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Estimating the Market Power of Banks in the EU: A Stochastic Frontier Approach with Environmental Variables

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1. Motivation

- Since the introduction of the **1992 Single Market Programme (SMP)** and the **first steps taken (2012) towards** the **EU Banking Union (EBU)** → the European Union (EU) has walked towards more integrated financial markets.

- An integrated financial market (ECB, 2020):

  I. Single set of rules for financial institutions
  II. The guarantee of an equal access to financial instruments and services for all market participants
  III. Harmonized procedures that permit an equal treat of financial services' users (ECB, 2020)

  Main objective → to permit the transaction of financial instruments and the provision of financial services under the same conditions in all EU countries.

- Advances in EBU (IMF, 2015):

  I. Lower resolution, restructuring and compliance costs.
  II. Elimination of any barriers to cross-border banking activity
  III. Lower bank funding costs

  Under these conditions → advances in the EU financial integration should have incentivized more banking competition.

1. Motivation

However:

- Empirical studies signal a **general trend of increasing baking market power** in the EU and a **persistent divergence among EU banks** (Delis and Tsionas, 2009).
- According to Cruz-García and Fernández De Guevara (2017) is mainly attributable **to country-specific factors**.
- ECB (2017): **ligation costs** and **differences in the legal and regulatory environment** could constitute persistent barriers to integration → which may lead to different competition scenarios within the EU.

❑ **To assess the EU banking competition scenario** → important to assess how environmental differences among EU members could affect the ability of banks to exercise market power.

This study aims to give response to the following **research questions**:

✓ Do different environmental conditions (such as different monetary policy or bank capital regulation) among EU countries affect banks' market power?

✓ Controlling for these environmental differences, have EU countries converged in market power levels from 2005 to 2019?

1. Motivation

- To answer these research questions, this study aims to:

  Provide a new measure of banks' market power by controlling for the influence of environmental conditions which are known exercise influence on banks' performance.

  ❖ This new measure allows to:

  ✓ Level up the banks' playing field – by controlling for their particular environment

  ✓ Make proper cross-country market power comparisons

  ✓ Analysis of convergence or divergence trends in market power among groups of banks (EMU and Non-EMU).

  Without controlling for the regulatory, institutional, or industry-specific environment, differences in banking market power between countries may hide these specific environmental divergences instead of reflecting internal bank-activity-driven differences that could lead to different market power levels.

1. Motivation

- **Methodology**: Frontier Model of Market Power proposed by ***Kumbhakar et al. (2012)*** & Maximum Likelihood (ML) random-effects truncated normal model of ***Battese and Coelli (1995)*** → Then a **Lerner index** is then estimated obtaining an ***Environmentally-adjusted Lerner index***.

- **The analysis includes five environmental dimensions:**

  (i) **EU monetary policy.** *Most studies find a positive relationship between short-term interest rates and banks' margins (for instance: Bolt et al., 2012; Borio et al., 2015; and Cleassens et al., 2018).*
  (ii) **EU bank capital regulation**. *Hackenes and Schnabel (2011) defend that higher capital requirements inhibit competition for loans, prompting the increase in loan rates*
  (iii) **Development of the financial system**. *Tan and Floros (2012): more developed banking institutions increase the demand for banking services, which incentivizes potential competitors to enter the market.*
  (iv) **Market structure**. *SCP hypothesis Bain (1951). Although concentration indicators may not be adequate proxies to directly infer competition, they provide significant industry-specific information of banking markets.*
  (v) **Economic shocks**. (Global Financial Crisis and Euro debt crisis).

2. Methodology

- 1st assumption. The output price (P) that banks set must be higher than the marginal cost (MC):

$$P > MC \equiv \frac{\partial C}{\partial Y} \qquad (1)$$

- Multiplying both sides of equation (1) by the ratio of output to total cost, it follows:

$$P\frac{Y}{C} > MC\frac{Y}{C} = \frac{\partial C}{\partial Y}\frac{Y}{C} = \frac{\partial lnC}{\partial lnY} \qquad (2)$$

  - (PY/C) = Revenue share in total cost
  - $(\partial lnC/\partial lnY)$ = Cost elasticity

