023	0.014
	(0.002)	(0.001)
No. of observations	344,511	344,511

Note: The left-hand-side variable is the natural logarithm for earnings per hour worked from the Services Register of the Earnings Statistics and regressions include a number of additional explanatory variables, cf. Box 5.1, not including, however, gender and immigrant background for fixed effects. For Pooled OLS, standard errors have been clustered at individual level in parentheses, while, for fixed effects, robust standard errors are reported in parentheses.

Source: Statistics Denmark, Danish Financial Supervisory Authority and own calculations.

For a small, open economy like Denmark, potential foreign competition is particularly important. Looking at the banking sector, most foreign banks in Denmark have a parent company in another Nordic country. The explanation is that the Nordic region is relatively homogenous in terms of culture, languages, legislation, traditions and product ranges. Conversely, such "entry barriers" could make it difficult for banks from other European countries to enter the Danish market and gain a foothold in Denmark, which has also opted out of the euro. Viewed in isolation, this weakens potential competition, which is key in a highly regulated sector such as finance.

Comparisons with foreign studies show that estimated earnings differentials between the financial sector and other industries in Denmark are roughly in line with those abroad, cf. Carruth, Collier and Dickerson

(2004), Björklund et al. (2007) Philippon and Reshef (2012) and Célérier and Vallée (2013). The economic literature provides a number of other explanations of why earnings levels in certain industries, e.g. the financial sector, may be higher than those of other industries for a number of years.

Some explanations could be that an industry has an ownership structure, e.g. dispersed ownership (for instance due to employee shares, shares associated with customer loyalty programmes and guarantor certificates), ownership or voting right restrictions, etc. that could dampen active ownership pressure to improve cost-efficiency, cf. Black and Strahan (2001). As a case in point, under dispersed ownership, owners may find it difficult to coordinate their wishes for efficient cost control. In a Danish context, other examples are financial enterprises owned by associations and foundations, which may lead to similar corporate governance issues in relation to cost control, cf. Andersen (1999).

It is a well-known fact that a high concentration of firms in the same industry, e.g. the IT or pharmaceutical industries, in a limited geographical area can generate positive externalities, which may lead to high corporate earnings and well-paid jobs. For instance, global financial hubs such as London or New York provide the basis for offering highly specialised, private continuing education courses that are open to individual firms. Outside these hubs, there is no basis for providing education offers to the same extent or of the same high quality. A high concentration of firms in the same industry also attracts highly educated, specialised labour, which cannot be utilised as efficiently – and paying the same high earnings – in less specialised firms outside the hub. A number of these factors may also apply to a regional financial hub such as Copenhagen, cf. Oxford Research (2009).

Additional earnings in the financial sector could also reflect growing demand for more specialised labour, e.g. as a result of increased focus on risk management and demand for more complex financial products and advisory services, cf. Philippon and Reshef (2012). Growing demand for specialists could have had a knock-on effect on other earnings in the financial sector.

Additional earnings in the financial sector may also reflect an element of "efficiency earnings", cf. Shapiro and Stiglitz (1984) and Lindbeck and Snower (1986). By paying earnings above the market level, an employer is able to attract and retain the best talents. This may be particularly important in an industry with specialised labour and a high element of job-specific competencies and may help to ex-

plain additional earnings in the financial sector, provided these factors are more prevalent in this sector than in other industries.

6. THE RELATIVE PRODUCTIVITY IN THE BANKING SECTOR AT BANK LEVEL

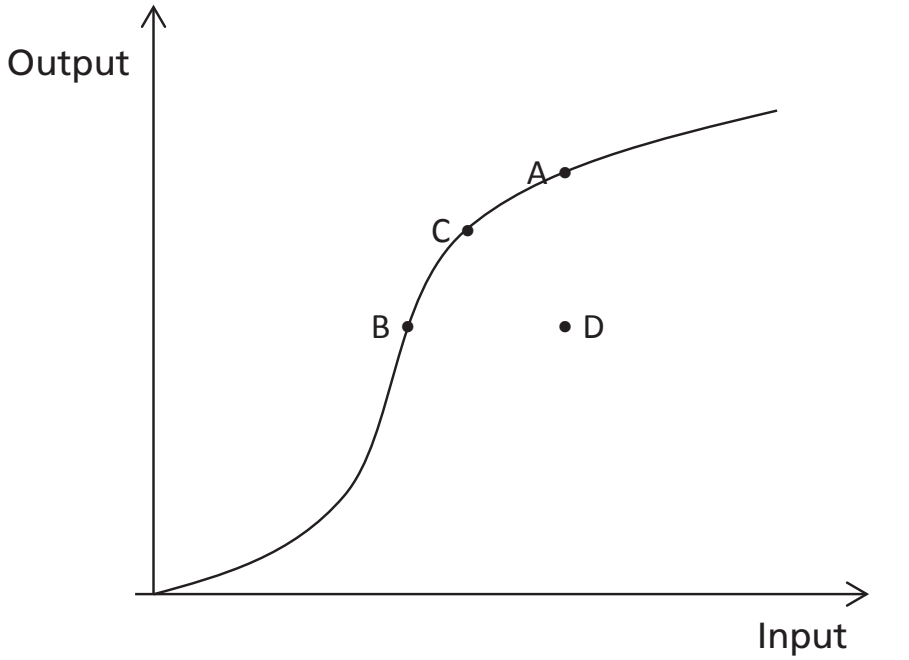
A comparison of the productivity and cost-efficiency of individual banks may be assessed based on an efficient frontier analysis, cf. Bukh (1996). The mindset behind this approach is a comparison of a number of financial ratios of individual banks' inputs (e.g. number of employees or costs) and outputs (e.g. corporate earnings, profit or total lending). The efficient frontier consists of banks that produce the most output with a given set of inputs.

This may be shown by Chart 6.1, in which banks that operate on the efficient frontier are illustrated by points A, B and C. Other things being equal, banks that are not on the efficient frontier would either be able to produce their current output with fewer inputs or produce more output with the same inputs if they were as efficient as the banks operating on the efficient frontier. This is illustrated by bank D in Chart 6.1, which, using the same inputs, would be able to produce more output, equivalent to bank A, if it were operating on the efficient frontier. Alternatively, bank D would be able to produce its current output with fewer inputs, equivalent to bank B, if it were operating on the efficient frontier. Finally, a combination of the two options could produce output equivalent to bank C.

Although, in principle, the mindset behind this analysis is relatively simple, in practice it may be difficult to identify the most appropriate indicators of input and output. For instance, it needs to be decided whether to base the analysis on financial ratios of a single year, which may be affected by random variability to a greater or lesser extent, or whether to include ratios for a number of years. Changes in accounting rules, as well as mergers, acquisitions and formation of financial groups may also render it difficult to assess bank efficiency performance over time.

In comparisons of banks from various countries, differences in accounting rules may play a role and cyclical variations may also impact performance results. Moreover, financial structures may differ from one country to another.

ILLUSTRATION OF THE EFFICIENT FRONTIER Chart 6.1



Note: The development of the efficient frontier in this chart should not be taken as an indication of whether, in practice, economies or diseconomies of scale exist in the operation of banks. The chart should be seen only as an illustration.

