Overseas Market Information and Firms' Export Decisions

(Former title: Bank's Role as an Information Provider for Exports: Evidence from Listed and Unlisted Firm Data)

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Based on Ver.2 paper

1. Introduction & Motivation

- Discussion after numerous empirical studies based on Melitz (2003)

  ⇒ Other important factors than TFP?

  - **Financial friction**:
    Manova et al. (2011), Minetti & Zhu (2011), Amiti & Weinstein (2011), Paravisini et al. (2011), Inui et al. (2012)
  - **Information spillovers**:
    Koenig et al. (2011), Inui et al. (2012)

- Remained questions?

  Our main motivation

  - Limited number of empirical studies in Japan (esp. for unlisted firms)
  - Simultaneous consideration (i.e., financial and information factors)

- What is this paper about?

  - Empirically study if lender banks could contribute to the extensive margin of firm exports through financial and information channels
  - Use a unique firm-level data augmented by the lender information
    - ✓ Samples firms include a large number of unlisted firms
    - ✓ The data contain firms' export dynamics (extensive and intensive margins)
    - ✓ The data also contain the ranking of lender banks to client firms in terms of their importance

2. Summary of Key Findings

- Information spillovers about export destinations through lender banks positively affect firms' decision both to (i) start export and (ii) extend export destinations

  ✓ The results become more sounding for smaller firms with higher productivity

  ✓ The results are kept even when we take deeper lags (e.g., five years) for the explanatory variables

- Information spillovers through nearby exporters in the same industry positively affect firms' decision to extend export destinations

- Financial characteristics of lender banks does not show any systematic impact on the extensive margin

- Financial characteristics of firms themselves (e.g., size, liquidity, listed status) does not show any systematic impact on the extensive margin

3. Related Literature: Theory

- Melitz (2003): extensive margin
  - Firms have to incur fixed costs to start exporting (collect information, modify products to fit local tastes, and/or set up distribution networks etc.)
  - Only firms productive enough to cover such fixed costs can be exporters

- Chaney (2008): extensive & intensive margins
  - A change in the fixed cost affects the extensive margin while a change in the variable cost affects both the intensive and extensive margins

- Krautheim (2007): extensive margin
  - Exchange of information between firms exporting to the same country reduces the individual fixed cost to export and increases export probability

- Rauch and Watson (2003): intensive margin
  - The agglomeration of exporters can increase the buyer's information on the quality of the suppliers, and hence positively affects the intensive margin

3. Related Literature: Empirical studies

- Productivity advantages: Criticizing TFP
  - Bernard et al. (2003), Mayer & Ottaviano (2008), Todo (2011): Productivity advantage does not sufficiently explain the self-selection of firms into exporting

- Export spillovers: Growing field but the results are still mixed
  - Koenig et al. (2010) : Presence of other exporters influences positively the export decision of other firms
  - Aitken et al. (1997), Barrios et al. (2003), Bernard & Jensen (2004): No evidence on the existence of export spillovers

- Role of financial institutions: New perspective but vague
  - Inui et al. (2011): banks' efficiency (a proxy for their ability to screen, monitor, and advise client firms) has a positive effect on the export decision and overseas sales ratio
  - Inui et al. (2012): banks' role as information conduit (***only listed firms!!!***)

4. Empirical Model (1)

- Basic assumption
  - Firms export if the profits when exporting exceeds the profits when not exporting
  - Determinants of the difference in the profits:
    - ✓ Firm characteristics (productivity, size, skill level of workers)
    - ✓ Firms' financial conditions (liquidity, listed status)
    - ✓ Amount of information on export markets available to the firm (★) from banks & nearby exporters
    - ✓ Top lender's ability to supply fund
  - The availability of (★) will lower the uncertainty of profits from exporting
    - ✓ Lower either the variable or the fixed cost of exporting
    - ✓ Increase the probability of being exporter, starting export, and decrease the probability of stopping export

4. Empirical Model (2)

- Extensive margin: **Panel probit** (random-effect)

