Inefficiency Distribution of the European Banking System

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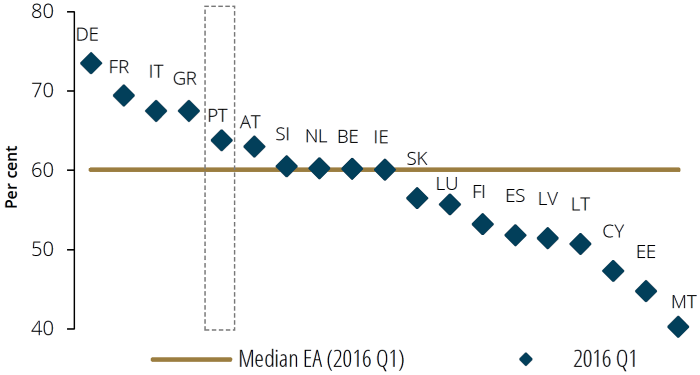
Why are we here?

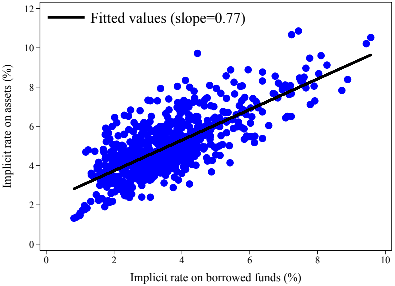


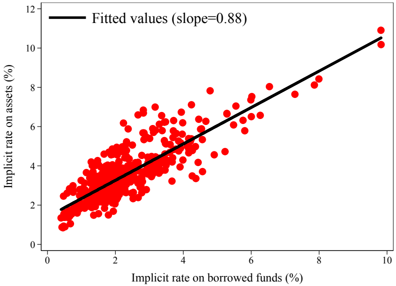
Source: European Central Bank (Consolidated Banking Data).
Note: Figures refer to the year ending in the first quarter of 2016.

Figure: Cost-to-income

Why are we here?

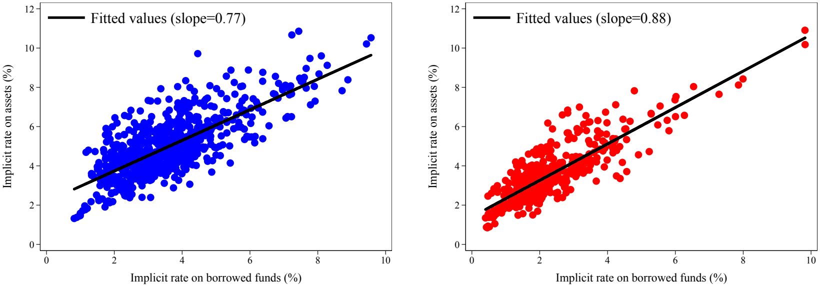
- The outcome variable is correlated with risk





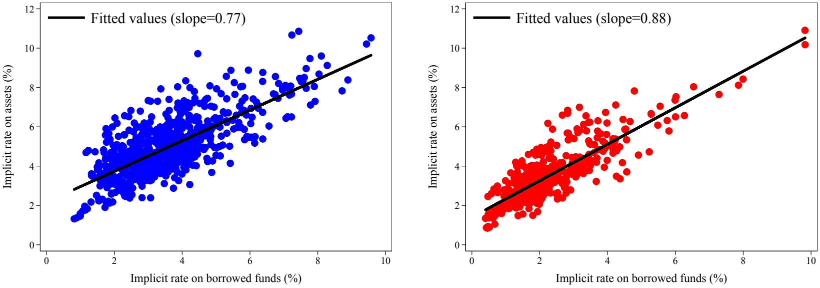
Why are we here?

- The outcome variable is correlated with risk
- Different factor prices



Why are we here?

- The outcome variable is correlated with risk
- Different factor prices
- Will consolidation of the banking system reduce average costs? Are there other financial stability consequences of inefficiency?