The Danish mortgage banking system makes it difficult to compare the Danish banking sector directly with those of other countries. Therefore, it may be argued that data should be applied on a consolidated basis in comparisons of Danish banks with their foreign counterparts.

At the technical level, a variety of methods are available for constructing the efficient frontier consisting of the most efficient banks, and each method has its strengths and weaknesses.

Berger and Humphrey (1997) conducted a summary analysis of 122 international bank efficiency studies based on the efficient frontier approach. These studies were originally published in the period 1987-1997, and studies focusing on US banks accounted for 66 of the 122 studies, while studies focusing on banks from 20 other countries, primarily European ones, accounted for the rest. The analysis indicates that Norwegian banks experienced improved productivity after the deregulation in the 1980s, while banking efficiency in the US and Spain was unchanged. Similarly, the stock-market crash in Japan in the early 1990s had no ef-

fect on the efficiency of Japanese banks. Berger and Humphrey, *op. cit.*, also conclude that the ranking of individual banks by their efficiency value may be sensitive both to the method used in the calculation of the efficient frontier and the definition of inputs and outputs. Overall, the review of the numerous studies indicated that, in the 1980s and 1990s, the banking sector had potential for further efficiency gains.

Bukh (1995) conducted a study of the relative efficiency of Danish banks in 1990, using the efficient frontier approach. Financial data for lending, deposits and certain types of fee income was used as indicators of output, while operating costs were used as input. Losses were treated either as a negative output or as an input to allow for the quality of lending. Results indicated wide dispersion of banking efficiency scores.

The analysis in Bukh (1995) comprised Danish banks only and did not include comparable banks from other countries. Berg et al. (1995) performed an analysis of the relative efficiency of Nordic banks in 1990, using the efficient frontier approach. This analysis showed that Danish and Swedish banks were operating on the efficient frontier to a greater extent than banks in Norway and Finland. The analysis calculations also showed that large Danish and Swedish banks were efficient in a Nordic context, while this was not the case for most large Norwegian and Finnish banks.

This section performs an analysis of the relative efficiency of Danish banks before and after the latest financial crisis. The analysis is based on the two most commonly used methods of efficiency analysis: Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA). Both methods can be used to benchmark the performance of individual banks relative to the efficient frontier. The model used and the choices made are described in Box 6.1.

It should be emphasised that these methods are used to assess the relative efficiency of banks relative to other banks and the development in efficiency. The methods cannot be used to assess the development in absolute efficiency. In principle, the relative distance of a bank to the most efficient banks could narrow other time, and, at the same time, the most efficient banks could experience an absolute decrease in efficiency.

As described in the box, the model calculations provide an indicator (the relative efficiency score) per bank per year. The efficiency score is a measure of the bank's technical efficiency relative to the estimated efficient frontier.

MODELS FOR THE RELATIVE PRODUCTIVITY OF INDIVIDUAL BANKS Box 6.1

To assess developments in the productivity of individual banks over the last decade, economic literature's two most widely used methods for efficiency analysis, i.e. Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA), are used. Both methods can be used to benchmark individual banks by calculating the distance between the bank's current combination of inputs and outputs and the efficient frontier, presenting, in stylised form, the optimal combination of inputs and outputs (see Chart 6.1).

The difference between DEA and SFA is in the calculation of the efficient frontier. DEA is a non-parametric, linear programming technique, where the point of departure is a conservative approach to the specification of the efficient frontier based on observed combinations of inputs and outputs. In practice, the efficient frontier is found as linear combinations of actually observed combinations of inputs and outputs, and the most efficient banks in various size groups will tend to be seen as fully efficient. SFA, on the other hand, is a parametric technique rooted in econometric theory. In SFA, the efficient frontier is estimated econometrically as a function of observed combinations of inputs and outputs. The advantage of SFA over DEA is that SFA allows that part of the variation in inputs and outputs may be due to random fluctuations or measurement errors, while DEA attributes the entire variation to differences in efficiency. The drawback, on the other hand, is that SFA requires specification of a functional form of the econometric model, while DEA is based exclusively on linear combinations of data.

A number of choices have to be made in the model specification for both DEA and SFA. These models are described further in Kuchler (2013), which also contains detailed results. In DEA, one of the major decisions is the returns to scale assumption. Often, either constant or variable returns to scale are assumed. The variable returns to scale assumption is the most natural, since the degree of economies or diseconomies of scale in banking operations is not clear. The variable returns to scale assumption also makes DEA results more robust to measurement errors and misspecification of the model. However, the variable returns to scale assumption means that most large banks are assessed as fully efficient, given that there are few other banks of the same size. As described above, the major choice in terms of SFA is the choice of functional form of the econometric model. The SFA model in this analysis is based on a translogarithmic distance function, which is a relatively flexible functional form.

The construction of banking efficiency models is complicated by the fact that banks produce a number of different services which are not necessarily settled directly with customers. Some of the services offered by banks are covered by the interest margin. It may be difficult to assess the dimensions that are to be regarded as inputs and outputs, respectively. An example that has attracted particular attention in the economic literature is deposits. Deposits may both be seen as an input (funding to the bank) and as an output (services to customers). More generally, a distinction is often made between the production approach and the intermediation approach. Under the production approach, banks are seen as providers of a number of services, such as financial transactions and deposits and lending. Accordingly, relevant outputs could be the number of accounts, number of transfers and, possibly, total deposits and lending.

CONTINUED Box 6.1

Under the intermediation approach, banks are seen more as intermediaries of financial services – "go-betweens" – and, therefore, relevant outputs are e.g. total lending and the bank's investments in bonds and shares.

The following variables are used in the analysis:

Inputs:

- Staff costs and administrative expenses
- Interest expenditure
- Depreciation, amortisation and impairment of intangible and tangible assets

Outputs:

- Interest income
- Fee and commission income
- Total lending
- Bonds and shares.

Specially-treated variable:

- Total deposits

Acknowledging the dispute in the economic literature about the significance of deposits, models are therefore estimated both with deposits as inputs and as outputs. In the models, no allowance is made for losses and impairment – primarily because losses and impairment are realised with a lag. Attempts have been made to examine the effect of losses and impairment in a sensitivity analysis, but such analysis is methodologically difficult.

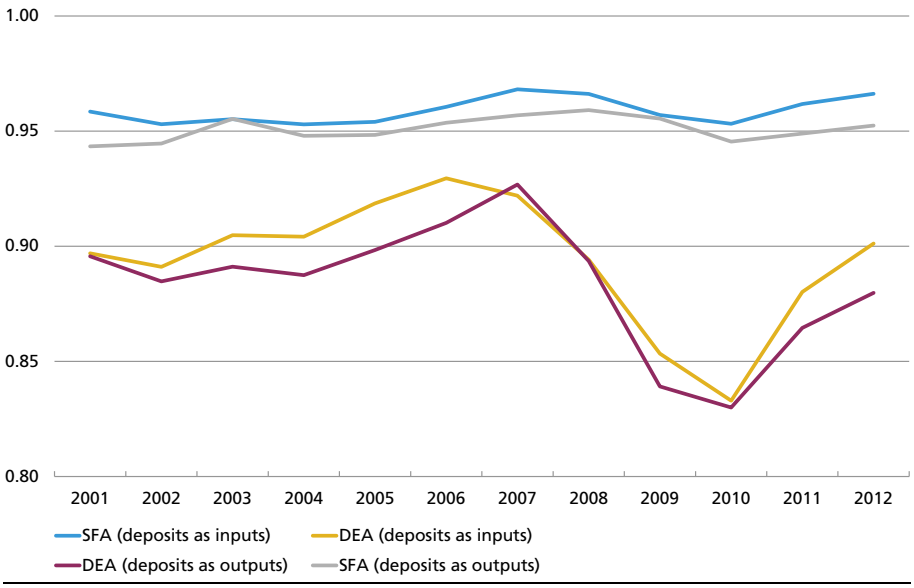
The model calculations provide a relative efficiency score for each bank. In one figure, the efficiency score expresses the bank's efficiency relative to the point on the efficient frontier that is "closest" to the bank, which for each construction is in the range of 0 to 1.