Working on Fe (i.e., conditional logit) too…

$$Prob_{it}(Export) = \alpha + \beta \times Z_{it-\tau} + \gamma \times I_{it-\tau} + \delta \times B_{it-\tau} + \eta_i + IND_i + TIME_t + \varepsilon \quad (1)$$

τ = 1, 3, 5 for featuring the exogeneity more

- $Prob_{it}$: Probability of firm-*i*'s exporting at *t*
- Z_{it}: A vector of firm characteristics
  - Including firm size, (liquidity asset/total asset), listed status
- I_{it}: A vector of variables representing information available to firms
  - Information provided by main banks, firms' own overseas activities, spillovers from nearby exporters
- B_{it}: A vector of main bank characteristics
  - Including main bank size, (equity/total asset), (loan/deposit)
- Individual effect η_i is controlled
- Industry IND_i and time-specific fixed effects $TIME_t$ are included

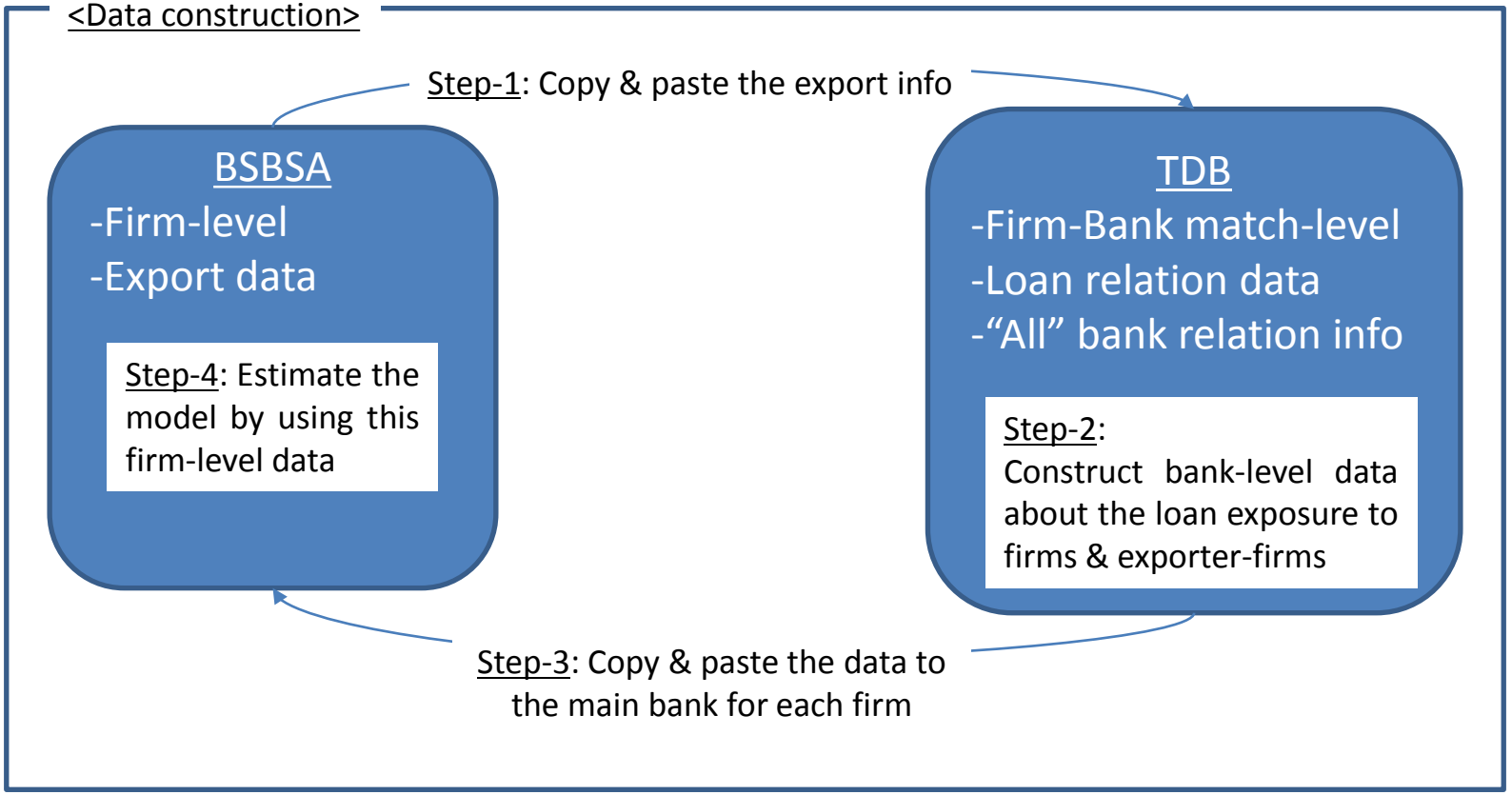
Omitted from the current paper

5. Data (1): Data Sources

- Basic Survey of Business Structure and Activities (BSBSA: Kigyo Katsudou Kihon Chosa)
  - ✓ Firm-level data
