

Economies of scale and technological development in depository and settlement systems

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New perspectives in securities

Industry

- Economies of scale and scope in stock exchange activities
Hasan, I. – Malkamäki, M. (JBF, 2001)
- Technological development and concentration of stock exchanges in Europe
Schmiedel, H. (RBF, 2003)
- Technology, automation, and productivity of stock exchanges: international evidence
Hasan, I. – Malkamäki, M. – Schmiedel, H. (JBF, 2003)
- Networks and equity market integration: European evidence
Hasan, I. – Schmiedel, H. (IRFA, 2004)
- Total factor productivity growth in European stock exchanges
Schmiedel, H. (BOF, 2002)

Introduction

Observation:

- Integration of global capital markets
- Technological progress making location less important
- Regulatory changes and introduction of European single currency to foster cross-border competition
- Limited cross-border consolidation of financial institutions within Europe due to efficiency barriers
Berger, DeYoung, and Udell (EFM, 2001), Giovannini Group (2001, 2003)
- Multiplicity of EU clearing and settlement systems
less cost-effective solutions for users

Introduction

Research questions:

- Does scale matter in securities settlement business?
- Do costs differ across types, settings, size, and regions?
- What is the average total cost to settle a single securities market trade?
- What are the major cost categories for settlement systems?
- What are the implications for cost efficiency?
- How cost-efficient is the European system compared to international experiences?

Literature

- No empirical study available
- *Lannoo and Levin (CEPS WP, 2001)* cross-country statistics on EU settlement systems
- Why is there a gap in the literature?
 - Infrastructure issue
 - Data availability and quality
 - What constitute cost, outputs and inputs?
- *Arnold et al. (JF, 1999), Domowitz and Steil (1999), and Pirrong (JFM, 1999)* ⇒ settlement agencies as operating firms
- Supply side
- Global multi-year analysis

Developments

Integration of securities market
infrastructures in the euro area
Schmiedel, H. – Schönenberger, A.
(ECB OP, 2005 forthcoming)

Empirical methodology

Multi-product translog and loglinear cost functions

$$\begin{aligned} \ln TC(P, Q, T, D, YR) = & \alpha_0 + \alpha_1 \ln Q_1 + \alpha_2 \ln Q_2 + \beta_{11} (\ln Q_1)^2 + \beta_{22} (\ln Q_2)^2 + \\ & + \sum_i \gamma_i \ln P_i + \sum_i \sum_j \gamma_{ij} \ln P_i \ln P_j + \beta_{12} \ln Q_1 \ln Q_2 + \\ & + \sum_i \sum_k \delta_{ik} \ln P_i \ln Q_k + \tau_1 T + \lambda_1 D_l + \sum_l \delta_l YR_l \end{aligned}$$

where:

TC	=	Total operating cost
P	=	Inputs
Q	=	Outputs
T	=	Time trend
D	=	Binary variables

Empirical methodology

Scale elasticity coefficients with respect to different model specification

$$\varepsilon_1^c = \frac{\partial \ln TC}{\partial \ln Q_1} = \alpha_1 + 2\beta_{11} \ln Q_1 + \beta_{12} \ln Q_2 + \sum_i \delta_{i1} \ln P_i$$

$$\varepsilon_2^c = \frac{\partial \ln TC}{\partial \ln Q_2} = \alpha_2 + 2\beta_{22} \ln Q_2 + \beta_{12} \ln Q_1 + \sum_i \delta_{i2} \ln P_i$$

Measurement issues

- Cost components?

Direct costs: settlement fees charged to market participants

⇒ *problematic: complex fee structure*

Indirect costs: back-office costs, interface costs, etc.