The analysis is based on estimation of an efficient frontier for each year to ensure that banks are compared with other banks at the same time. This may be important, since cyclical patterns and rules and practices may vary over time. A consistency check has been performed by using models in which the efficient frontier is based on the overall data set irrespective of the observation year. Results are roughly similar to the results presented here, although the exact timing of the developments found varies.

Chart 6.2 shows the average relative efficiency score of the Danish banking sector estimated by DEA and SFA in the period 2001-2012. Levels and sizes of fluctuations for DEA and SFA vary, which may be attributed to the methods used to calculate the efficient frontier and, therefore, should not be given significance in comparisons. However, the performance over time is comparable across methods. The precise timing of fluctuations in the curves varies slightly across the four combinations of methods and specifications, but the overall performance is comparable.

AVERAGE EFFICIENCY SCORE IN THE DANISH BANKING SECTOR, ESTIMATED USING DEA AND SFA

Chart 6.2



Note: Differences in levels and fluctuation sizes are attributable to methodological differences.
Source: Own calculations based on data from the Danish Financial Supervisory Authority.

In the run-up to the financial crisis (2004-2007), the average efficiency score increased, while it decreased during the crisis years 2008-2010.[1] The latter should be seen in the context of weaker output growth, while inputs were not adjusted to new, lower output levels at the same pace in all banks. In recent years (2011-2012), the average relative efficiency score has increased again, presumably reflecting that many banks are adjusting inputs to the lower level of output. General consolidation in the sector has also contributed to a higher average relative efficiency score.

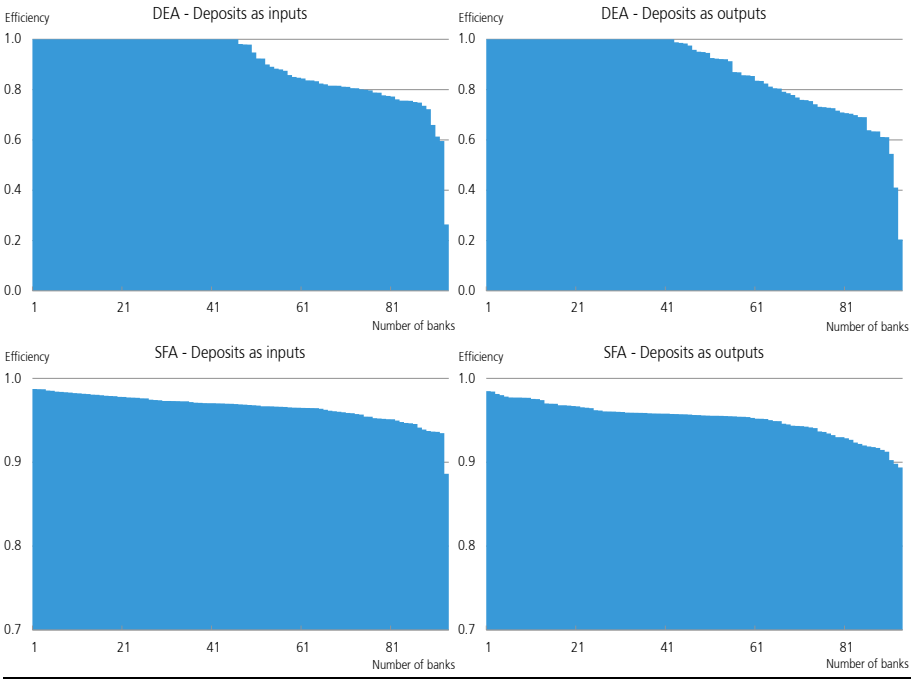
[1] In general, studies on financial sector efficiency find that banking efficiency increases in periods of rapidly rising output, such as the period leading up to the financial crisis, cf. Martín-Oliver et al. (2013). One reason is that banks produce more loans per cost-to-income ratio in economic upswings. However, it may be debated whether efficiency estimates should be adjusted for the quality of loans, which would be useful if the aim is to analyse financial stability. Methods for such adjustment are still not well-developed. Against this backdrop, Kuchler (2013) constructs a model to adjust pre-crisis bank lending based on the impairment losses recorded by individual banks during the crisis. In such models, impairment losses are regarded as undesired output. The distribution of efficiency scores based on lending adjusted for impairment losses during the crisis does not deviate substantially from the distribution that does not allow for impairment losses. Presumably, part of the explanation is that this analysis can be performed only for banks existing during the crisis and for which impairment losses can be recorded. Thus banks that failed during the crisis are underrepresented in the analysis, which adjusts for impairment losses during the crisis, and since these banks would probably be assessed as being less efficient, the non-inclusion of these banks presumably explains the absence of distribution differences.

The average relative efficiency score is a frequently used measure in comparisons of results from relative efficiency studies. However, the average may reflect variations in underlying developments, and, therefore, it may be useful also to consider the distribution across banks. Although the average efficiency score has increased in recent years, the variation in relative efficiency across banks still exists, cf. Chart 6.3. This means that, in terms of efficiency, certain banks are some distance away from the most efficient Danish banks.

Model calculations also show that 23 per cent of Danish banks are in the least efficient half of the population in all four model specifications for 2012, and 35 per cent are in the least efficient half in at least three out of the four specifications. These groups of banks are primarily small banks in the Danish Financial Supervisory Authority's groups 3 and 4.

In order to examine whether banks that are assessed as efficient in the model calculations share special characteristics, a supplementary analysis has been performed of the factors that are correlated with relative efficiency, cf. Kuchler (2013).

DISTRIBUTION OF EFFICIENCY IN 2012, ESTIMATED USING DEA AND SFA — Chart 6.3



Note: The charts show the distribution of efficiency, estimated using DEA and SFA. The charts are based on all banks in 2012, ranked by efficiency score.

Source: Own calculations based on data from the Danish Financial Supervisory Authority.

Before the crisis, large banks tended to be more efficient than small ones. There were also indications that better capitalised banks and banks focusing less on corporate customers were more efficient.

Most of these results do not apply to calculations related to the post-crisis period. A possible interpretation is that the increase in the average efficiency score seen over the last few years has wiped out some of the differences between particular types of banks. Moreover, general consolidation in the sector has contributed to making banks more homogeneous.