    - ➢ Export for each region, overseas activities (e.g., employees)
    - ➢ Universe of enterprises in Japan with 50 or more employees whose paid-up capital or investment fund is greater than 30 million yen
- Database provided by Teikoku Databank Ltd.
  - ✓ List of banks that each firm transacts with rank (used to identify main bank)
  - ✓ Information about loan outstanding is not available
  - ✓ RIETI provides the data which basically covers the sample firms of BSBSA
- Nikkei NEEDs Financial Quest
  - ✓ Bank characteristics (not including Credit union: Shinso)
- Firm-level TFP is computed by applying the multilateral TFP index method developed (Good et al. 1997) to BSBSA data
- Sample periods: 1997FY～2008FY

5. Data (2): Data Construction

- The procedure of data construction



5. Data (3): Sample selection

- **BSBSA**:
  - #(Obs.) in this firm-level data 464,575 in 1991FY, 1994FY-2009FY

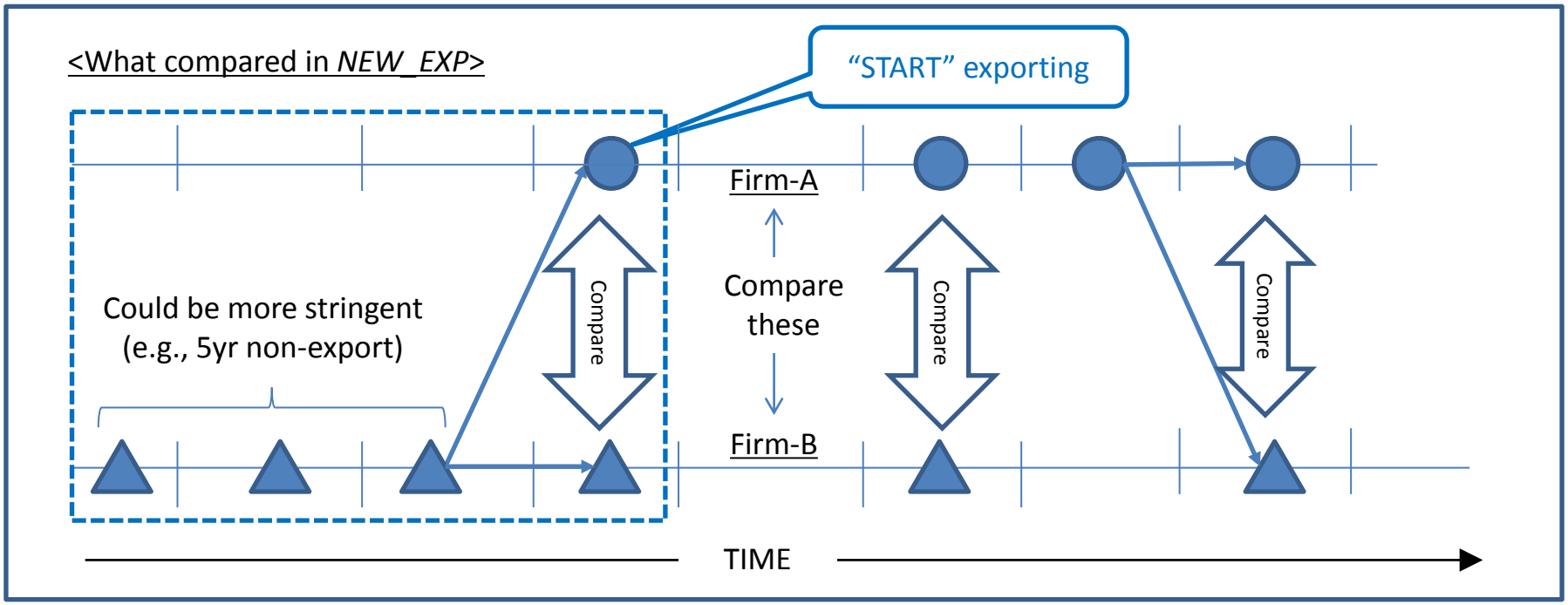
- **Merge BSBSA with TDB and construct match-level data (as in the previous slide)**:
  - #(Obs.) in this firm-level data 286,943 over 1997FY-2008FY