2. Methodology

- 2nd assumption. Bank's technology is represented by a **translog cost function**:

$$ln\,C = \beta_0 + \sum_{j=1}^{J} \beta_j\, lnW_j + 0.5 \sum_{j=1}^{J} \sum_{j=1}^{J} \beta_{jk}\, lnW_j\, ln\, W_k + \beta_Y lnY + 0.5\, \beta_{YY}\, (lnY)^2 + \\ + \sum_{j=1}^{J} \beta_{Jy}\, lnW_j\, ln\, Y + \beta_T T + 0.5\, \beta_{TT}\, T^2 + \sum_{j=1}^{J} \beta_{jT}\, lnW_j\, T + \beta_{YT} T lnY, \qquad (3)$$

- The **cost elasticity (∂lnC/∂lnY)** is then equal to:

$$\frac{\partial lnC}{\partial lnY} = \beta_Y + \beta_{YY} lnY + \sum_{j=1}^{J} \beta_{jY} lnW_j + \beta_{YT} T \qquad (4)$$

- The inequality (2) can be converted into an equality adding a **non-negative one-sided term, *u***:

$$\frac{PY}{C} = \frac{\partial lnC}{\partial lnY} + u, \qquad u \geq 0. \qquad (5)$$

2. Methodology

- By adding a two-sided noise disturbance term, v, and developing the cost elasticity term, equation (4) becomes the following stochastic frontier function::

$$\frac{PY}{C} = \frac{\partial lnC}{\partial lnY} + u + v = \beta_Y + \beta_{YY} lnY + \sum_{j=1}^{J} \beta_{jY} lnW_j + \beta_{YT} T + u + v. \qquad (6)$$

  - u represents the deviations of the revenue share to total cost from its frontier.
  - Given that (5) has been derived from (1):
    - ✓ It is indifferent to obtain a measure of market power either by estimating the distance between the output price and the marginal cost or by estimating the distance between the revenue share in total cost ($\frac{PY}{C}$) and its frontier ($\frac{\partial lnC}{\partial lnY} + v$).
    - ✓ Mark-ups estimates will be directly obtained from the estimation of equation (6).

2. Methodology

- If we define the **"mark-up factor" (θ):**

$$\theta = \frac{P-MC}{MC} \tag{7}$$

- The above specification (7) can be related to u as follows:

$$\theta = \frac{u}{\frac{\partial lnC}{\partial lnY}} \tag{8}$$

- Once (6) is estimated, the mark-up factor, $\hat{\theta}$, can be obtained from:

$$\hat{\theta} = \hat{u} / \left(\hat{\beta}_Y + \hat{\beta}_{YY} lnY + \sum_{j=1}^{J-1} \hat{\beta}_{jY} ln\tilde{W}_j + \hat{\beta}_{YT} T \right), \tag{9}$$

2. Methodology

- After obtaining $\hat{\theta}$, this value can be then employed to obtain the Lerner index (L) from the following relationship:

$$L = \frac{\hat{\theta}}{(1+\hat{\theta})} \tag{10}$$

- **Incorporation of environmental variables in Kumbhakar et al. (2012) model – by applying the Battese and Coelli (1995) simultaneous estimation:**

$$\frac{PY}{C} = \beta_Y + \beta_{YY} lnY_{it} + \sum_{j=1}^{J} \beta_{jYt} lnW_{jt} + u_{it} + v_{it}. \tag{11}$$

$$u_{it} = z_{it}^{'} \delta + \varepsilon_{it} \tag{12}$$

  - $v_i \sim N(0, \sigma_v^2)$
  - $u_i \sim N^{+}(\mu_i, \sigma_u^2)$
  - Where: $\mu_i = z_i' \delta$; z_i is the vector of environmental variables and δ the vector of parameters

3. Data

- Unbalanced panel dataset of EU-28 banks spanning the period **2005-2019**:
  - 2005-2015: Bureau Van Dijk's BankScope database
  - 2015-2019: Moody's Analytics BankFocus database

- The sample comprises a total of **5,235 observations** for **705 banks**. Banks' specialisation**: Commercial**, **cooperative** and **savings banks**.

