The cost efficiency and productivity growth of euro area banks

Ivan Huljak*
Senior Advisor
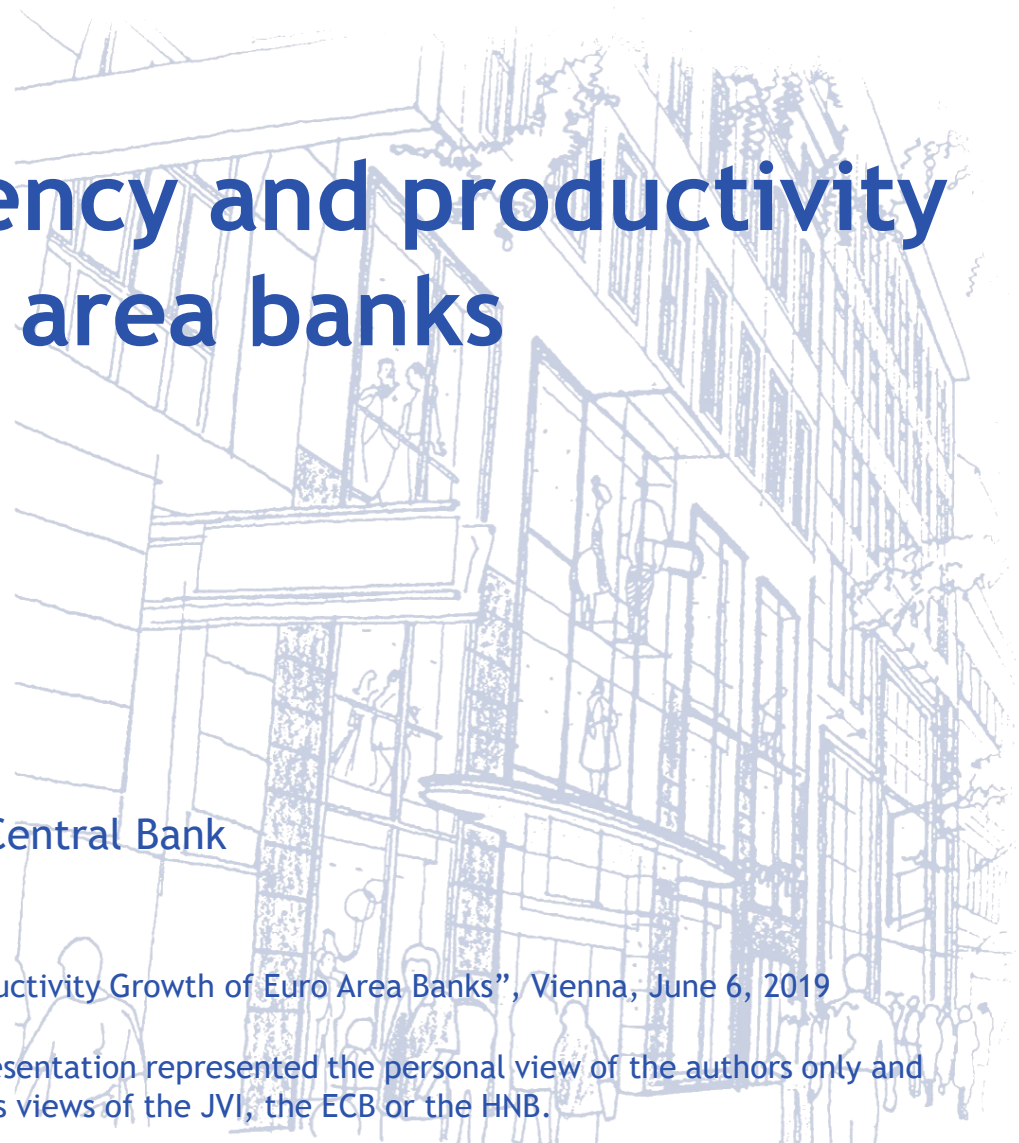Croatian National Bank

Reiner Martin*
Lead Economist
Joint Vienna Institute / European Central Bank

JVI Public event "The Cost-Efficiency and Productivity Growth of Euro Area Banks", Vienna, June 6, 2019

*Joint work with Diego Moccero (ECB). This presentation represented the personal view of the authors only and should not be seen as views of the JVI, the ECB or the HNB.

Outline

1. Introduction – Why does it matter?

2. Accounting indicators of bank efficiency

3. Total Factor Productivity Growth of euro area banks

- Modelling approach
- Data issues
- Empirical results

4. Conclusions

INTRODUCTION - WHY DOES IT MATTER?

'Weak' EA banks seen as medium-term financial stability risk

1- Disorderly increase in risk premia

High risk taking

Still high valuations

Low market liquidity

2 - Debt sustainability concerns

High private sector leverage and signs of releveraging

High public indebtedness with limited fiscal space and structural weaknesses

Property price overvaluations in some countries

3 - Hampered bank intermediation capacity

Operating inefficiencies and overcapacities

Weak profitability

High non-performing loans

Funding challenges for some banks

4 - Liquidity strains in the investment fund sector

Continued risk-taking and thinner liquidity buffers

Exposures to non-euro area regions

Pro-cyclical investor redemption patterns
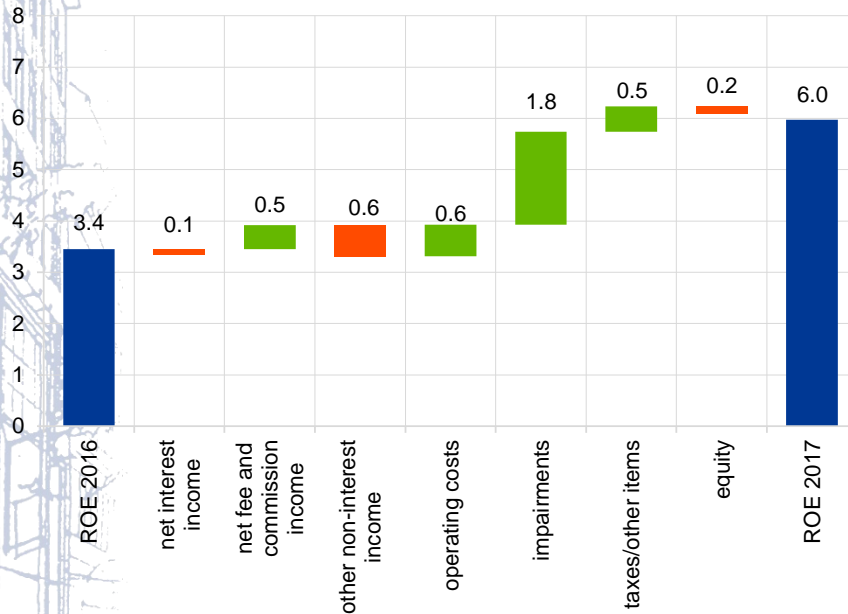
Pro-cyclical margining and haircut practices

pronounced systemic risk   **medium-level systemic risk**   **potential systemic risk**

The colours indicate the current level of risk, which is a combination of the probability of materialisation and an estimate of the likely systemic impact of the identified risk over the next two years, based on ECB staff assessment.