- **Focus on manufacturing industry, merge it with bank data, drop the outlier etc.**:
  - Construct firm-level unbalanced panel data
  - Merge bank characteristics obtained from NEEDs FQ
  - Drop 1% in each tail (TFP) and focus on the main bank with at least 50 clients
  - #(Obs.) for estimation **60,718** (at most) over 2000FY-2008FY

5. Data (4): Dependent Variables

- Export Status --- (dependent variable)
  - *START_EXPORT_DUMMY*: NEW_EXP
    1 for the firm not exporting in year ***t-1*** but exporting in year *t* (compare ▲→● vs. ▲→▲)
  - (Alternative-1) *EXPORT_DUMMY*:
    1 for the firm exporting in year ***t*** (compare ● vs. ▲)
  - (Alternative-2) *STOP_EXPORT_DUMMY* :
    1 for the firm exporting in year ***t-1*** but not exporting in year *t* (compare ●→▲ vs. ●→●)

Working on these too…



5. Data (5): Key Variables

- Information accumulated by banks
  - *NUM_EXPORTER*: # of exporting client firms for the bank which is the top lender for the firm
  - *BANKINFO*: Ratio of *NUM_EXPORTER* to the total number of client firms for each bank

Defined both

① by ignoring destination information

② for each destination

Omitted from the current paper

- Firm size, firms' financial constraints, firms' own overseas activities, TFP
- Number of exporter firms located in the same city and the same industry
- Main bank size, financial conditions

5. Data (6): Summary Stats

- Firm-level variables

Denominator is conditional

Variable	Obs.	Average	Std. Dev.	Min	Max
NEW_EXP （Dummy for starting export）	35,612	0.024	0.154	0	1
NEW_EXP_REGION（Dummy for starging export to a new region）	60,718	0.070	0.255	0	1
NEW_EXP_ASIA （Dummy for starting Asian export）	37,520	0.024	0.154	0	1
NEW_EXP_MEAST （Dummy for starting Middle East export）	50,837	0.007	0.083	0	1
NEW_EXP_EU （Dummy for starting EU export）	45,554	0.012	0.108	0	1
NEW_EXP_NA （Dummy for starting Northern America export）	44,304	0.014	0.116	0	1
TFP （Productivity）	35,612	-0.003	0.148	-0.662	0.593
BANKINFO （Number of clients exporting／Number of clients exporting）	35,612	0.207	0.072	0	0.512
BINFO_ASIA （Number of clients exporting to ASIA／Number of clients exporting）	35,612	0.185	0.067	0	0.488
BINFO_MEAST （Number of clients exporting to MEAST／Number of clients exporting）	35,612	0.028	0.017	0	0.138
BINFO_EU （Number of clients exporting to EU／Number of clients exporting）	35,612	0.084	0.040	0	0.288
BINFO_NA （Number of clients exporting to NA／Number of clients exporting）	35,612	0.098	0.044	0	0.321
F_SIZE （Log of the firm's total asset）	35,612	8.007	1.089	3.714	15.128
F_CASH （Firm's Liquidity asset／Total asset）	35,612	0.538	0.177	0.014	0.997
F_LISTED （Dummy for listed status）	35,612	0.058	0.234	0	1
F_NEARBYEXP （Number of firm's nearby exporter firms in the same city）	35,612	1.522	4.475	0	246
B_SIZE （Log of the bank's total asset）	35,612	16.385	1.588	12.657	18.896
B_CAP （Bank's equity／Total asset）	35,612	0.011	0.006	0.002	0.088
B_YOTAI(Bank's loan／Deposit)	35,612	0.824	0.295	0.537	5.031
B_NUM_CLIENT(Bank's number of clients)	35,612	3114	3580	4	10432