Variable name	Description	Source
HHI	Hirschman–Herfindahl index (HHI) for total assets	ECB Banking Structural Financial Indicators Database
FID	Financial Institutions' Depth. Normalized and concentrated index from: ○ Private-sector credit to GDP ○ Pension fund assets to GDP ○ Mutual fund assets to GDP ○ Insurance premiums, life and non-life to GDP	IMF Financial Development Index Database (IMF WP/16/5)
FIA	Financial Institutions' Access Normalized and concentrated index from: ○ Bank branches per 100,000 adults ○ ATMs per 100,000 adults	IMF Financial Development Index Database (IMF WP/16/5)
FMD	Financial Markets' Depth Normalized and concentrated index from: ○ Stock market capitalization to GDP ○ Stocks traded to GDP ○ International debt securities of government to GDP ○ Total debt securities of financial corporations to GDP ○ Total debt securities of nonfinancial corporations to GDP	IMF Financial Development Index Database (IMF WP/16/5)
G-SIB	Dummy variable equal to 1 if the bank is listed as Global Systematically Important Bank, and 0 otherwise; in any year within the period 2011-2019.	Own elaboration. Data on G-SIBs from Financial Stability Board (FSB) official banks' lists
Buffer	Capital Buffer = (Equity/Total Assets) – Minimum capital adequacy ratio (8%)	Own elaboration. Data on Equity and Total Assets from BankScope and BankFocus databases
IR	Over-night or short-term interest rates For EMU countries: ○ Euro Over-Night Index Average (EONIA) For non-EMU countries: ○ Over-night / three-month interest rates (e.g. for UK: Sterling OverNight Interbank Average index (SONIA))	European Commission Eurostat Exchange and Interest Rates dataset and European Central Bank (ECB) Statistical Data Warehouse.
Crisis	Global Financial Crisis and Euro Sovereign Debt crisis: dummy variable equal to 1 if the year is 2008-2013; and 0 otherwise.	Own elaboration

5. Estimation results

Table 5. Posterior mean estimates of the Lerner index without environmental variables (BC95(2)).

Estimated Lerner Index	***Total sample***	***EMU***	***Non-EMU***
Number of observations	5,235	3,874	1,361
Mean	**0.147**	**0.136**	**0.173**
Estimated cost elasticity (1)	***Total sample***	***EMU***	***Non-EMU***
Number of observations	5,235	3,874	1,361
Mean	**0.921**	**0.914**	**0.937**

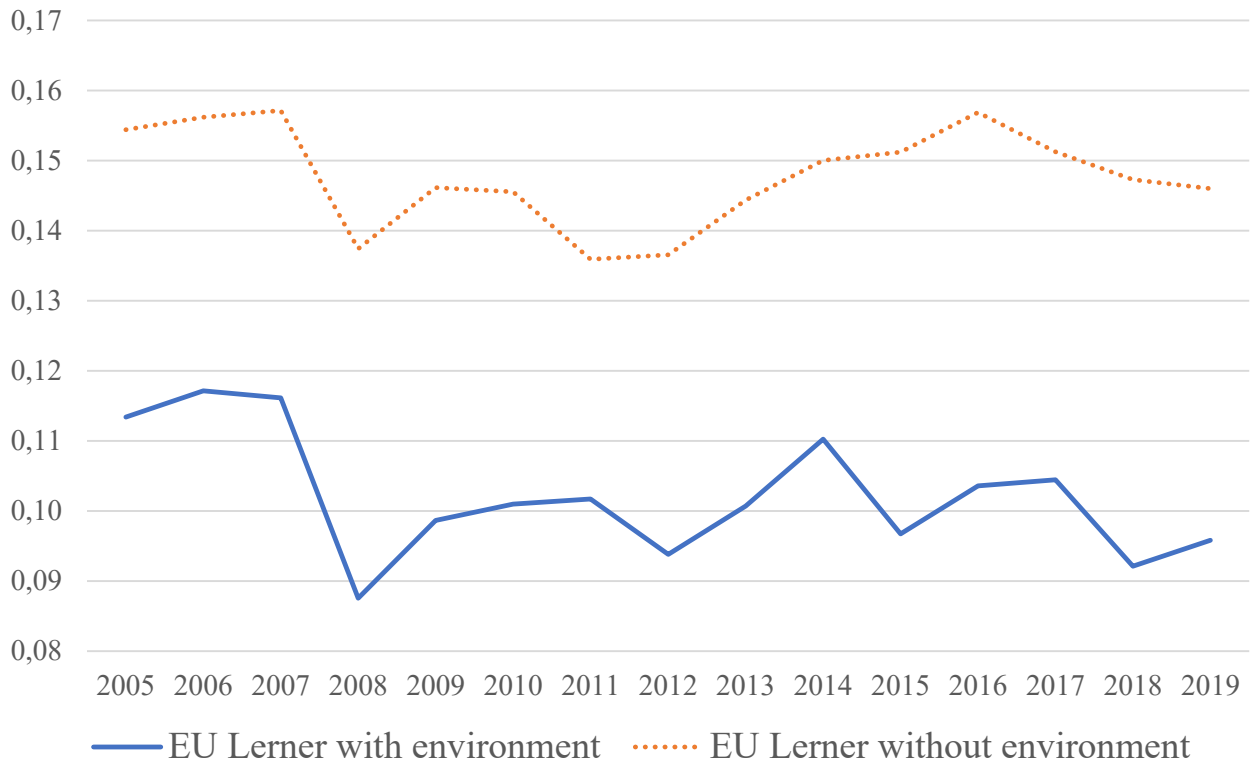
Table 6. Posterior mean estimates of the Lerner Index and scale elasticities with environmental variables included (BC95(1)).