Method

- We apply the method of Boucinha et al. (2013) who use a stochastic frontier analysis (SFA) to study the features of the cost function of the Portuguese banking system
- Banks produce loans and other earning assets and use borrowed funds, physical capital and labour as inputs

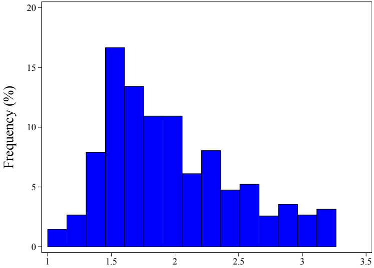


Figure: Cost-to-assets

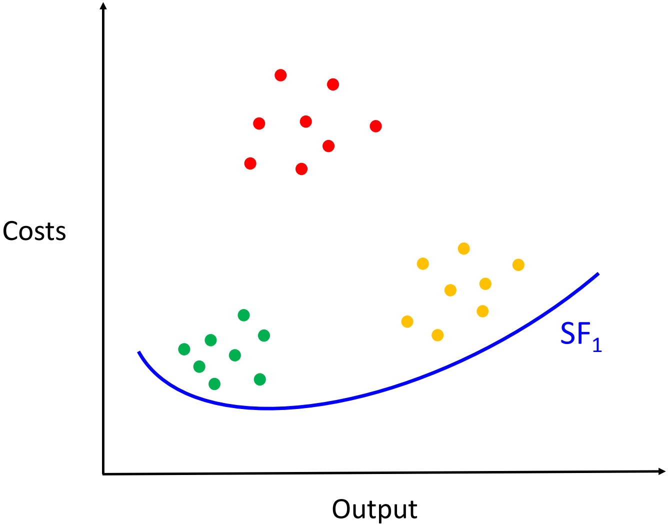
Method: Battese & Coelli, 1992 and Battese & Coelli, 1988

$$\ln C_{it} = \delta_0 + \sum_{j=1}^{2} \delta_j \ln y_{it} + \delta_F \ln \omega_{Fit} + u_{it} + \nu_{it} \ ,$$

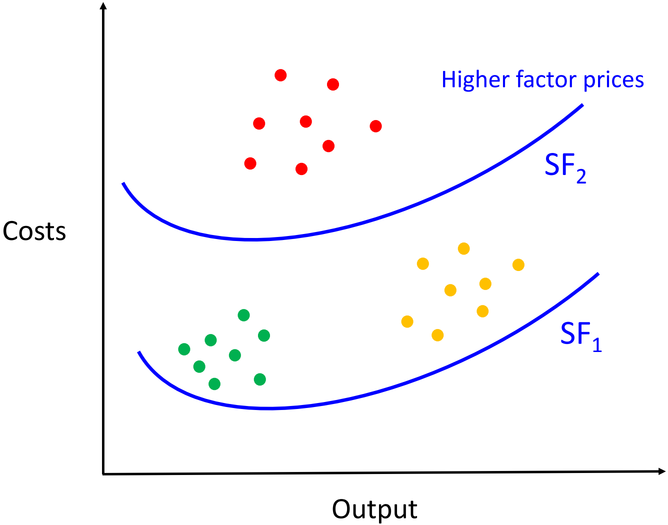
- C_{it}: interest plus overheads
- y_{it}: bank i's production (net loans or other earning assets)
- ω_{Fit}: **exogenous** cost of funding
- u_{it}: bank i's inefficiency. $u_i \sim \mathcal{N}^{+}(\mu, \sigma_u^2)$ (identifying assumption)
- ν_{it}: random error. $\nu_{it} \sim \mathcal{N}(0, \sigma_\nu^2)$ (identifying assumption)