5. Data (7): Correlation

- Firm-level variables

(Obs.=35612)

	NEW_EXP	NEW_EXP_ASIA	NEW_EXP_MEAST	NEW_EXP_EU	NEW_EXP_NA	TFP	BANKINFO	BINFO_ASIA	BINFO_MEAST	BINFO_EU	BINFO_NA	F_SIZE	F_CASH	F_LISTED	F_NEARBYEXP	B_SIZE	B_CAP	B_YOTAI	B_NUM_CLIENT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1)	1.00																		
(2)	0.89	1.00																	
(3)	0.17	0.14	1.00																
(4)	0.37	0.26	0.20	1.00															
(5)	0.49	0.26	0.20	0.41	1.00														
(6)	0.02	0.02	0.01	0.01	0.02	1.00													
(7)	0.04	0.03	0.02	0.01	0.02	0.10	1.00												
(8)	0.04	0.03	0.02	0.02	0.02	0.11	0.99	1.00											
(9)	0.03	0.03	0.03	0.02	0.03	0.09	0.88	0.88	1.00										
(10)	0.04	0.03	0.03	0.02	0.03	0.10	0.94	0.94	0.92	1.00									
(11)	0.04	0.03	0.03	0.02	0.03	0.10	0.95	0.94	0.91	0.97	1.00								
(12)	0.07	0.06	0.05	0.04	0.05	0.20	0.21	0.21	0.21	0.22	0.22	1.00							
(13)	0.03	0.03	0.01	0.01	0.01	0.39	0.05	0.05	0.04	0.04	0.04	-0.08	1.00						
(14)	0.01	0.01	0.01	0.00	0.00	0.03	0.05	0.05	0.05	0.05	0.05	0.04	0.01	1.00					
(15)	0.03	0.03	0.01	0.04	0.02	0.05	0.19	0.19	0.16	0.17	0.16	0.11	0.06	0.02	1.00				
(16)	0.02	0.01	0.01	0.01	0.02	0.08	0.46	0.46	0.40	0.47	0.48	0.14	0.05	0.03	0.09	1.00			
(17)	0.00	-0.01	0.00	0.00	0.00	0.01	0.16	0.14	0.16	0.15	0.17	0.05	-0.01	-0.01	0.04	-0.04	1.00		
(18)	0.00	-0.01	0.01	0.00	0.01	0.01	0.27	0.23	0.29	0.28	0.31	0.12	-0.02	0.01	0.04	0.18	0.29	1.00	
(19)	0.02	0.01	0.01	0.01	0.02	0.07	0.35	0.36	0.29	0.35	0.35	0.10	0.05	0.03	0.08	0.88	-0.13	-0.03	1.00

5. Data (8): BANKINFO

- Banks with large *BANKINFO* for illustration

Ranking	*NUM_CLIENT*	*BANKINFO*
1	126	0.44
2	76	0.41
3	56	0.38
4	62	0.34
5	3,347	0.31
6	1,670	0.30
7	7,035	0.30
8	1,232	0.30
9	58	0.29
10	453	0.29
11	2,110	0.28
12	378	0.28
13	107	0.27
14	616	0.27
15	828	0.27
16	9,582	0.26
17	1,109	0.26
18	7,492	0.26
19	1,196	0.26
20	55	0.25
21	402	0.25
22	1,044	0.25
23	4,705	0.24
24	206	0.24
25	167	0.24
26	71	0.24
27	3,234	0.24
28	1,384	0.24
29	416	0.24
30	143	0.23
31	561	0.22
32	185	0.22
33	224	0.21
34	571	0.21
35	260	0.21
36	128	0.21
37	171	0.21
38	627	0.21