Estimated Lerner Index	***Total sample***	***EMU***	***Non-EMU***
Number of observations	5,235	3,874	1,361
Mean	**0.103**	**0.081**	**0.164**
Estimated cost elasticity (1)	***Total sample***	***EMU***	***Non-EMU***
Number of observations	5,235	3,874	1,361
Mean	**0.961**	**0.956**	**0.975**

Note: (1): given that Returns to Scale: RTS = $(1/\varepsilon)$. Then, $\varepsilon < 1$ indicates increasing returns to scale (economies of scale); $\varepsilon = 1$ indicates constant returns to scale; and $\varepsilon > 1$ indicates decreasing returns to scale (diseconomies of scale).

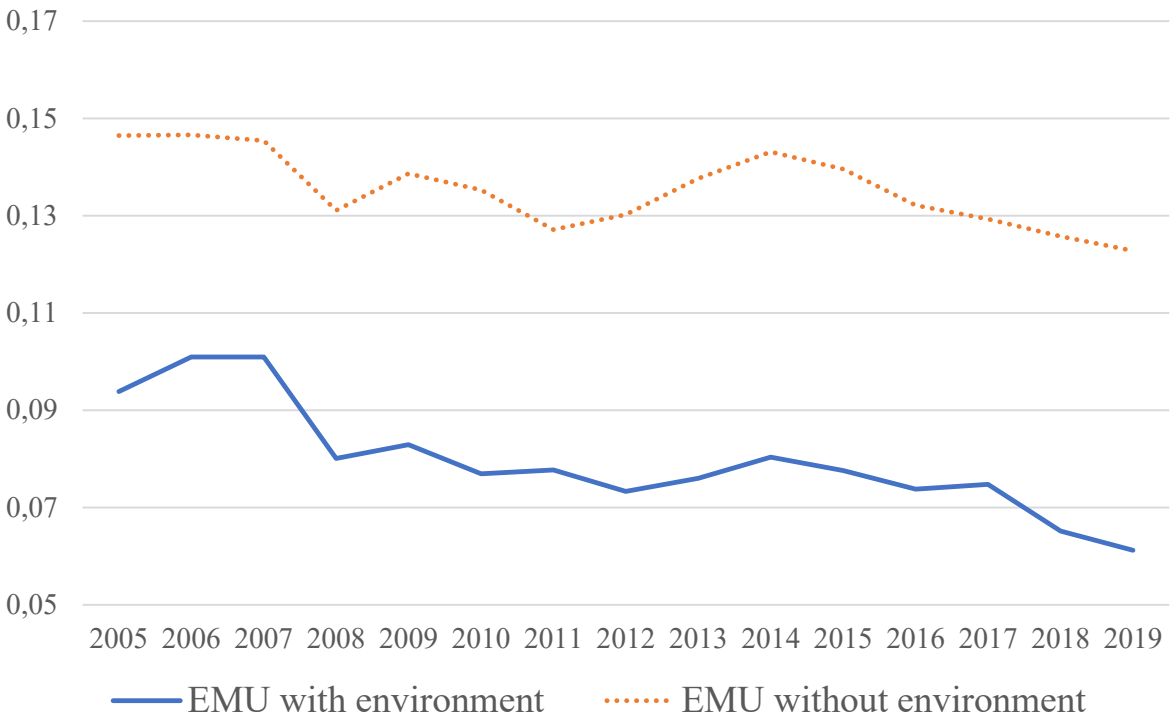
5. Estimation results

Figure 1. Mean Lerner Index for EU banks (2005-2019)



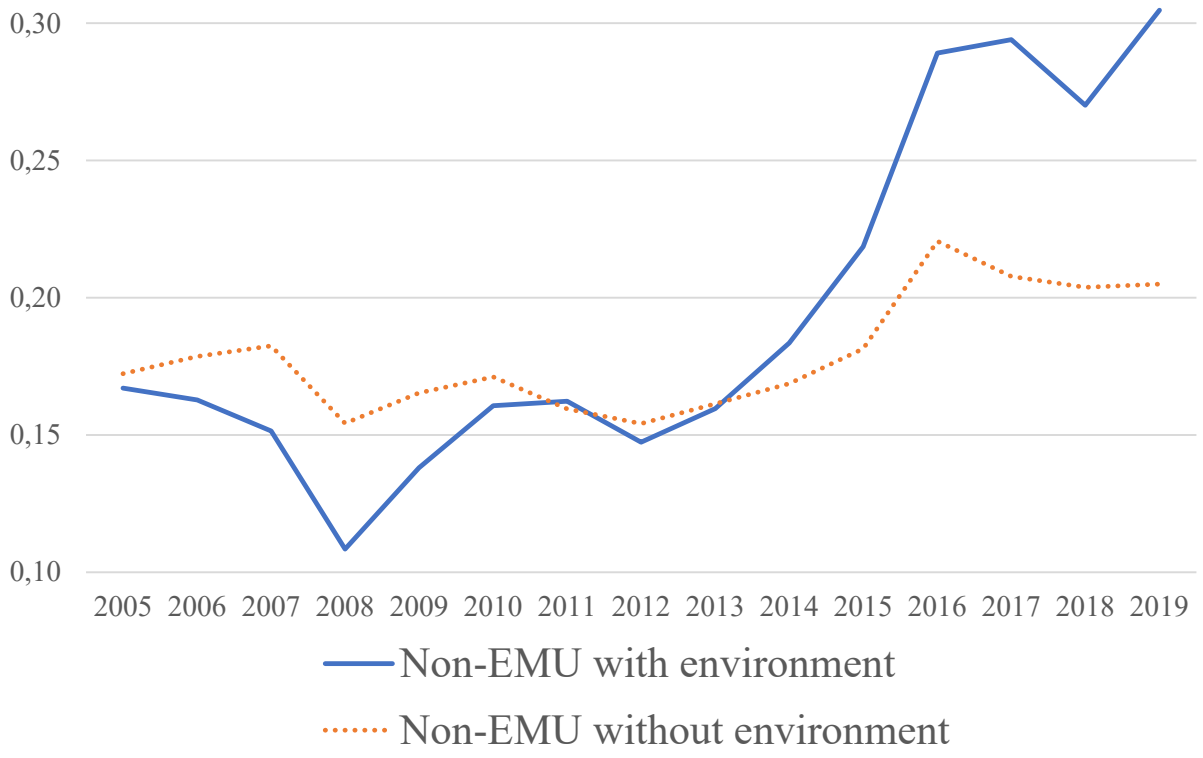
5. Estimation results

Figure 2. Mean Lerner Index for EMU banks (2005-2019)