The significance of the consolidation in the sector is also evidenced in the fact that banks that either failed or were acquired by other banks in the period after 2008 were, on average, less efficient at the time of acquisition than the surviving banks, cf. Chart 6.4. This result is consistent across all four methods and specifications.[1] In other words, the consolidation in the sector has contributed to the increase in average efficiency seen over the last few years, cf. Chart 6.2. Furthermore, a supplementary analysis of banks that were acquired by the Financial Stability Company during and after the crisis shows that, in terms of efficiency, these banks did not deviate substantially from other banks before the crisis. Thus the pre-crisis increase in average efficiency was not driven by a few high-risk banks.

In principle, the results presented so far can be seen only as an indication of relative efficiency in the Danish banking sector. In order to assess the efficiency of the largest Danish banks in an international context, a supplementary analysis has been performed, using data from 2012, which covers 203 banks in EU 15, along with Norway and Switzerland. The variables included in the analysis are defined slightly differently from the analysis based on Danish figures, cf. Box 6.2. Moreover, data at consolidated level is used to ensure that the special Danish mortgage banking system is also reflected in the analysis. A total of 15 Danish institutions are included in the analysis.[2]

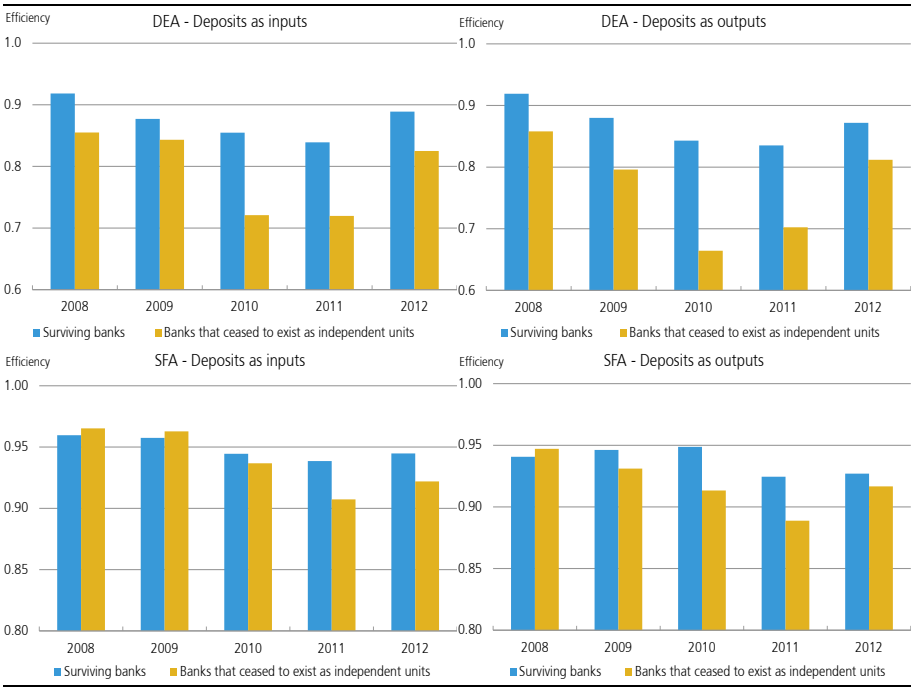
Results of an international benchmarking analysis like this one should be seen as indicative only, since cyclical variability, differences in framework conditions and a number of other factors that are beyond the control of banks may influence results. Due to the relatively large

[1] Except for the SFA models in 2008. The reason could be that results for banks which were discontinued in 2008 refer to efficiency in 2007, i.e. before the outbreak of the financial crisis in Denmark.

[2] Three of the largest banks from the Danish Financial Supervisory Authority's group 1 (as the analysis uses consolidated data, the last two group 1 banks have been consolidated into their parent company's accounts), five medium-sized banks from group 2, four of the largest banks from group 3 and three mortgage banks.

EFFICIENCY OF BANKS THAT WERE DISCONTINUED DURING AND AFTER THE CRISIS

Chart 6.4



Note: The chart shows the average efficiency of banks that are discontinued in a given year, and the average efficiency of banks that were continued. For example, results for 2008 refer to banks that were discontinued in 2008, while efficiency is based on data from 2007.

Source: Own calculations based on data from the Danish Financial Supervisory Authority.

variation in the number of banks in individual countries, results here are reported only for groups of countries. As in the previous analysis of Danish banks, both DEA and SFA are used. Furthermore, two versions of each model are estimated: one in which deposits are regarded as an input and one in which deposits are regarded as an output.

There are no indications that the largest Danish banks are, on average, less efficient that their European counterparts, cf. Chart 6.5. The average relative efficiency score estimated by DEA is higher in Denmark than in the other groups of countries, while the average relative efficiency score estimated by SFA is largely the same across country groups. The reason could be that the analysis has been performed on a consolidated basis, since mortgage banks produce a relatively high output per unit of input. In the DEA models, this is attributed solely to increased efficiency, while the stochastic element of the SFA model probably captures part of this difference and, consequently, the efficiency difference is estimated to be smaller in SFA than in DEA.

INTERNATIONAL COMPARISON OF BANK PRODUCTIVITY Box 6.2

The international benchmarking analysis is based on data from 2012 from a total of 203 banks domiciled in EU 15, Switzerland and Norway. Data used in the analysis has been derived from the banks' annual reports as compiled in the SNL database.[1] All banks included in the SNL database are included where data is available. The models use the following variables:

Inputs:

- Interest expenditure
- Number of employees

Outputs:

- Interest income
- Operating income
- Total lending
- Bonds and shares

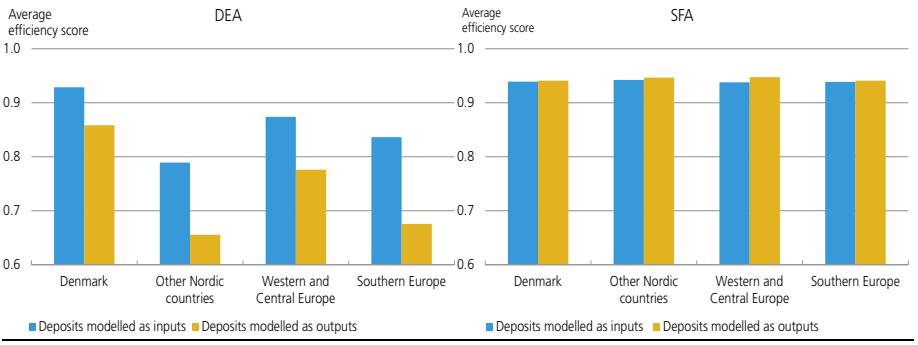
Specially treated variable:

- Total deposits

The international comparison uses consolidated data, while the earlier analysis of Danish banks used bank data from the accounts statistics of the Danish Financial Supervisory Authority. This means that Danish banks that are part of a foreign group are not included in the Danish data in this part of the analysis. Moreover, the analysis has been conducted only for banks with total assets exceeding EUR 1 billion to ensure international comparability based on size. The main criterion for inclusion in the SNL database is that the bank is listed, entailing that the number of banks varies considerably from one country to the next.

[1] See www.snl.com for more information. SNL is a private provider of financial data.