Ranking	*NUM_CLIENT*	*BANKINFO*
39	780	0.21
40	3,033	0.20
41	54	0.20
42	69	0.20
43	499	0.20
44	508	0.20
45	3,312	0.19
46	493	0.19
47	208	0.18
48	4,544	0.18
49	83	0.18
50	504	0.18
51	100	0.18
52	553	0.18
53	73	0.18
54	377	0.18
55	97	0.18
56	263	0.17
57	975	0.17
58	476	0.17
59	279	0.17
60	143	0.17
61	54	0.17
62	186	0.17
63	642	0.17
64	716	0.16
65	147	0.16
66	295	0.16
67	136	0.16
68	94	0.16
69	208	0.16
70	1,400	0.16
71	57	0.16
72	541	0.16
73	552	0.15
74	145	0.15
75	179	0.15
76	317	0.15

6. Empirical Analysis (1): Start Export Dummy (All, τ=1)

	(1)	(2)	(3)
	NEW_EXP	NEW_EXP	NEW_EXP
Extensive Margin (t)	dy/dx	dy/dx	dy/dx
F_SIZE (t-1)	0.2413 ***	0.2421 ***	0.2090 ***
	(0.0226)	(0.0226)	(0.0179)
F_CASH (t-1)	0.5313 ***	0.5278 ***	0.4110 ***
	(0.1341)	(0.1343)	(0.1083)
F_LISTED (t-1)	0.0731	0.0718	0.0169
	(0.0823)	(0.0825)	(0.0687)
F_NEARBYEXP (t-1)	0.0050	0.0048	0.0045
	(0.0035)	(0.0035)	(0.0028)
B_SIZE (t-1)	-0.0037	-0.0663 **	
	(0.0133)	(0.0287)	
B_CAP (t-1)	-6.1243 *	-5.2844	
	(3.6617)	(3.6520)	
B_LTD (t-1)	-0.1126	-0.0393	
	(0.0773)	(0.0796)	
TFP (t-1)	-0.1567	-0.1525	0.0273
	(0.1508)	(0.1510)	(0.1219)
BANKINFO (t-1)	0.6138 *	0.6130 *	0.5433 **
	(0.3259)	(0.3267)	(0.2395)
NUM_CLIENT (t-1)		0.000031 **	0.000007
		(0.000012)	(0.000005)
# Obs	35,612	35,612	50,317
# Groups	8896	8896	9857
Obs per group: min	1	1	1
avg	4	4	5.1
max	10	10	10
Year dummies	yes	yes	yes
Industry dummies	yes	yes	yes

Firms' own characteristics

No systematic Responses (poorly measured?)