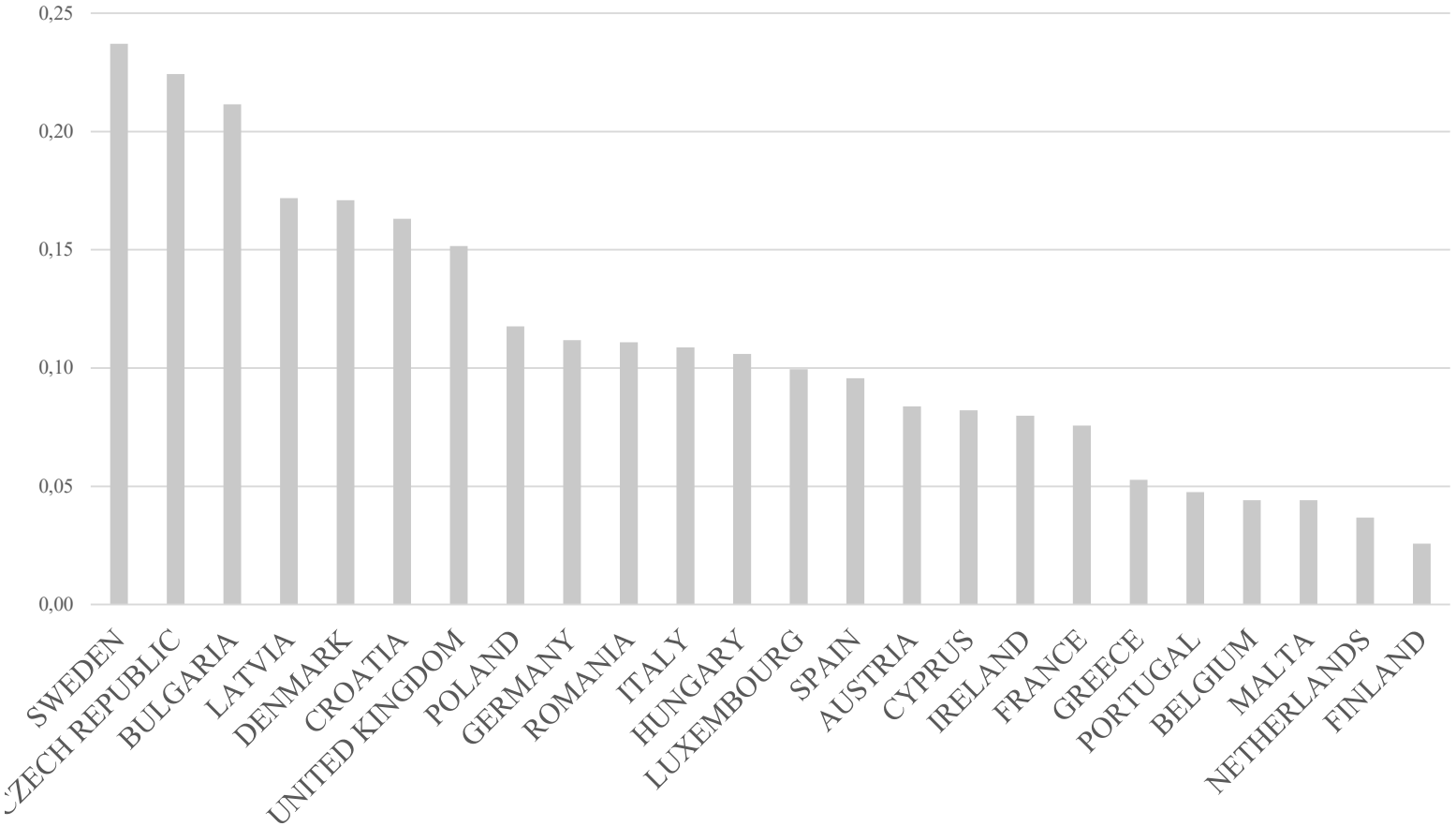
5. Estimation results

Figure 3. Mean Lerner Index for non-EMU banks (2005-2019)