Source: ECB Financial Stability Review

# Bank profitability and solvency in the EA recently increased…

Decomposition of the change in euro area significant banks' aggregate return on equity
(2016-17; percentage points)

Decomposition of changes in euro area significant institutions' aggregate fully loaded CET1 ratios in 2016 and 2017
*(*2016-2017; percentage points)

- retained earnings
- other CET1 capital
- total assets
- average risk weight

Sources: ECB supervisory data and ECB calculations.

Notes: Based on a balanced sample of 112 SIs (adjusted for mergers and acquisitions). Green and red bars denote positive and negative contributions respectively.
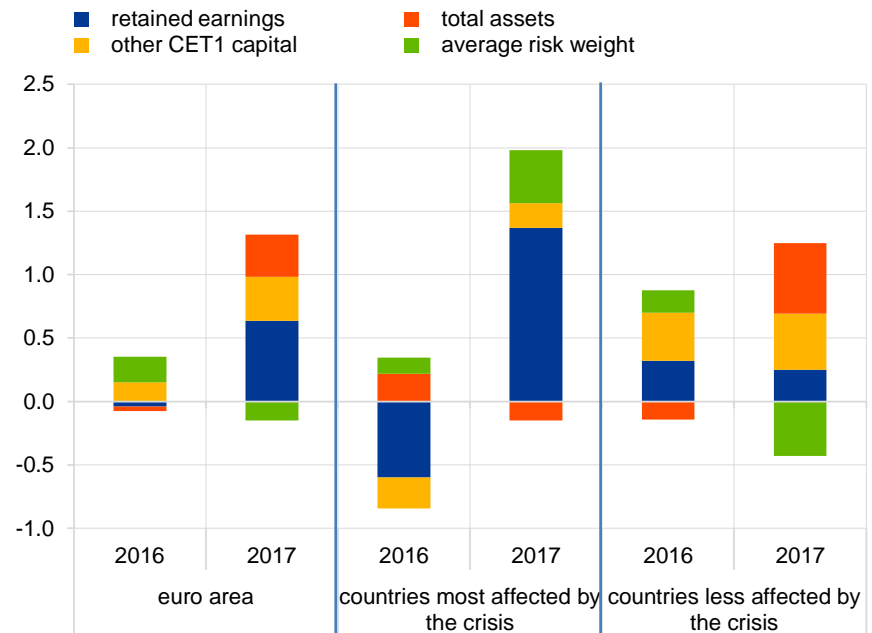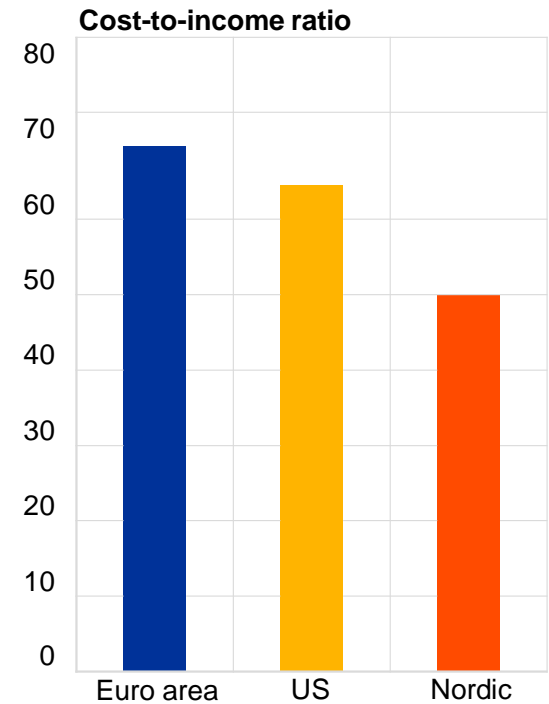
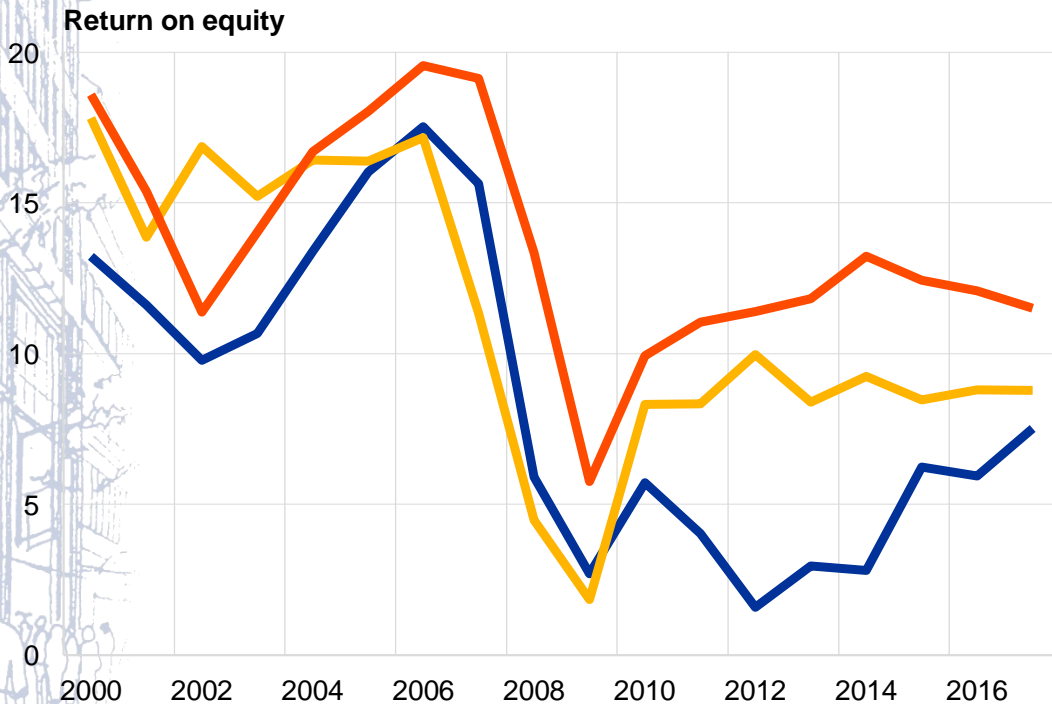Sources: ECB and ECB calculations.