⇒ *measurement lacks detailed information and comparability*

- Operating income and cost
- Publicly available information, financial statements, annual reports,...
- Comparable and consistent panel data set

Data and descriptive statistics

- Unbalanced panel of 16 SSSs
- ...across different regions with special focus on European agencies
- 1993-2000
- Data sources:
 - Annual reports
 - ECB Blue Book
 - BIS
 - Internet sites
 - Correspondence
 - Others

Data and descriptive statistics

Table Average key performance ratios for selected settlement institutions, 1993–2000

Years/ Region / Code	OPCOST/NSETT	OPINC /NSETT	OPMARGIN (%)	OPCOST/VDEP	OPINC/VDEP	NSETT/VDEP
1993-1996	3.43	3.74	8.18	0.035	0.037	0.0099
1997-2000	3.22	3.77	14.56	0.009	0.011	0.0028
1993-2000	3.33	3.75	11.39	0.022	0.024	0.0063
Europe (ICSD)						
Clearstream Luxembourg	29.02	35.57	18.41	0.015	0.015	0.0008
Euroclear Bank	53.64	65.79	18.46	0.010	0.012	0.0002
Europe (excl. ICSDs)						
APK	12.81	21.60	40.69	0.077	0.091	0.0044
CRE	1.58	2.31	31.37	0.031	0.045	0.0166
DBC	3.72	4.39	15.29	0.033	0.041	0.0125
MON	3.93	6.71	41.46	0.060	0.091	0.0097
NEC	5.88	5.97	1.54	0.035	0.036	0.0072
SEG	6.73	7.80	13.68	0.042	0.050	0.0066
SC	3.15	4.31	26.83	0.029	0.040	0.0099
VP	5.03	6.13	17.97	0.071	0.088	0.0148
VPC	5.17	6.47	20.00	0.054	0.067	0.0198
VPS	6.43	6.94	7.48	0.141	0.152	0.0196
Europe						
All	3.86	5.10	24.27	0.042	0.060	0.0115
excluding ICSDs	3.11	3.82	18.52	0.060	0.072	0.0204
ICSDs	40.54	49.61	18.29	0.013	0.017	0.0004
North America						
CDS	2.93	3.12	6.37	0.063	0.067	0.0236
DTC	2.90	2.92	0.80	0.007	0.007	0.0026
Asia, Pacific						
HSC	4.42	7.79	43.26	0.100	0.176	0.0212
JAS	2.64	3.22	18.09	0.141	0.150	0.0166

Data and descriptive statistics

- Cost per securities settled:
 - Average unit cost \$3.86 in EU vs. \$2.90 in US
 - Cross-border settlement cost \$40.54 vs. \$3.11 domestic level
 - Only EU CSD's vs US cost differential is less pronounced (\$3.11 vs. \$2.90)
 - Lower cost ratio driven by cost effective UK system (\$1.58)
 - All other EU CSDs above average
 - Highest average unit cost for Finish silo system of \$12.81
- Cost per value deposited instructions:
 - ICSDs almost same cost effectiveness as US system (\$0.013 vs. \$0.007)
 - Domestic CSDs lower cost efficiency of \$0.060
 - Asia-Pacific systems lowest in terms of cost per value deposited instructions

Data and descriptive statistics

- Income per securities settled:
 - Average unit income in EU (EU excl. ICSDs) almost 75% (30%) higher than in US system
 - Average operating margin of EU SSSs 18.52% - 24.27%
 - Asia-Pacific institutions almost same margins as in EU
 - North American systems substantially smaller margins vs. others
 - Revenues in centralised US system just cover cost (\$0.80)

Empirical results

Empirical strategy:

1. Translog and loglinear regression results using alternative model specifications
2. Decomposition of multiproduct scale economies according to size and geographical location
3. Scale economies and technological progress
4. Relative efficiency of individual settlement institutions

Empirical results

Loglinear and translog cost functions:

Model I:

- Loglinear model specification
- 2 outputs: no. of settlement instructions, value of deposited securities
- Technological change
- 1993-2000 period

Model II:

- Translog model specification
- Single output: no. of settlement instructions
- Single input: GDP per capita
- Technological change
- 1993-2000 period

Model III:

- Same as model II
- Multiple outputs: no. of settlement instructions, value of deposited securities

Empirical results

New model features!