$$CI_{it} = \frac{E[C|u_{it}, X_{it}]}{E[C|u_{it} = 0, X_{it}]} \ .$$

Method: SFA



Method: SFA



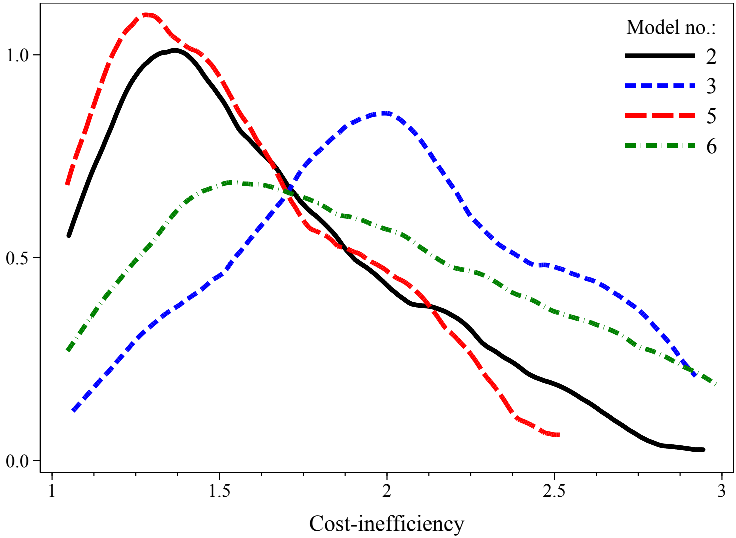
Method: is the price of funding exogenous?

- ω_{F1}: implicit rate on liabilities (bank-specific) - **not exogenous to bank-level efficiency**
  - Efficiency (unobserved) is correlated with future cash flows
  - All else equal, lower future cash flows imply lower probability of repayment
  - This raises bank's interest rate
- ω_{F2}: median implicit rate on liabilities (by country) - less dependent on a individual bank's performance
- ω_{F3} local money market rate (by currency area) - determined by the monetary authority

Data: Bankscope

- Countries: EU-15 (1995)
- Coverage: 122 banks - 45% of UK total assets to 100% of Greek total assets
- Time period: 2000-2013 with a median of 14 periods per institution

Results: Inefficiency distribution(s)

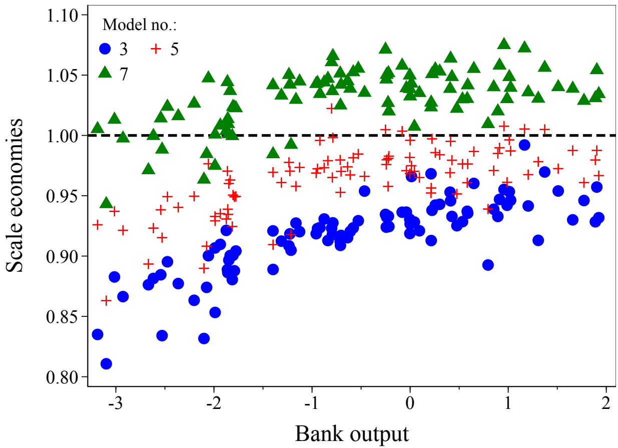


Results: Scale economies

Table: Scale economies estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Wald test	0.96	0.92	0.40	0.78	0.80	0.97
SE (at the mean)	1.00	0.99	0.97	0.98	0.98	1.00

Results: Scale economies (cross-section)



- Limited evidence of scale economies

Robustness: Greene, 2005a

- **True fixed effects**

$$\ln C_{it} = \alpha_i + \beta' X_{it} + u_{it} + \nu_{it} \ ,$$

where α_i is the bank-specific effect and $\beta' X_{it}$ are the regressors. Here we make the assumptions that: (i) $[x_{it}, \nu_{it}, u_{it}]$ are mutually uncorrelated; (ii) α_i is correlated with the regressors x_{it} and (iii) u_{it} is a random draw from a non-negative distribution

- **True random effects**

$$\ln C_{it} = \alpha + \beta' X_{it} + w_i + u_{it} + \nu_{it} \ ,$$

where α is the grand mean, w_i is the bank-specific effect and both w_i and u_{it} and are independent of the regressors and ν_{it}

Robustness: Greene, 2005a

	BC92	TRE	TFE	BC92	TRE
Inefficiency statistics					
Mean	1.74	1.25	1.31	2.26	1.28
Std.dev.	0.69	0.37	0.45	0.98	0.40
25^{th} percentile	1.29	1.05	1.05	1.53	1.04
Median	1.57	1.12	1.15	2.04	1.12
75^{th} percentile	2.08	1.35	1.47	2.82	1.36
Scale economies					
Wald test	0.80	0.27	0.85	0.97	0.46
Scale economies	0.98	1.08	0.98	1.00	1.04