Notes: Changes in average risk weight and total assets are shown with the opposite sign as their decline (increase) indicates a positive (negative) contribution to the capital ratios. Based on a balanced sample of 89 SIs. Countries most affected by the crisis include Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain.

.

...but EA bank remain less profitable than peer banks...

Return on equity (left panel) and cost-to-income ratio (right panel) for large global listed banks
left panel: 2000-17, median, annual percentages; right panel: averages over the period 2008-17

- Euro area
- US
- Nordic

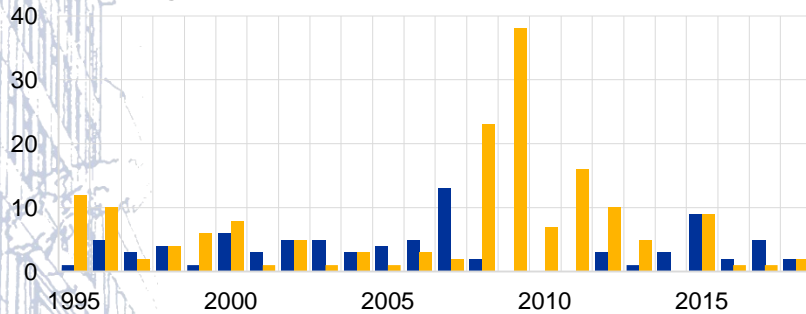Sources: Bloomberg and ECB calculations.

Note: The sample consists of 21 large banks for the euro area, 17 for the United States and 6 for the Nordic countries.

6

...which is reflected in ratings – compared to US banks

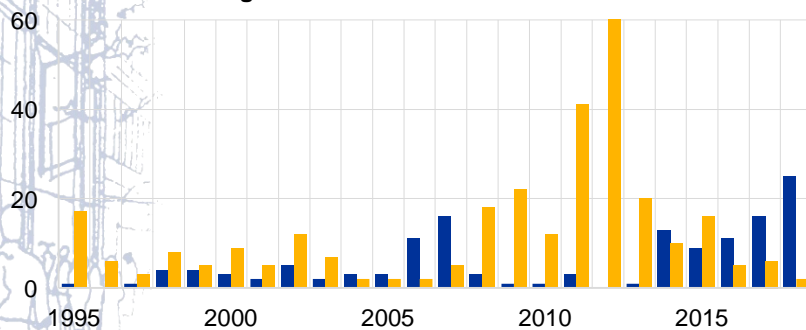**Upgrades/downgrades for large US and euro area banks (left panel) and recent distributions of ratings and outlooks for euro area and US banks (right panel)**

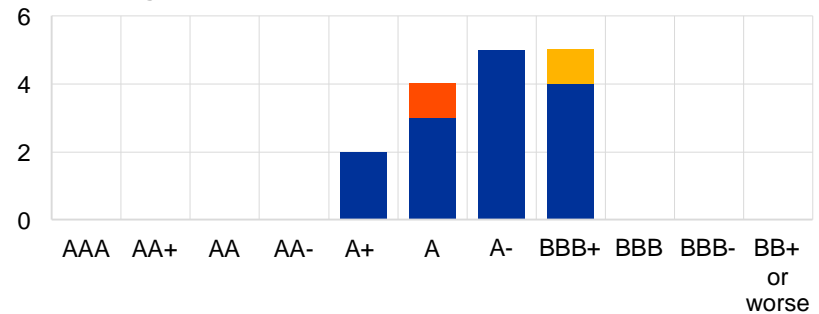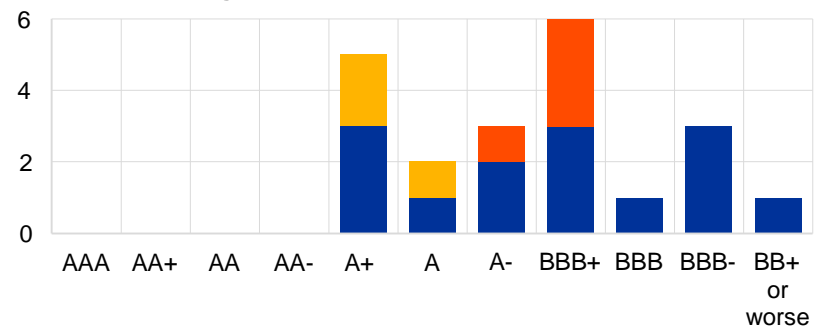Source: Standard & Poor's, Moody's, Fitch Group, ECB calculations. Left panel 1995-2018, Right panel as of December 2018.

Notes: The sample consists of 22 euro area banks and 16 US banks.

20

ACCOUNTING INDICATORS OF BANK EFFICIENCY

'Standard' indicators: Average cost and Cost to income ratio

- **Average cost (AC) - Total cost per unit of assets**

$$\text{Average cost} = \frac{\text{Total cost (funds, labour, fixed assets)}}{\text{Total assets}}$$

- **Cost to income ratio (CIR) - Administrative costs to operating income**

$$\text{Cost to income} = \frac{\left(\dfrac{\text{Number of employees}}{\text{Total assets}} \times \dfrac{\text{Personell expenses}}{\text{Number of employees}} \right) + \dfrac{\text{Personell expenses}}{\text{Number of employees}}}{\dfrac{\text{Net interest revenue}}{\text{Total assets}} + \dfrac{\text{Net fees and com.}}{\text{Total assets}} + \dfrac{\text{Net other PNL}}{\text{Total assets}}}$$