- Same model specifications with single/multiple outputs
- Two alternative inputs:
 - Price of labour (staff costs per employee)
 - Price of capital (information and communication technology expenditure)
- Comparable significant full/sub-sample estimates

Empirical results

Single and multiple output estimations:

- Evidence potential cost savings concerning
 - Number of settlement instructions
 - Value of securities deposited
- National vs. ICSD
 - Potential cost saving three times higher for ICSDs
- Technological progress over time

Empirical results

Scale economies estimates

... for single and multiple output framework:

- Substantial overall scale economies, ie 69.6% (53.4%) concerning number of settlement instructions
- Large EOS in depository activities
- Identical results for log-linear model
- Doubling settlement and depository businesses associated with 71% to 74% higher cost

Empirical results

Scale economies estimates

...according to different type and geographical location:

- European CSDs highest potential cost savings of 63.9% to 68.6%
- European ICSDs somewhat higher than CSDs reveal EOS of 69.6% to 71.4%
- Asia-Pacific systems show cost effectiveness of 74.1% to 73.6%
- US centralized system cost saving benchmark of 94.4%

Empirical results

Scale economies estimates

...by different size categories:

- Substantial economies of scale for relatively smaller systems
- Smaller EOS among larger settlement institutions

Empirical results

Scale economies and technological change:

- Technical progress over time
- Yearly average rate of 6%
- Similar results for yearly average changes:
 - Yearly cost reductions
 - 1995 intensive investments in technologies
 - In later years, investments pay off in becoming more cost effective
- Comparable results of improving cost-effectiveness over time in stock exchange industry

Empirical results

Table: Relative efficiency of individual settlement institutions

Code	Model IIb [1 output, 1 input, trend, ICSD]	Code	Model IIIb [2 output, 1 input, trend, ICSD]
CRE	-0.3068	NEC	-0.2936
JAS	-0.2943	CRE	-0.2769
NEC	-0.2807	MON	-0.1893
MON	-0.2117	VP	-0.1552
VPS	-0.1500	SEG	-0.0777
VP	-0.1440	DTC	-0.0419
CDS	-0.0060	VPS	-0.0085
ECB	0.0000	ECB	0.0000
CEB	0.0141	CEB	0.0112
DTC	0.0272	CDS	0.0228
HSC	0.1014	JAS	0.0744
SEG	0.1473	VPC	0.0974
VPC	0.1894	DBC	0.1958
DBC	0.2589	HSC	0.2071
SC	0.3102	SC	0.2150
APK	0.4658	APK	0.5372

Note: The coefficients reported in this table are calculated as residuals from the models including outputs, input, and binary variables. The scores are listed in descending order according to the relative efficiency levels of the individual settlement institutions.

Empirical results

Relative efficiency of settlement institutions:

- Residuals provide indicative information on efficiency of each individual settlement service providers
- Future research: efficient frontier analysis
- Overall, substantial differences in efficiency

Conclusions

- Empirical analysis of the performance, competitiveness, and overall understanding of the behavioral underpinnings of securities depository and settlement systems
- Multi-year, global data set of 16 depository and settlement service providers during 1993-2000 period
- Test for economies of scale in settlement institutions according to different types, size, and geographical location
- Focus: role of organizational design, technological development, and structure of national and cross-border settlement arrangements

Conclusions

- Existence of EOS in depository and settlement activities
- US system is cost saving benchmark settlement system
- European and Asia-Pacific regions high potential unit cost savings
- Rule of thumb for smaller settlement providers: cost should increase by about $2/3$ as output or potential volume doubles
- Settlement across borders associated with higher cost than domestic level
- Continuous improvement in cost-effectiveness over time

Conclusions

- Accelerate investment plans, reduce prices, or merge..., to achieve higher production at lower unit cost
- Regulation matters?
- Centralized US settlement system at optimal scale
- Successful implementation of a US style model in EU?
- Further integration of EU settlement infrastructure
some kind of collaboration or consolidation of existing

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