AVERAGE EFFICIENCY SCORE IN DENMARK AND ABROAD Chart 6.5

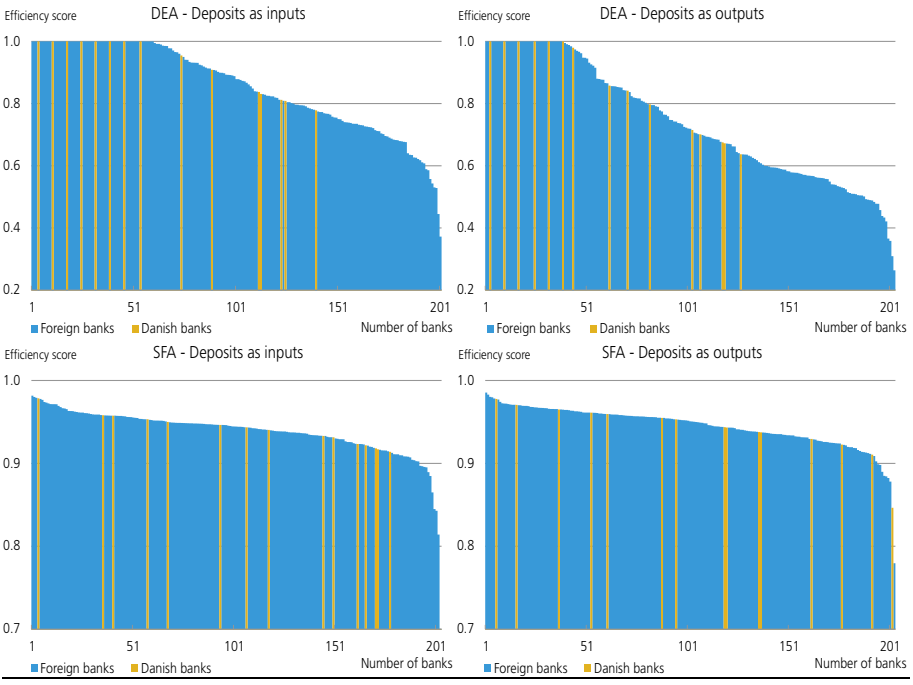


Note: Other Nordic countries are Finland, Norway and Sweden. Western and Central Europe comprise Belgium, France, the Netherlands, Ireland, Luxembourg, the UK, Switzerland, Germany and Austria. Southern Europe comprises Greece, Italy, Portugal and Spain. Consolidated basis.

Source: Own calculations based on data from the SNL database.

Just as in the analysis based on Danish data, the average efficiency score reflects wide dispersion. Moreover, the two methods do not give exactly the same ranking to banks. The dispersion of efficiency across all banks included in the sample is illustrated in Chart 6.6. Calculations indicate that some Danish banks are fully able to match the efficiency score of the most efficient foreign banks. But calculations also indicate that, in terms of efficiency, a number of Danish banks are some distance away from the most efficient Danish and foreign banks.

DISTRIBUTION OF EFFICIENCY IN 2012 – DANISH AND FOREIGN BANKS Chart 6.6



Note: The charts are based on 203 European banks in 2012, ranked by efficiency score.
Source: Own calculations based on data from the SNL database. Consolidated basis.

7. FINANCIAL SECTOR SIZE, ECONOMIC PROSPERITY AND GROWTH

As mentioned in section 2, historically financial sector total assets as a percentage of GDP have expanded considerably. This trend has been evidenced not just in Denmark, but also in other countries. The question is whether there is a causal link from the size of a country's financial

sector to its GDP, or whether the causality is reversed, entailing that a higher GDP prompts the need for a larger financial sector, cf. Levine (1997).

In several ways, it could be argued that financial development has a positive effect on economic growth. A financial sector can bring savers and investors together, thereby reducing transaction costs and ensuring that more investments obtain funding. The financial sector also facilitates risk diversification, which reduces funding costs and promotes investment. At a more general level, the financial sector's payment solutions help to support a large volume of transactions in a dynamic market economy.

King and Levine (1993) have conducted an analysis of the relationship between various measures of the size of the financial sector and economic prosperity and growth, based on 80 countries in the period 1960-1989. This analysis finds a significant relationship between financial sector size and the level of income measured by real per capita GDP. The analysis also finds a strong, positive relationship between financial sector size and per capita economic growth. To illuminate the question of whether economic growth follows financial development – or vice versa – the relationship between the size of the financial sector in 1960 and the next 30 years of economic growth is also examined. Indications are found that the size of the financial sector in 1960 had a significantly positive effect on the growth in labour productivity and real per capita GDP in the subsequent decades – even adjusted for a number of other variables[1] that are normally assumed to be important to economic growth.

But it could also be argued that there is a limit to the positive effect of financial development on economic growth. Thus the negative effects of systemic banking crises may increase with the size of the financial sector in the economy. A large financial sector will also attract many resources, e.g. competent employees, at the expense of resources to other corporate sectors.

Andersen (2001) has conducted an empirical analysis of the relationship between financial development and economic growth in South Korea, India and Thailand in the period 1953-97. This analysis does not find any causal effect from the degree of financial development measured by the money supply or credit relative to GDP and economic growth.

[1] King and Levine (1993) adjust for the following variables: initial income level, initial education level, public consumption as a percentage of GDP, inflation and the openness of the economy measured by imports and exports as a percentage of GDP.

A recent study was conducted by Cecchetti and Kharroubi (2012) on the relationship between the size and growth of the financial sector, on the one hand, and economic growth per employee, on the other, during the period 1980-2009. The analysis of financial sector size covers 50 advanced and emerging market economies. The conclusion is that an increase in financial sector size is good for economic growth – but only up to a point. As long as the financial sector represents a small share of the economy, an increase in sector size will have a positive impact on productivity growth through the sector's contribution to lower transactions costs and more efficient allocation of capital and risk. If the financial sector becomes too large, it draws in too many resources that could have been employed more productively elsewhere in the economy. If the size of the financial sector is measured in terms of private credit, the turning point for the "optimal" size of the financial sector is estimated to be at the point where private credit exceeds GDP.

The same result is found by Arcand et al. (2012), using more sophisticated econometric methods and a different data basis.

Based on a more limited sample of countries (21 OECD economies), Cecchetti and Kharroubi (2012) also estimate the turning point for economic growth when the size of the financial sector is measured in terms of employment. The turning point is found to be when the financial sector represents more than 3.5 per cent of total employment in the economy. Specifically, Cecchetti and Kharroubi, *op. cit.*, also find that in a country where financial sector employment grows at 1.6 percentage points a year, real GDP growth per employee will be about 0.5 percentage points lower than in an economy where the financial sector's share of the economy is stable.

Below, the robustness of conclusions from the above types of analyses is examined.

Data and descriptive statistics

An analysis is conducted of the relationship between the size of the financial sector and real GDP growth per employee. The size of the financial sector is calculated either from the output side as domestic credit to the private, non-financial sector as a percentage of GDP or from the input side as the financial sector's share of total employment, cf. Box 7.1.

As already mentioned, early studies of the relationship between the size of the financial sector and economic growth indicated a positive relationship, while later studies have questioned this relationship. This

DATA Box 7.1

Basically, the same data as in Cecchetti and Kharroubi (2012) is used, but the econometric analysis is more in line with Arcand et al. (2012), cf. Boxes 7.2 and 7.3. Data covers all sub-analyses over the period 1980-2009.