'Standard' indicators: Average cost and Cost to income ratio

Average cost and Cost to income ratio for different types of banks in the EA
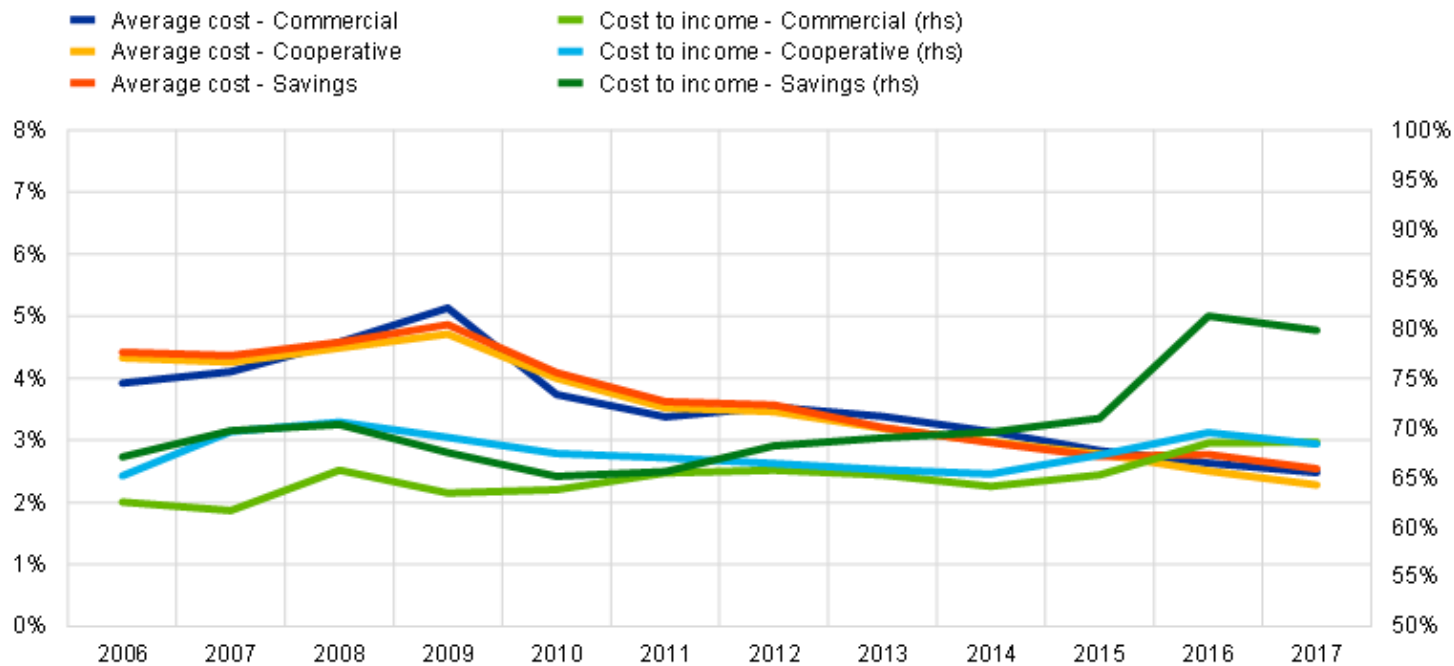
Source: Author's calculations based on BankFocus data.

'Standard' indicators: Average cost and Cost to income ratio

Components of the Cost to income ratio for banks in the EA
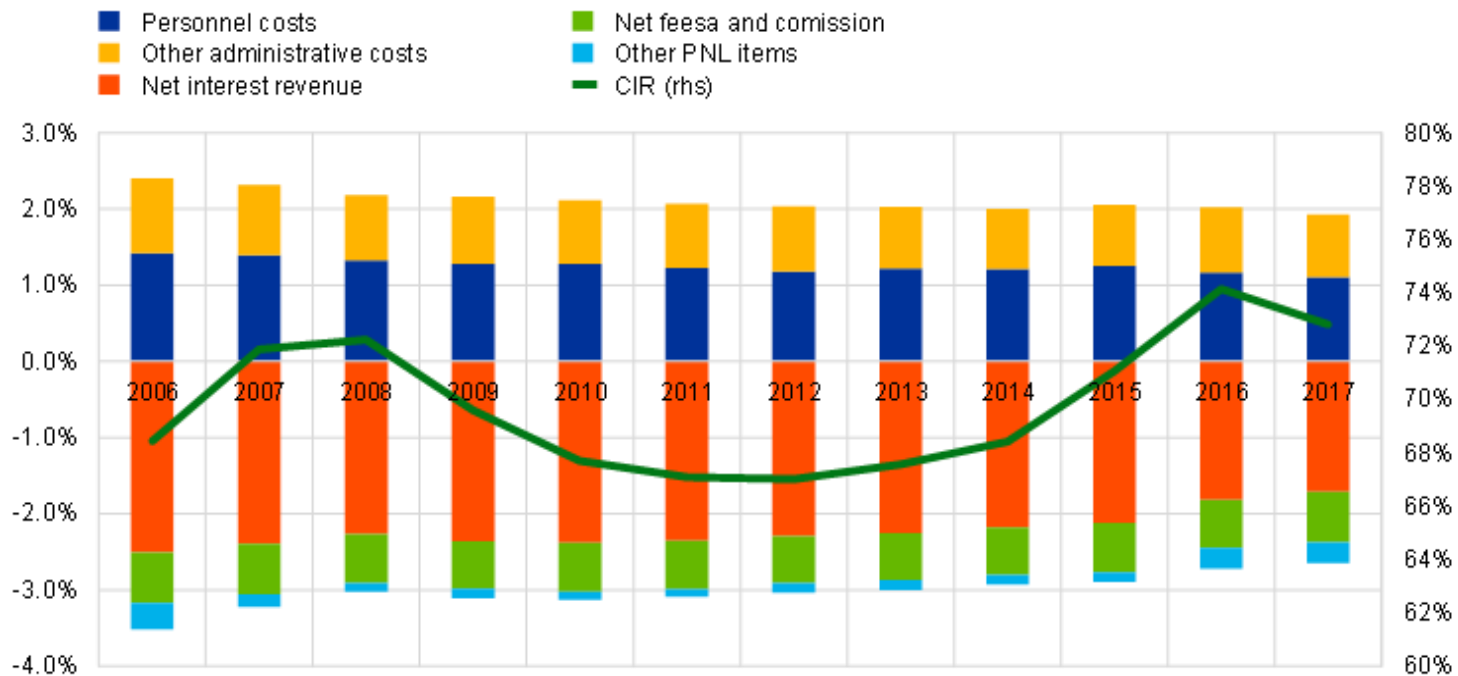
Source: Author's calculations based on BankFocus data
Note: The Chart reports each CIR component. Components in the numerator (denominator) are reported with positive (negative) values..

Usefulness of the 'standard indicators'

- **AC and CIR provide useful information but none of them is a perfect measure for managerial bank efficiency**

  - CIR is a better proxy of efficiency than AC, as it provides more insights into banks' cost structure (Burger and Moormann, 2008).

  - Both measures are strongly affected by business model and country specific variables, especially the price of labour and interest margins.