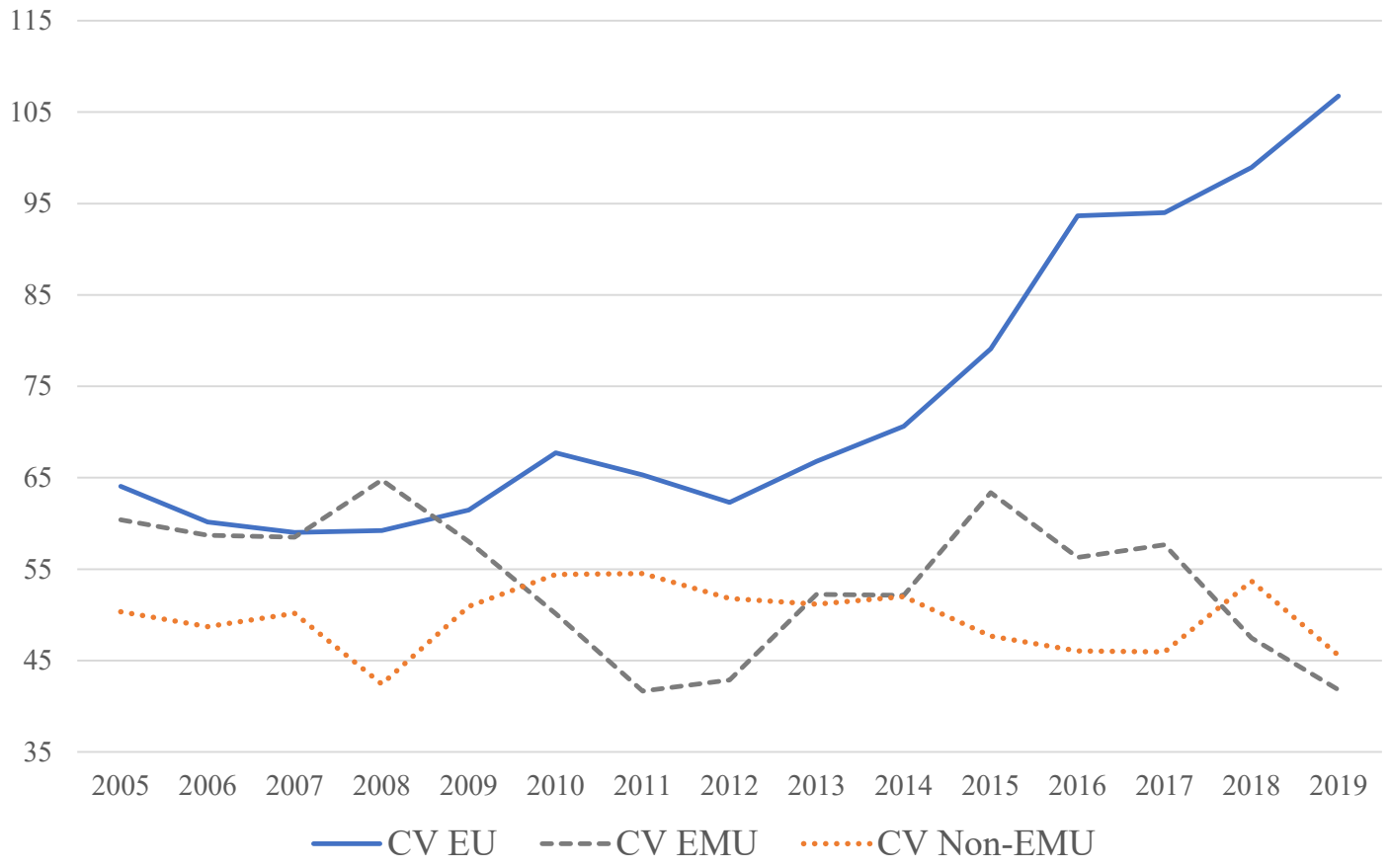
5. Estimation results

Figure 4. Average Lerner Index (from BC95(1)) estimation per country.