Financial sector size

As there is no single, obvious measure of the size of the financial sector, two separate analyses are performed.

In one analysis, the size of the financial sector is measured from the output side as domestic credit to the private, non-financial sector as a percentage of GDP. The source of this data is the World Bank (Financial Structure and Development Database), and the following 50 countries are included in the analysis: Argentina, Australia, Bangladesh, Belgium, Brazil, Canada, Chile, Colombia, Denmark, Egypt, Estonia (from 1990), the Philippines, Finland, France, Greece, the Netherlands, India, Indonesia, Ireland, Iceland, Italy, Japan, China, Luxembourg, Morocco, Mexico, New Zealand, Nigeria, Norway, Pakistan, Poland, Portugal, Russia (from 1990), Switzerland, Slovakia (from 1987), Slovenia (from 1990), Spain, Sweden, South Africa, Thailand, the Czech Republic (from 1990), Turkey, Germany, the UK, South Korea, Hungary, the USA, Venezuela, Vietnam and Austria.

In the other analysis, the size of the financial sector is measured from the input side as the size of the financial sector, measured by share of total employment. The source of this data is the OECD (Structural Analysis Database), and the following 21 countries are included in the analysis: Australia, Belgium, Canada, Denmark, Finland, France, the Netherlands, Ireland, Italy, Japan, New Zealand, Norway, Portugal, Switzerland, Spain, Sweden, Germany, the UK, South Korea, the USA and Austria.

Left-hand-side variable and background variables

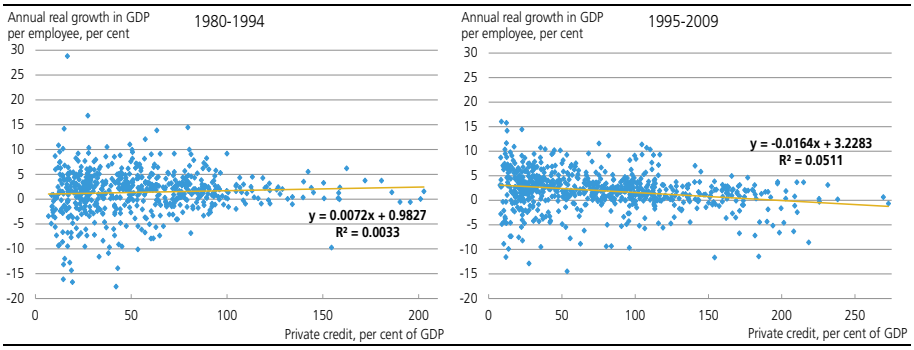
The relevant variable we seek to explain in the analysis (the "left-hand-side variable") is growth in purchasing-power-adjusted GDP at constant prices (chain index) per employee. Adjustment is made for a number of background variables that are likely to affect economic growth, i.e. the initial level of GDP per employee, the openness of the economy measured by the sum of exports and imports as a percentage of GDP, public consumption as a percentage of GDP, consumer price inflation and labour force growth. The source of this data is the Penn World Table – with the exception of public consumption as a percentage of GDP, the source of which is the World Bank.

is confirmed by Chart 7.1, which shows a slightly positive correlation between private credit as a percentage of GDP and real GDP growth per employee for the period 1980-1994 – and a slightly negative relationship for the period 1995-2009.[1]

[1] A recent meta-analysis conducted by Havránek et al. (2013) also indicates that the positive relationship between the size of the financial sector and economic growth has weakened after the 1980s.

CORRELATION BETWEEN REAL GROWTH IN GDP PER EMPLOYEE AND PRIVATE CREDIT

Chart 7.1



Note: For a delineation of the sample, see Box 7.1.
Source: Penn World Table, World Bank and own calculations.

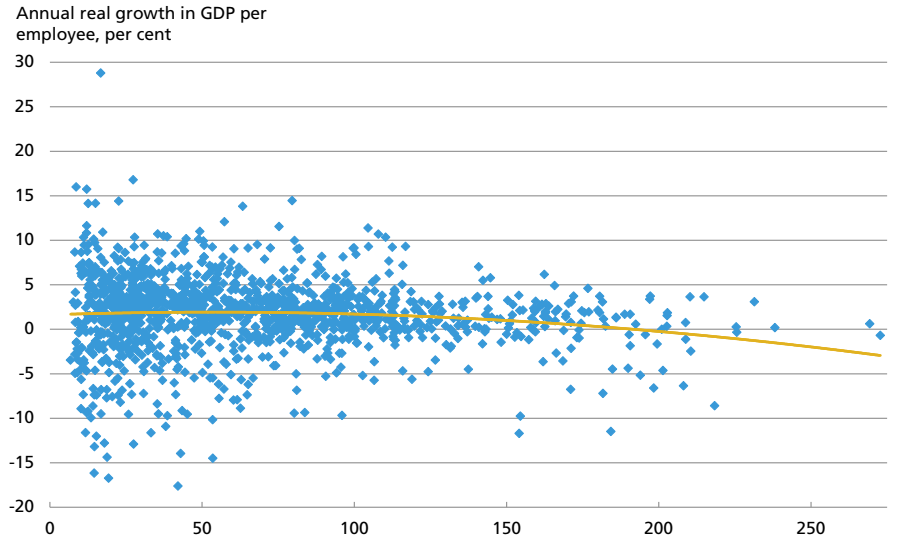
An inverted U-shaped relationship may be seen if the total period 1980-2009 is considered, cf. Chart 7.2. This implies that a larger financial sector (i.e. more private credit) is beneficial to economic growth if the financial sector is already relatively small, but is detrimental to economic growth in countries where the financial sector is already voluminous. But the points are very scattered, entailing rather low explanatory power. This also questions whether it makes any sense to describe the relationship using a simple parabola.

If the financial sector's share of total employment is used as a measure of the size of the financial sector, there are also indications that the relationship between the size of the financial sector and economic growth has changed over time. A slightly negative correlation is seen for the period 1980-1994, while a slightly positive correlation is seen for the period 1995-2009. When employment is used as a measure of the size of the financial sector, the opposite result to using private credit as a measure of the size of the financial sector is observed.

Again, there may be indications of an inverted U-shaped relationship if the total period 1980-2009 is considered, cf. Chart 7.4. But also in this case, the points are very scattered.