  - Credit risk is partly determined by banks and partly by exogenous factors.
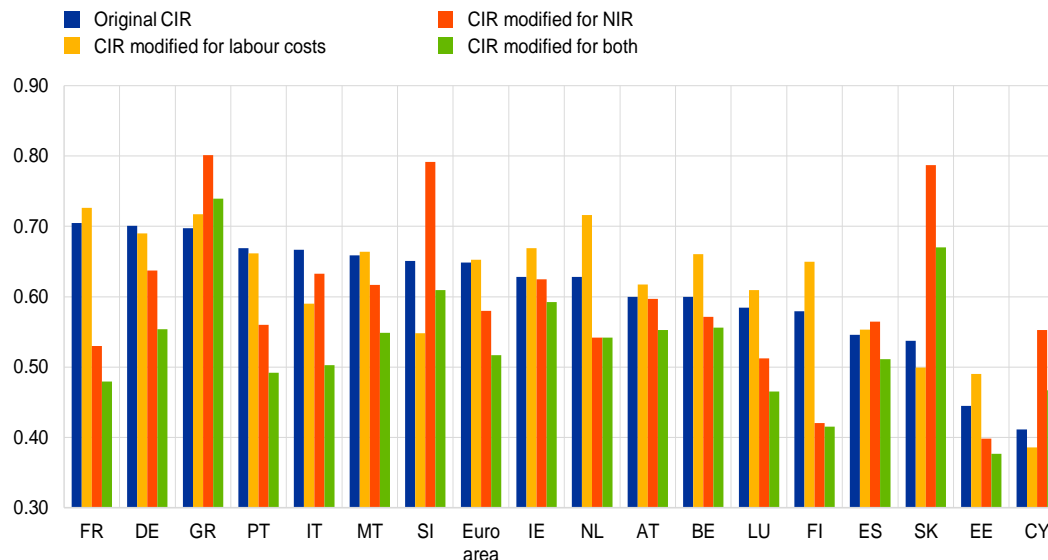
Source: ECB calculations based on Fitch data

TOTAL FACTOR PRODUCTIVITY GROWTH OF EURO AREA BANKS

Total Factor Productivity Growth – The modelling approach

- **TFPG can be decomposed as follows**

$$\text{TFPG = TEC + TPROG + SCALE + EQUITY}$$

- TFPG is total factor productivity growth,
- TEC is technical efficiency,
- TPROG is technological progress
- SCALE is the scale effect on total costs and
- EQUITY is the equity effect on total costs.

The modelling approach – Frontier analysis

- Benchmarking procedure- estimating the banks' relative ability to convert inputs (financial capital, labour and fixed assets) into outputs (loans, investments and deposits), while minimizing costs.

- The most efficient bank is the one that has the lowest cost to generate a given amount of output for given input prices and also controlling for measurement error.

- An advantage is that the resulting measure of cost efficiency controls for the fact that banks produce different outputs and pay different prices for inputs.
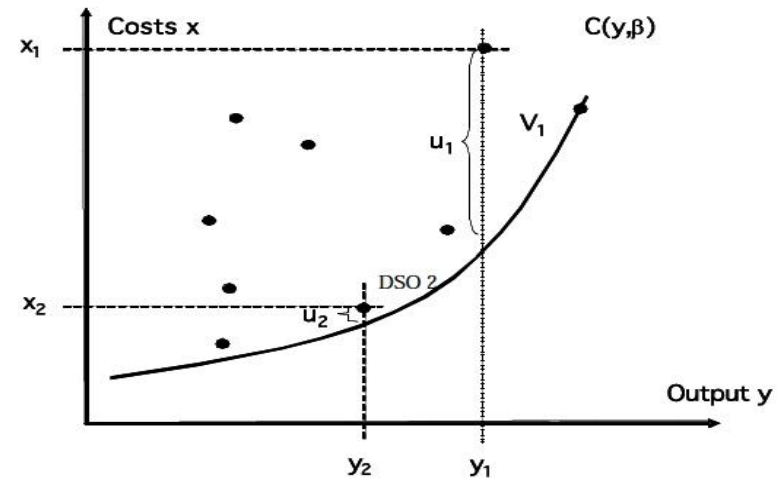
- Efficiency of 80% for bank X means that the bank on the frontier produces the same output, facing the same input prices and spending 80% of the resources used by bank X.

The modelling approach – some key issues

- Parametric vs. non-parametric frontier analysis
  - Non-parametric approaches without priori assumptions on the functional form of the best practise frontier work well with small samples. However, non-parametric techniques do not allow for random error in the model, making the efficiency scores sensitive to changes in the definition of inputs and outputs.

- Common vs. country frontier
  - Common frontier allows for better statistical performance and was chosen despite remaining heterogeneity in EA banking sectors and across types of banks.

- Accounting balance-sheet versus value-added approach
  - In our approach liabilities are treated as inputs and assets as outputs, given the key bank function of maturity transformation.

- Cost definitions
  - Labour expenses are calculated per employee; fixed asset prises are the ratio of non-labour administrative costs to fixed assets; the price of funds is computed as ratio between interest expenses and total liabilities. Total costs, our dependent variable, is computed as the sum of these three components.

The modelling approach - The cost function

- Cost of each bank depends on: products, prices of inputs and an error term with two components: random part and inefficiency part:

$$lnTC_{it} = \alpha_0 + lnTC(y_{it}, w_{it}, \beta) + v_{it} + u_{it}$$

- α_0 is a constant, i refers to banks and t to time, TC_{it} represents total costs, $TC(y_{it}, w_{it}, \beta)$ is a function of two outputs (y_{it}), prices for three inputs (w_{it}) and β is a vector of parameters. v_{it} is an idiosyncratic random error that affects the performance of banks. u_{it} is the inefficiency component. ln denotes the natural logarithm.

The modelling approach - The cost function

- The generalized true random-effects (GTRE) model by Kumbhakar et al. (2014) further decomposes the error term into four components, namely: i) general bank-specific effect μ_i, capturing heterogeneity across banks; ii) short-term (time-varying) bank-specific inefficiency v_{it}^+; iii) persistent bank-specific inefficiency η_i^+; and iv) a pure random component u_{it}. v_{it}^+ and η_i^+ are sign-restricted (+).

$$lnTCit = \alpha_0 + lnTC(y_{it}, w_i t, \beta) + \mu_i + v_{it}^+ + \eta_i^+ + u_{it}$$

- To calculate the efficiency scores, we follow a 3-step approach: i) run standard panel regression model to estimate β and to predict the values of α_i and ϵ_{it}; ii) estimate the time-varying technical efficiency, v_{it}^+ using the predicted values of ϵ_{it} from the first step; iii) apply a similar approach as in the second step to obtain estimates of the persistent technical inefficiency component η_i^+.