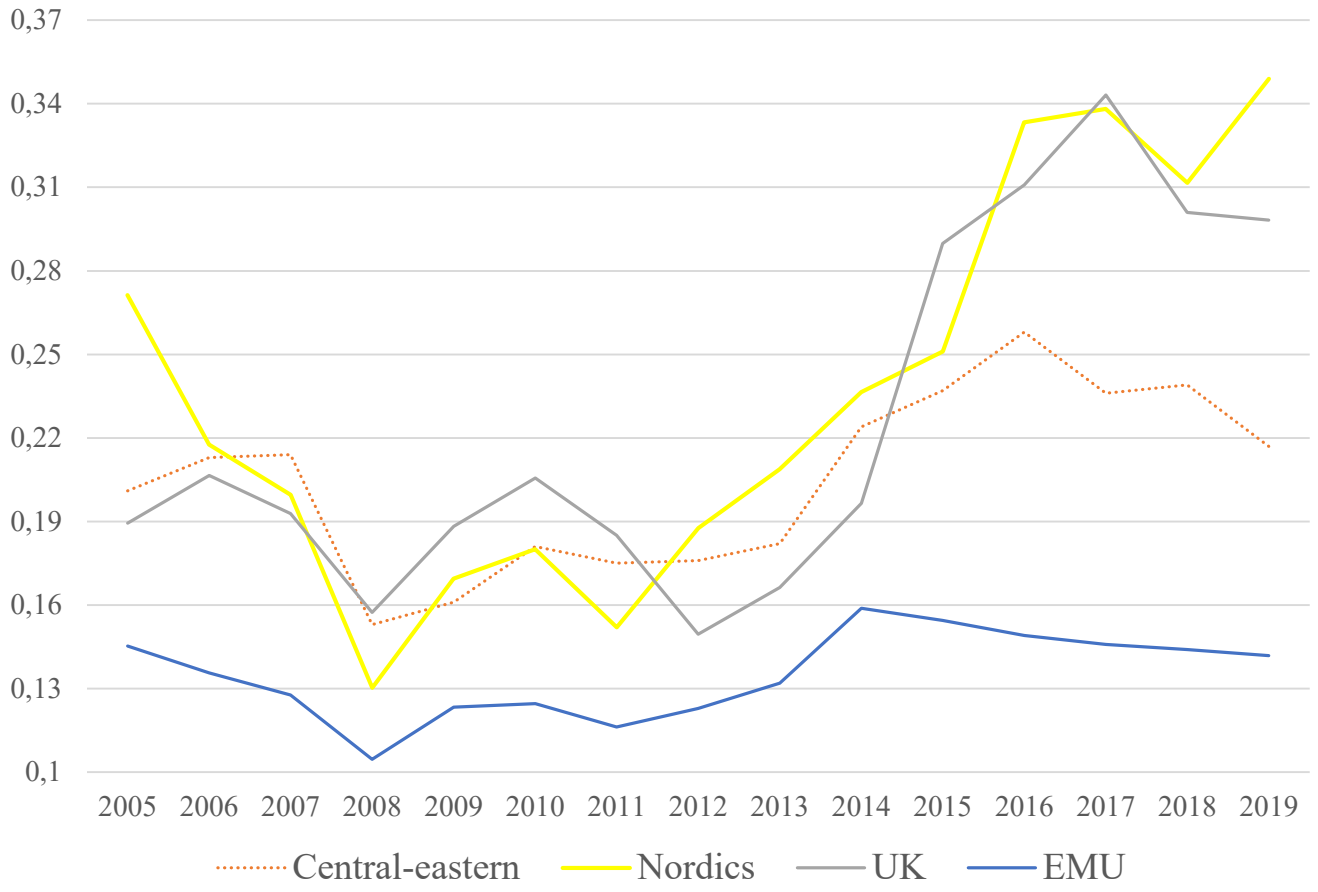
5. Estimation results

Figure 5. Evolution of the Coefficient of Variation per group of countries (2005-2019).



5. Estimation results

Figure 6. Mean Lerner index estimation with environmental variables by group of non-EMU banks.



6. Conclusions

- **Environmentally-adjusted Lerner index → "cleaner" estimation of market power**:
  - It **levels down Lerner index estimations** for the whole sample (EU) and for groups (EMU and Non-EMU).
  - **Boosts any trend** in market power levels for each group of banks (either positive or negative).
- **Notable divergence in market power levels between EMU and non-EMU banks** for the whole period of study (2005-2019). Intensified since 2012, due to the remarkably increase in market power levels within non-EMU countries → mainly driven by **UK and Nordic banks**.
- Environmentally-adjusted Lerner index reveals: Fragile although constant deterioration of banking market power levels within **EMU countries → may indicate advances in the Banking Union**.
- No process of market power convergence (within group) is obtained for **non-EMU banks** → persistent **barriers to the integration** of the EU banking market.
- *Further research:* to analyse the existing disparities detected for the group of non-EMU banks (specially for UK and Nordic banks), as well as, to study which factor may explain their sharp increase in market power observed from 2012.

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