However, these correlations should be interpreted with caution, since they have not been adjusted for a number of factors that affect economic growth. In particular, adjustment needs to be made for the initial level of GDP. The reason is that catching-up effects will indicate that an emerging economy in which the financial sector is not very voluminous will experience relatively high economic growth, driven by the possibilities of utilising technological progress achieved by advanced economies. Moreover, there are a number of methodological

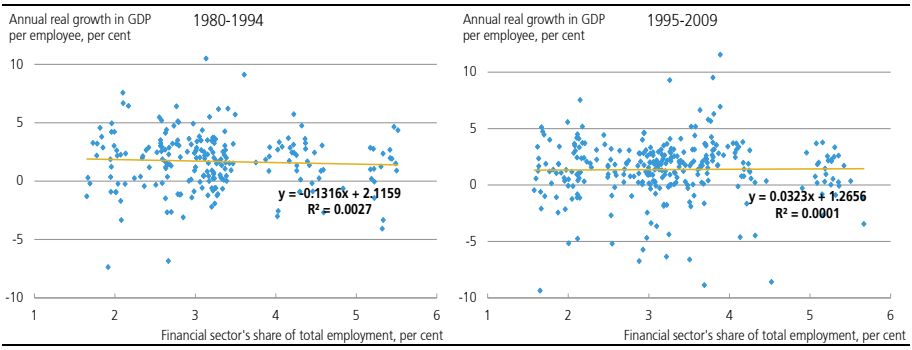
RELATIONSHIP BETWEEN REAL GROWTH IN GDP PER EMPLOYEE AND PRIVATE CREDIT, 1980-2009 Chart 7.2



Note: For a delineation of the sample, see Box 7.1.
Source: Penn World Table, World Bank and own calculations.

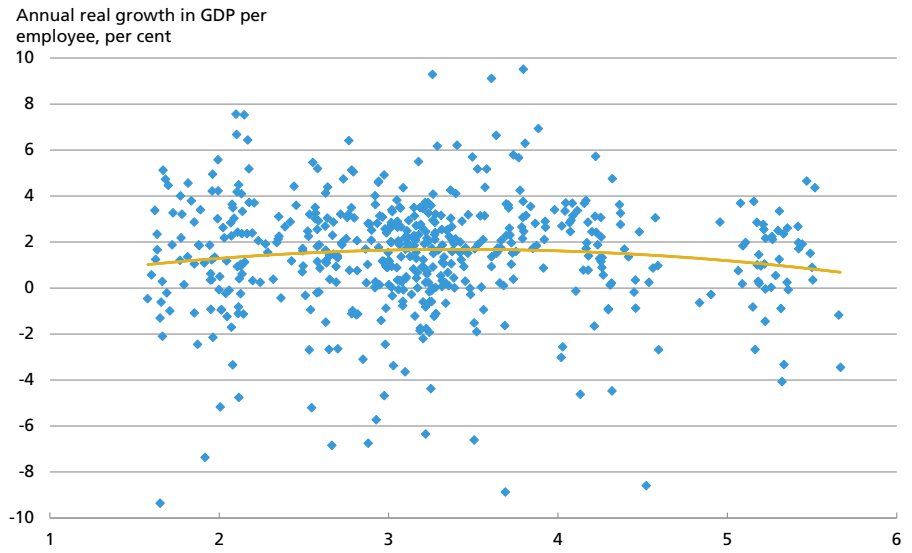
challenges, e.g. endogeneity problems, cf. the discussion earlier of the causal link between the size of the financial sector and economic growth. To further elucidate the relationship, a number of regression analyses will be performed below to address some of the methodological challenges.

CORRELATION BETWEEN REAL GROWTH IN GDP PER EMPLOYEE AND FINANCIAL SECTOR EMPLOYMENT Chart 7.3



Note: For a delineation of the sample, see Box 7.1.
Source: Penn World Table, OECD and own calculations.

CORRELATION BETWEEN REAL GROWTH IN GDP PER EMPLOYEE AND FINANCIAL SECTOR EMPLOYMENT, 1980-2009 Chart 7.4



Note: For a delineation of the sample, see Box 7.1.
Source: Penn World Table, OECD and own calculations.

Results

In the introductory section of the analysis, the method of least squares (OLS) is used, cf. Box 7.2.

The estimated turning point of the relationship between real GDP growth per employee and private credit as a percentage of GDP fluctuates between 87 per cent and 105 per cent, depending on the background variables included, cf. Table 7.1. Furthermore, the calculated 95 per cent confidence intervals show that the accuracy of the estimation is limited. For instance, the interval has been calculated at 56 per cent to 117 per cent in the specification including all background variables. Moreover, in several of the estimations, the coefficients are insignificant.

If, instead, the financial sector's share of total employment is used as the measure of the sector's size, the turning point is calculated at between 3.63 per cent and 3.83 per cent. According to this estimation, countries with a large number of financial sector employees will be able to improve economic growth by reducing the size of the financial sector. Again, the estimate is relatively inaccurate, and the 95 per cent confidence interval in the estimation, including all background variables, is between 3.11 per cent and 4.63 per cent.

PANEL DATA METHOD Box 7.2

Initially, the following regression model is estimated, using the method of least squares (OLS)

$$y_{i|t,t+5} = \beta S_{i,t-1} + \gamma S_{i,t-1}^2 + \boldsymbol{x}_{i,t-1}\boldsymbol{\delta} + \epsilon_{i,t}$$

where $y_{i|t,t+5}$ is the annual average real growth in GDP per employee in country *i* over a five-year period, $S_{i,t-1}$ is the size of the financial sector the previous year (measured by private credit as a percentage of GDP or by the financial sector's share of total employment, cf. Box 7.1), and $\boldsymbol{x}_{i,t-1}$ is a vector of other background variables: the natural logarithm of the initial level of GDP per employee, a measure of the degree of economic openness, public consumption as a percentage of GDP, consumer price inflation and labour force growth.

Thus a positive estimate $\hat{\beta}$ and a negative estimate $\hat{\gamma}$ will indicate that there is a turning point for whether or not a larger financial sector is beneficial for economic growth. The turning point for the size of the financial sector can then be calculated as

$$S = -\hat{\beta}/(2\hat{\gamma})$$

As is typical in the economic literature, five-year[1] average annual growth rates are calculated in non-overlapping intervals, entailing that, since data is used for the period 1980-2009, no more than six observations are included for each country.

[1] Although this is typical in the economic literature, it may be debated whether data should be divided into intervals of longer duration, for example to take into account that the typical business cycle is longer than five years. However, Arcand et al. (2012) find that the result with the inverted U-shaped relationship between economic growth and private credit is robust to using 10-year non-overlapping intervals.

RELATIONSHIP BETWEEN ECONOMIC GROWTH AND PRIVATE CREDIT, OLS Table 7.1

Parameter estimate	(1)	(2)	(3)	(4)	(5)	(6)
Private credit as a percentage of GDP	0.031 (0.017)	0.031 (0.017)	0.025 (0.017)	0.020 (0.015)	0.019 (0.015)	0.024 (0.011)
Private credit as a percentage of GDP, squared	-0.016 (0.008)	-0.017 (0.008)	-0.013 (0.008)	-0.010 (0.007)	-0.009 (0.007)	-0.014 (0.005)
Calculated peak	0.98	0.91	0.98	1.05	1.04	0.87
95 per cent confidence interval	[0.68; 1.29]	[0.58; 1.24]	[0.55; 1.41]	[0.52; 1.58]	[0.50; 1.58]	[0.56; 1.17]
Background variables						
Initial level of GDP	+	+	+	+	+	+
Time dummies	–	+	+	+	+	+
Openness	–	–	+	+	+	+
Public consumption	–	–	–	+	+	+
Consumer price inflation	–	–	–	–	+	+
Labour force growth	–	–	–	–	–	+
No. of observations	259	259	259	249	249	249

Note: The calculated peak denotes the value of *S*, where $\hat{\beta} + 2\hat{\gamma}S = 0$. For a delineation of the sample and elaboration on the variables included, see Box 7.1. Standard errors have been clustered at country level in parentheses.
Source: Penn World Table, World Bank and own calculations.