Data issues – the sample

BankFocus database covering the period 2006-2017

Unbalanced panel with 1441 – 2062 Euro area banks (commercial, cooperative and saving), covering 17 countries (LV, LT not available)

Data-cleaning rules:

- No negative products, no negative prices

- Removing smallest institutions (bellow 50 mill. EUR of average assets)

- Removing extreme asset volatility (+/-50% total asset growth recorded)

- Removing non-banks (less than 33% of total assets in loans and less than 33% of total assets financed by short-term liabilities

Around half of the banks are from Germany (well developed network of cooperative and saving banks) and another 20% from Italy.

Data issues – key descriptive data

Table 2: Key features of bank types

(end-2017)

		Total assets (bn. of euros)	Loans to assets	Other earning assets to assets	Customer deposits to assets	Price of labour (th. of euros)	Price of funds	Price of physical capital	Equity to assets	Average cost
Specialisation	**Commercial** Min.	0.1	34.2%	0.0%	0.8%	44.1	0.1%	27.2%	5.7%	0.7%
	Mean	68.9	65.7%	25.8%	71.5%	75.2	0.6%	114.8%	9.6%	3.0%
	St.dev.	220.0	13.6%	12.6%	22.5%	17.8	0.4%	62.8%	3.5%	2.0%
	Max.	1960.0	89.6%	66.0%	99.0%	95.4	1.2%	223.4%	15.7%	17.2%
	Cooperative Min.	0.1	33.0%	4.6%	14.8%	44.1	0.1%	27.2%	5.7%	0.8%
	Mean	5.6	61.7%	35.4%	78.5%	64.1	0.5%	81.5%	9.9%	2.3%
	St.dev.	63.3	12.2%	12.5%	15.2%	11.6	0.3%	47.0%	2.4%	0.9%
	Max.	1760.0	89.5%	66.9%	99.4%	95.4	1.2%	223.4%	15.7%	22.0%
	Savings Min.	0.1	33.1%	5.6%	27.1%	44.1	0.1%	27.2%	5.7%	1.2%
	Mean	6.7	63.3%	32.9%	84.2%	58.6	0.5%	113.5%	9.9%	2.6%
	St.dev.	89.0	12.3%	12.7%	9.7%	9.7	0.3%	57.9%	2.3%	0.6%
	Max.	2130.0	89.5%	68.3%	98.9%	95.4	1.2%	223.4%	15.7%	6.8%
	All euro area Min.	0.1	33.0%	0.0%	0.8%	44.1	0.1%	27.2%	5.7%	0.7%
	Mean	14.4	62.8%	33.3%	79.5%	63.9	0.5%	95.1%	9.9%	2.5%
	St.dev.	108.0	12.5%	13.0%	15.4%	13.1	0.3%	54.7%	2.5%	1.0%
	Max.	2130.0	89.6%	68.3%	99.4%	95.4	1.2%	223.4%	15.7%	22.0%

Notes: The price of labour is calculated as personnel expenses over the total number of employees; the price of physical capital is calculated as other overhead costs to non-earning assets; and the price of funds is computed as interest costs to total liabilities.

Source: Author's calculations based on BankFocus.

- Commercial banks on average largest with largest loan / asset ratio.
- Cooperative and savings banks relatively more dependent on deposits.
- Commercial banks recruit relatively more expensive labour and have higher AC.
- Standard deviations tend to be generally large.

Data issues – indicators to be used in the cost function

Table 3. Indicators included in the cost function

	Unit	Obs.	Mean	Std. Dev.	Min	Max
Dependent variable						
Total costs	Mill. EUR	21,224	352	2827	-1	101000
Outputs						
Gross loans	Mill. EUR	21,224	6,384	47,200	9.117363	1,220,000
Other earning assets	Mill. EUR	21,224	4,325	41,200	0.009	1,180,000
Prices						
Personnel costs per employee	000 EUR	19,332	58.4	12.0	38.7	95.4
Interest expenses to total liabilities	%	21,224	2%	1%	0%	4%
Other overheads to non-earning assets	%	19,829	85%	44%	27%	225%
Semi-fixed input						
Total equity to total assets	%	21,224	9%	3%	4%	16%

Source: Author's calculations based on BankFocus data.

Empirical results

1. **Efficiency scores**

2. **Technological progress**

3. **Shadow cost of equity**

4. **Economies of scale**

5. **Summing up - TFPG**

Empirical results – efficiency scores

Table 4. Efficiency per bank specialisation

(median for all banks and each category)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Persistent efficiency												
Commercial	84.1%	83.8%	83.6%	83.5%	83.8%	83.5%	84.1%	84.3%	84.0%	83.9%	84.3%	84.0%
Cooperative	89.5%	89.5%	89.5%	89.6%	89.5%	89.5%	89.5%	89.5%	89.5%	89.1%	89.5%	89.4%
Savings	85.6%	85.8%	85.8%	85.8%	86.0%	86.1%	86.2%	86.1%	86.1%	86.0%	86.1%	86.0%
All banks	88.3%	88.3%	88.3%	88.3%	88.3%	88.3%	88.3%	88.3%	88.3%	87.9%	88.2%	88.1%
Short-term (time-varying) efficiency												
Commercial	96.2%	96.1%	95.7%	95.5%	95.9%	95.7%	95.2%	95.4%	95.4%	95.4%	94.8%	94.5%
Cooperative	95.2%	95.4%	95.3%	95.2%	95.2%	95.2%	95.5%	95.4%	95.5%	95.3%	95.7%	96.4%
Savings	95.8%	95.3%	95.3%	95.0%	95.4%	95.7%	95.8%	95.7%	95.6%	95.6%	94.1%	95.4%
All banks	95.4%	95.4%	95.3%	95.1%	95.3%	95.4%	95.6%	95.5%	95.5%	95.4%	95.2%	95.9%
Overall efficiency												
Commercial	79.8%	80.1%	79.5%	79.5%	80.3%	79.7%	79.9%	79.7%	80.2%	79.8%	79.8%	79.4%
Cooperative	84.8%	85.1%	85.1%	84.9%	84.9%	85.1%	85.2%	85.2%	85.2%	84.5%	85.1%	85.6%
Savings	81.7%	81.5%	81.6%	81.1%	81.9%	82.4%	82.8%	82.4%	82.2%	81.8%	80.3%	81.2%
All banks	83.7%	83.9%	83.9%	83.8%	83.9%	84.1%	84.2%	84.0%	84.1%	83.5%	83.4%	83.8%

Source: Author's calculations based on BankFocus data.