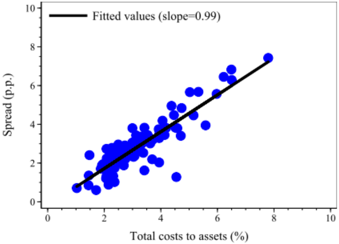
Figure: Alternative model stats

Robustness: Correlations between inefficiency estimates

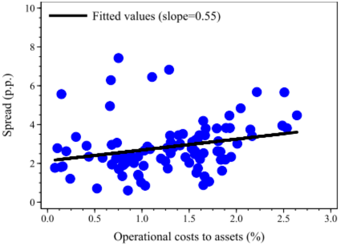
	Model 3	Model 5	Model 6	TRE ω_{F2}	TFE ω_{F2}	TRE ω_{F3}
Model 3	1.00					
Model 5	0.57	1.00				
Model 6	0.50	0.93	1.00			
TRE ω_{F2}	0.29	0.67	0.59	1.00		
TFE ω_{F2}	0.36	0.69	0.59	0.98	1.00	
TRE ω_{F3}	0.27	0.62	0.62	0.93	0.93	1.00

TABLE 6. Correlation between inefficiency measures

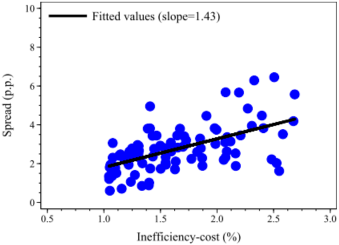
Further consequences of inefficiency



(A) Total costs



(B) Operational costs



(C) Inefficiency-cost (Model 5)

Further consequences of inefficiency

	(A)	(B)	(C)	(D)	(E)
ω_{F2}	1.05^{***}	0.87^{***}	0.46^{***}	1.05^{***}	0.55^{***}
	(0.20)	(0.13)	(0.17)	(0.12)	(0.11)
HHI	4.50^{**}	5.11^{***}	4.18^{***}	4.54^{***}	4.51^{***}
	(2.08)	(1.63)	(1.38)	(1.29)	(1.48)
Model 2	0.45^{*}				
	(0.24)				
Model 5		1.17^{***}			
		(0.19)			
Model 6			0.93^{***}		
			(0.12)		
TRE ω_{F2}				2.27^{***}	
				(0.50)	
TRE ω_{F3}					2.31^{***}
					(0.22)
Obs.	90	90	90	90	90
R^2	0.37	0.67	0.70	0.73	0.73

Bootstrap standard errors in parenthesis
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Conclusion

- Inefficiency distribution depends on the assumptions made, but **correlation of inefficiency estimates between methods is high**
- Evidence of scale economies is limited (more plausible for smaller banks). **This depends on the funding cost indicator**
- We find evidence of a link between credit spreads and inefficiency

Annex: Baseline Models

	(1)	(2)	(3)	(4)	(5)	(6)
t	-0.05***	-0.05***	-0.04***	-0.02	-0.02	-0.07**
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
$\ln y_1$	0.51***	0.51***	0.58***	0.61***	0.62***	0.47***
	(0.08)	(0.08)	(0.03)	(0.06)	(0.07)	(0.09)
$\ln y_2$	0.47***	0.47***	0.37***	0.35***	0.35***	0.51***
	(0.06)	(0.07)	(0.02)	(0.06)	(0.05)	(0.07)
$\ln y_1 \times \ln y_1$	0.09***	0.09***	0.06***	0.07***	0.07***	0.09***
	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
$\ln y_1 \times \ln y_2$	-0.15***	-0.15***	-0.09***	-0.11***	-0.10***	-0.15***
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)
$\ln y_2 \times \ln y_2$	0.06***	0.06***	0.05***	0.05***	0.04***	0.06***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
$\ln \omega_{F1}$			0.64***			
			(0.04)			
$\ln \omega_{F2}$				0.56***	0.56***	
				(0.10)	(0.10)	
$\ln \omega_{F3}$						0.40***
						(0.09)
μ	0.29	0.00	0.71***	0.44	0.00	0.62**
	(0.51)	(0.00)	(0.19)	(0.64)	(0.00)	(0.30)
η	-0.09***	-0.09***	-0.03**	-0.08***	-0.08***	-0.09***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Obs.	1,243	1,243	1,243	1,243	1,243	1,243
Log-likelihood	-107.55	-108.02	968.57	126.64	124.20	58.30
γ	0.83	0.88	0.87	0.81	0.90	0.84
σ^2	0.33	0.46	0.07	0.20	0.37	0.25
σ_u	0.52	0.63	0.24	0.40	0.58	0.46
σ_ν	0.24	0.24	0.09	0.19	0.19	0.20