RELATIONSHIP BETWEEN ECONOMIC GROWTH AND FINANCIAL SECTOR EMPLOYMENT, OLS — Table 7.2

Parameter estimate	(1)	(2)	(3)	(4)	(5)	(6)
Financial sector share of total employment	2.21 (1.11)	1.38 (0.93)	1.40 (0.93)	1.44 (0.94)	1.43 (0.93)	1.43 (0.93)
Financial sector share, squared	-28.79 (14.20)	-18.98 (11.90)	-19.31 (11.93)	-19.63 (11.99)	-19.10 (11.80)	-19.12 (11.74)
Calculated peak (per cent)	3.83	3.63	3.63	3.67	3.74	3.74
95 per cent confidence interval	[3.42; 4.24]	[3.03; 4.22]	[3.05; 4.21]	[3.09; 4.25]	[3.19; 4.28]	[3.11; 4.36]
Background variables						
Initial level of GDP	+	+	+	+	+	+
Time dummies	–	+	+	+	+	+
Openness	–	–	+	+	+	+
Public consumption	–	–	–	+	+	+
Consumer price inflation	–	–	–	–	+	+
Labour force growth	–	–	–	–	–	+
No. of observations	99	99	99	99	99	99

Note: The calculated peak denotes the value of *S*, where $\hat{\beta} + 2\hat{\gamma}S = 0$. For a delineation of the sample and elaboration on the variables included, see Box 7.1. Standard errors have been clustered at country level in parentheses.
Source: OECD, Penn World Table, World Bank and own calculations.

However, given the methodological problems associated with the OLS estimations above, a causal interpretation of results is difficult. Therefore, a more advanced dynamic econometric method, System GMM, will be used below, cf. Box 7.3.

SYSTEM GMM — Box 7.3

The OLS analysis above uses a static panel data method, which is subject to a number of endogeneity problems. For example, as described earlier, the direction of causality is unclear. Inclusion instead of the lagged left-hand-side variable from the regression equation in Box 7.2 on the right-hand side makes the panel data method dynamic. This means that standard OLS methods (or fixed-effects methods) can no longer be used. Instead a System GMM is used, cf. Arellano and Bover (1995) and Blundell and Bond (1998), which is an extension of the original Arellano-Bond estimator (Difference GMM), cf. Arellano and Bond (1991).

In short, a system of two equations is estimated, one for variables at level and one for variables as differences. In both equations, lagged values of the right-hand-side variables are used as instruments for endogenous right-hand-side variables, facilitating a causal interpretation of the estimates.

In order to avoid an obvious endogeneity problem, labour force growth is left out as a background variable in these estimations, since a problem of simultaneity would otherwise occur.

A similar approach is used by Arcand et al. (2012).

Application of the more advanced econometric method does not substantially change the conclusions, cf. Table 7.3. But when the financial sector's share of total employment is used as the measure of the size of the financial sector, the turning point of the relationship between economic growth and financial sector size is somewhat higher than for the OLS estimation. Moreover, accuracy is (even) poorer, cf. the 95 per cent confidence intervals, and the coefficients are insignificant in all cases.

However, the Danish financial sector remains outside the 95 per cent confidence interval when domestic private credit as a percentage of GDP is used as the measure of the size of the financial sector. Thus domestic private credit in Denmark accounted for approximately 200 per cent of GDP at the end of the period observed. On the other hand, the Danish financial sector does not stand out when the financial sector's share of total employment is used as the measure of the size of the financial sector. On the contrary, in this instance, the Danish financial sector is below the estimated peak, since employment in the Danish financial sector accounts for about 3.5 per cent of total employment, cf. section 2. This inconsistency in results when using different measures of the size of the financial sector gives rise to a number of questions. For instance, it could be argued that private credit is a highly imperfect measure of the size of the financial sector, since no adjustment is made for the quality of lending. For instance, Denmark has a highly developed and safe mortgage system in which lending is always collateralised. At the end of 2012, domestic lending by Danish mortgage banks accounted for about 135 per cent of GDP, while domestic lending by Danish banks was equivalent to approximately 65 per cent of GDP, cf. Chart 2.1.

An obvious question is: what mechanisms lead to an increase in the size of the financial sector that is beneficial to economic growth only as long as the financial sector is appropriately small? A possible mechanism is that the size of the financial sector affects the volatility of important economic variables which, in turn, impacts economic growth. Thus Dabla-Norris and Srivisal (2013) find a U-shaped relationship between the size of the financial sector and volatility in output, consumption and investment. This means that an increase in the size of the financial sector (measured by private credit as a percentage of GDP) will reduce volatility when the financial sector is relatively small to begin with, but increase volatility when the financial sector is very voluminous. However, based on a number of robustness analyses, Arcand et al. (2012) conclude that the inverted U-shaped relationship between economic growth and the size of the financial sector is not driven by output volatility. Moreover,

RELATIONSHIP BETWEEN ECONOMIC GROWTH AND FINANCIAL SECTOR SIZE, SYSTEM GMM

Table 7.3

Parameter estimate	Private credit as a percentage of GDP	Financial sector share of total employment
Financial sector size	0.016	1.35
	(0.019)	(1.25)
Financial sector size, squared	-0.008	-13.56
	(0.009)	(15.01)
Calculated peak (per cent)	96.8	4.99
95 per cent confidence interval	[18.5; 175.1]	[2.56; 7.41]
No. of observations	191	78

Note: The first column shows the estimation in which private credit as a percentage of GDP is used as a measure of financial sector size, while the second column uses financial sector share of total employment as a measure. The calculated peak denotes the value of S, where $\hat{\beta} + 2\hat{\gamma}S = 0$. For a delineation of the sample and elaboration on the variables included, see Box 7.1. All available lags have been included as instruments. Robust standard errors are reported in parentheses. In both cases, the null hypotheses of absence of second-order autocorrelation (the Arrelano-Bond test) or over-identified restrictions (the Hansen test) cannot be rejected, indicating that the model is well-specified.

Source: OECD, Penn World Table, World Bank and own calculations.

Arcand et al., *op cit.*, seek to make adjustments e.g. for banking crises and differences in banking regulations and financial supervision. The conclusion is that results indicating an inverted U-shaped relationship are robust to inclusion of these factors.

Finally, it may be debated whether the real relationship between economic growth and the size of the financial sector is a simple parabola. A semiparametric analysis in which no specific functional form is forced upon the relationship can further elucidate this issue. By using this method, Arcand et al., *op cit.*, find that the "true" relationship is actually very close to being parabolic.

In summary, it may be concluded that there are some indicators that a "too large" financial sector could have a negative impact on economic prosperity and growth. But this relationship is highly uncertain, and results do not seem to be robust enough to formulate simple "rules" for the "optimal" size of the financial sector. Moreover the possibility of reverse causality, as mentioned by way of introduction, can by no means be ruled out – despite the use of relatively advanced econometric methods. For instance, an increased level of income could prompt the need for a larger financial sector. Consequently, the conclusions of such studies should be interpreted with caution.

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