- Overall bank efficiency for the entire euro area banking sector, was around 84% over the period from 2006 to 2017

- Structural long-term factors (such as location, client structure, macroeconomic environment, regulation, etc.) seem to play the key role

Empirical results – efficiency scores

Table 5.Efficiency by bank market share in the local market

(median for each category)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Overall efficiency												
<25th pctile.	87.80%	87.32%	86.97%	86.72%	85.73%	85.89%	85.83%	85.83%	85.81%	85.29%	86.09%	86.64%
25th to 50th pctile.	84.88%	84.38%	84.28%	84.20%	83.09%	83.16%	83.60%	84.03%	84.08%	83.74%	83.65%	84.13%
50th to 75th pctile.	82.38%	82.07%	81.76%	81.46%	81.82%	82.25%	82.20%	82.43%	82.80%	82.56%	81.63%	82.70%
>75thpctile.	80.90%	80.94%	81.55%	81.27%	82.46%	82.58%	83.02%	82.26%	82.54%	82.14%	81.22%	81.17%

Note: The Table reports median efficiency scores (relative distance to the frontier) by bank size. The bank size is measured by the respective market share in the country of origin.

Source: Author's calculations based on Bankscope data.

- Larger institutions tend to display lower overall efficiency scores.

- Different explanations. More difficult to manage, given more sophisticated business model <u>or</u> might invest more in intangible assets such as brand value or strategy to increase market power rather than cost efficiency.

- Additional findings in the paper: more efficient banks tend to have lower credit risk ratios and are better capitalised.

Empirical results – Technological progress

- Technological progress can be divided into three components. i) 'pure technological progress', depending only on the time trend; ii) 'scale-augmenting technological progress', capturing the change in the sensitivity of total costs as output changes over time; iii) 'non-neutral technological progress', reflecting input prices change.

- Average rate of technological progress for median euro area bank amounted to 2.4% p.a. between 2006 and 2017. Largest component is 'non-neutral', implying that 'technological progress' as defined here is mostly driven by factors outside the control of the banks

Technological progress
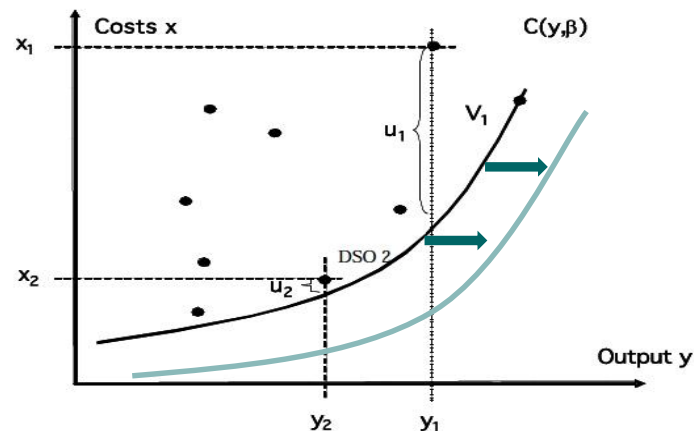
Empirical results – Shadow cost of equity

- Shadow cost of equity (SCOE) included because higher equity ratio should lead to lower cost of debt (Modigliani and Miller, 1958). Some banks may look more efficient while in fact they are better capitalised.

- SCOE computed as first derivative of total cost w.r.t. equity. How much would a bank save if it had an additional unit of equity / how much would it be willing to pay for one additional unit of equity?

Figure 5. Shadow cost of equity and cost of equity derived from the CAPM

(weighted average)
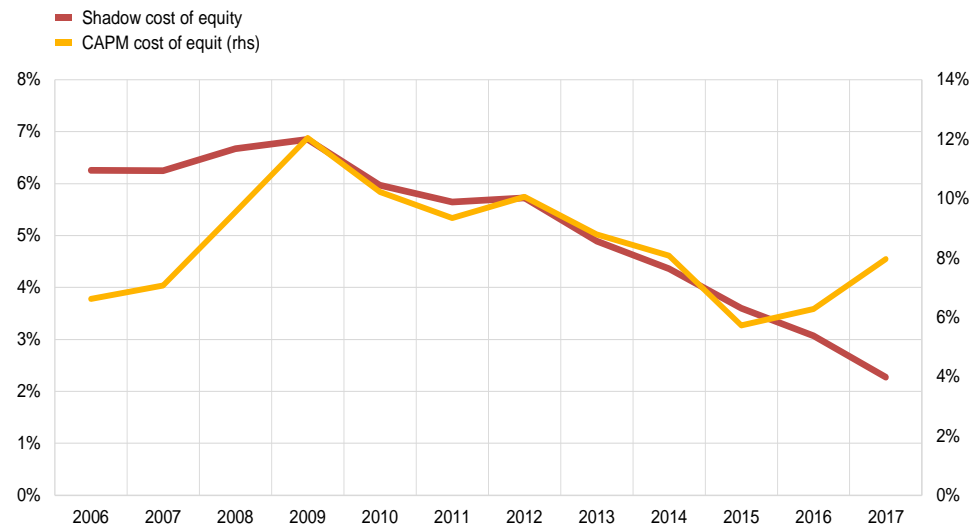
- CAPM cost of equity measure added for comparison purposes. Only available for a smaller number of banks.

Source: Author's calculations based on BankFocus data and Bloomberg (CAPM).

Empirical results - Economies of scale

- The 'scale effect' is computed as the product between economies of scale and (weighted) output growth and captures the importance of operating at the optimal scale. We report constant EoS and EoS that are modified for the SCOE.

- Results suggest that euro area banks exhibited on average constant EoS of around 4%, over the period. Modified EoS are higher but declining.

Figure 6. Modified economies of scale and scale effect in euro area banks

(median)
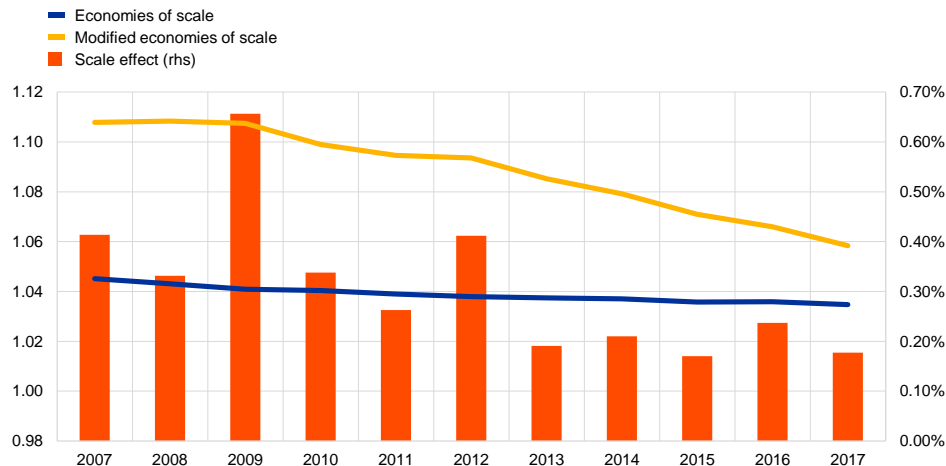
- The findings suggest that increasing outputs by a factor of one in 2017 led to an increase in total costs by a factor of 0.94 (modified approach). The scale effect peaked in 2009 and (less so) 2012 when bank products (loans and investments) rebounded from the crises years 2008 and 2011.