Figure: Regressions: Baseline

Annex: Alternative models

	BC92	TRE	TFE	BC92	TRE
Inefficiency statistics					
Mean	1.74	1.25	1.31	2.26	1.28
Std.dev.	0.69	0.37	0.45	0.98	0.40
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Wald test	0.80	0.27	0.85	0.97	0.46
Scale economies	0.98	1.08	0.98	1.00	1.04

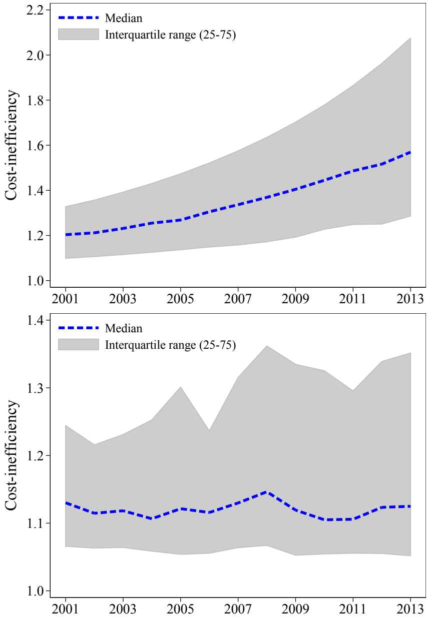
Figure: Alternative model stats

Annex: Alternative models

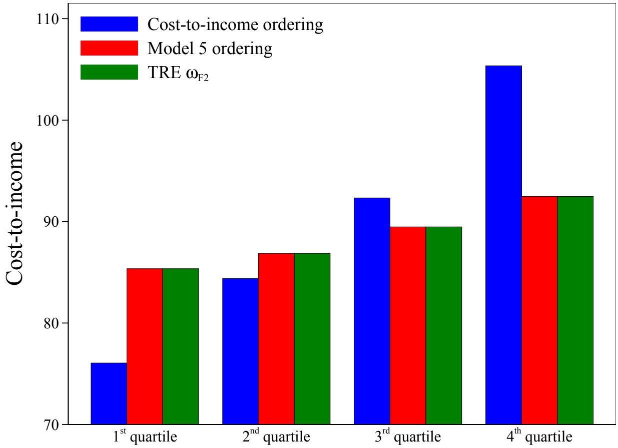
	BC92	TRE	TFE	BC92	TRE
t	-0.02	-0.04***	-0.03	-0.07**	-0.02
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
$\ln y_1$	0.62***	0.70***	0.68***	0.47***	0.66***
	(0.07)	(0.05)	(0.07)	(0.09)	(0.05)
$\ln y_2$	0.35***	0.34***	0.29***	0.51***	0.36***
	(0.05)	(0.04)	(0.06)	(0.07)	(0.04)
$\ln \omega_{F2}$	0.56***	0.46***	0.50***		
	(0.10)	(0.09)	(0.11)		
$\ln y_1 \times \ln y_1$	0.07***	0.08***	0.05**	0.09***	0.08***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
$\ln y_1 \times \ln y_2$	-0.10***	-0.10***	-0.09***	-0.15***	-0.12***
	(0.03)	(0.03)	(0.03)	(0.04)	(0.02)
$\ln y_2 \times \ln y_2$	0.04***	0.05***	0.04***	0.06***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\ln \omega_{F3}$				0.40***	0.49***
				(0.09)	(0.08)
μ	0.00			0.62**	
	(0.00)			(0.30)	
η	-0.08***			-0.09***	
	(0.02)			(0.02)	
Obs.	1,243	1,243	1,243	1,243	1,243
Log-likelihood	124.20	194.91	427.79	58.30	135.71
σ_u	0.58	0.16	0.17	0.46	0.18
σ_ν	0.19	0.11	0.09	0.20	0.10

Figure: Regressions: Alternative

Robustness: Baseline and true random effects model



Annex: Cost-to-income ranking



- Extreme quartile medians are closer to the centre of the distribution

Annex: Country rankings