Source: Author's calculations based on BankFocus data.

Empirical results - Total Factor Productivity Growth of EA banks

- Total factor productivity growth of the median euro area bank grew about 1.7% per year between 2007 and 2017. However, TFPG gradually decreased from above 2% in 2007 to below 1% in 2017.

- The largest component of TFPG is technological progress. Technical efficiency, the second largest component, exerts an increasingly negative impact on TFP; euro area banks are moving away from the efficiency frontier.

Figure 7. Total factor productivity growth and components

(median)
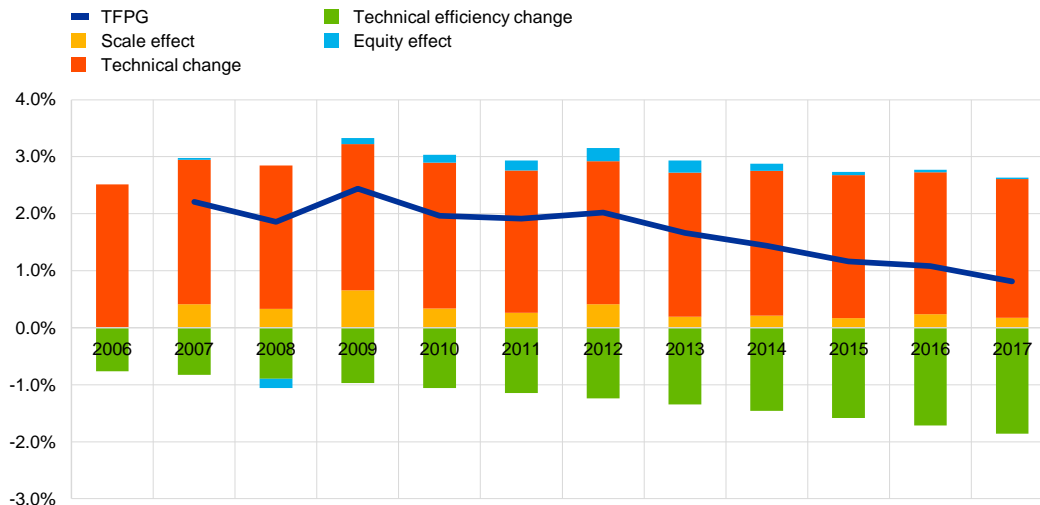
- The scale and equity effects contribute only moderately to TFPG in the euro area.

Legend:
- TFPG
- Scale effect
- Technical change
- Technical efficiency change
- Equity effect

Source: Author's calculations based on BankFocus data.

CONCLUSIONS

Conclusions

- Bank efficiency and profitability are an important issue for the euro area, notably relative to peer banking sectors such as the US.

- We find that the average cost efficiency of euro area banks was around 84% over the 2006 to 2017 period. If the average bank would operate on the technical efficiency frontier, it could produce the same output with 84% of the current costs.

- During the same period total factor productivity growth of the median euro area bank gradually decreased from above 2% in 2007 to below 1% in 2017.

- Technical efficiency, the second largest TFPG component, exerts an increasingly negative impact on TFP; euro area banks are moving away from the efficiency frontier.

- The largest part of bank inefficiency is persistent, suggesting that structural long-term factors play a bigger role than time-specific factors.

- Our findings suggest that banks should enhance their efforts in areas such as branch rationalisation, digitalisation of business processes and possibly mergers and acquisitions.

Thank you for your attention!

Dr. Ivan Huljak

Senior Advisor/ Croatian National Bank

Senior Financial Stability Expert / European Central Bank
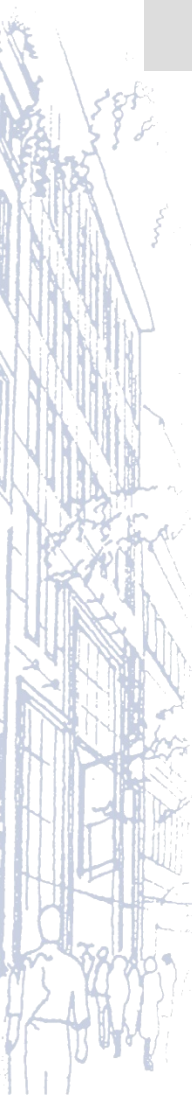
ihuljak@hnb.hr

ivhuljak@gmail.com

Dr. Reiner Martin

Lead Economist / Joint Vienna Institute

Deputy Head of Division / European Central Bank

rmartin@jvi.org

reiner_martin@hotmail.com

BACKGROUND SLIDES

Data

Table 1: Minimum and maximum number of banks per country and bank specialisation during the period 2006-17

	Specialisation			
Countries	Commercial banks	Cooperative bank	Savings banks	**All banks**
Austria	13/20	32/56	43/74	88/150
Belgium	6/11	2/4	1/3	9/18
Cyprus	1/9	1/2	1/1	3/12
Estonia	1/1	0/0	0/0	1/1
Finland	2/13	1/3	1/8	4/24
France	41/51	39/61	5/11	85/123
Germany	23/44	555/656	343/425	921/1125
Greece	2/5	1/1	0/0	3/6
Ireland	1/5	0/0	0/0	1/5
Italy	30/38	237/314	13/22	280/374
Luxembourg	3/13	1/7	1/1	5/21
Malta	2/5	0/0	0/0	2/5
Netherlands	3/13	1/1	1/1	5/15
Portugal	2/7	1/4	1/74	4/85
Slovakia	3/7	0/0	1/2	4/9
Slovenia	5/9	2/2	1/1	8/12
Spain	7/19	8/47	3/11	18/77
Total EA	145/270	881/1158	415/634	1441/2062

Source: Author's calculations based on BankFocus.