Information source

6. Empirical Analysis (1): Start Export Dummy (All, τ=3, 5)

	τ = 3			τ = 5		
	(1)	(2)	(3)	(1)	(2)	(3)
	NEW_EXP	NEW_EXP	NEW_EXP	NEW_EXP	NEW_EXP	NEW_EXP
Extensive Margin (t)	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
F_SIZE (t-τ)	0.2530 ***	0.2604 ***	0.2390 ***	0.2319 ***	0.2288 ***	0.2303 ***
	(0.0268)	(0.0271)	(0.0225)	(0.0302)	(0.0300)	(0.0267)
F_CASH (t-τ)	0.6410 ***	0.6489 ***	0.5378 ***	0.6240 ***	0.6261 ***	0.6443 ***
	(0.1543)	(0.1550)	(0.1326)	(0.1758)	(0.1749)	(0.1580)
F_LISTED (t-τ)	-0.0834	-0.0825	-0.0269	-0.1561	-0.1569	-0.0670
	(0.1016)	(0.1013)	(0.0847)	(0.1164)	(0.1159)	(0.0994)
F_NEARBYEXP (t-τ)	0.0008	0.0004	0.0043	0.0074	0.0077	0.0089 *
	(0.0047)	(0.0048)	(0.0035)	(0.0053)	(0.0053)	(0.0046)
B_SIZE (t-τ)	0.0010	-0.0014		-0.0080	0.0536	
	(0.0162)	(0.0362)		(0.0203)	(0.0414)	
B_CAP (t-τ)	-2.2919	-2.5333		6.9931	5.7779	
	(4.1991)	(4.2630)		(4.3881)	(4.4584)	
B_LTD (t-τ)	-0.0408	-0.0440		-0.0695	-0.1160	
	(0.0793)	(0.0853)		(0.0794)	(0.0853)	
TFP (t-τ)	0.1644	0.1586	0.1758	-0.0359	-0.0392	-0.0779
	(0.1786)	(0.1792)	(0.1517)	(0.2082)	(0.2072)	(0.1825)
BANKINFO (t-τ)	0.8046 **	0.8326 **	0.7221 **	1.3540 ***	1.2459 ***	1.1500 ***
	(0.4059)	(0.4088)	(0.3139)	(0.4512)	(0.4532)	(0.3654)
NUM_CLIENT (t-τ)		2.6200E-07	3.0300E-07		-2.8500E-05 *	-4.1900E-06
		(0.0000)	(0.0000)		(0.0000)	(0.0000)
# Obs	30,698	30,735	41,873	21,681	21,681	29,359
# Groups	8096	8073	8872	6529	6529	7386
Obs per group: min	1	1	1	1	1	1
avg	3.8	3.8	4.7	3.3	3.3	4
max	9	9	9	7	7	7
Year dummies	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes

Confirmed

6. Empirical Analysis (2): Start Export Dummy (Region)

	(1)	(2)	(3)	(4)	(5)
	NEW_EXP _REGION	NEW_EXP _ASIA	NEW_EXP _MEAST	NEW_EXP _EU	NEW_EXP _NA
Extensive Margin (t)	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
F_SIZE (t-1)	0.2113 ***	0.2522 ***	0.3373 ***	0.2781 ***	0.3071 ***
	(0.0100)	(0.0222)	(0.0320) ***	(0.0269)	(0.0298)
F_CASH (t-1)	0.5882 ***	0.5150 ***	0.7330	0.4278 ***	0.6132 ***
	(0.0760)	(0.1320)	(0.2113)	(0.1562)	(0.1708)
F_LISTED (t-1)	0.0473	0.0924	0.0249	-0.0797	-0.1026
	(0.0435)	(0.0798)	(0.1115)	(0.0970)	(0.1052)
F_NEARBYEXP (t-1)	0.0082 ***	0.0079 **	0.0115 ***	0.0116 ***	0.0096 ***
	(0.0017)	(0.0033)	(0.0031)	(0.0028)	(0.0030)
B_SIZE (t-1)	0.0149 **	-0.0069	0.0011	0.0312	0.0144
	(0.0069)	(0.0132)	(0.0194)	(0.0156)	(0.0162)
B_CAP (t-1)	-1.4114	-4.5883	-9.4800 *	-1.5581	-1.6933
	(1.8270)	(3.5412)	(5.3838)	(4.2856)	(4.3377)
B_LTD (t-1)	-0.0083	-0.1055	0.0741	-0.1013	-0.0609
	(0.0305)	(0.0696)	(0.0693)	(0.0749)	(0.0717)
TFP (t-1)	-0.1103	-0.0448	-0.2417	0.1842	0.0435
	(0.0786)	(0.1475)	(0.2126)	(0.1685)	(0.1841)
BANKINFO_General† (t-1)	1.1647 ***	4.4923 *	-0.4439	1.7807 *	2.0467 *
	(0.1717)	(2.3875)	(0.9026)	(0.9592)	(1.0511)
BANKINFO_Region†† (t-1)		0.5436	8.0539 ***	1.4154 *	1.4704 *
		(0.3567)	(2.7078)	(0.8296)	(0.7756)
# Obs	60,718	37,520	50,837	45,557	44,304
# Groups	13199	9286	11732	10767	10576
Obs per group: min	1	1	1	1	1
avg	4.6	4.0	4.0	4.2	4.2
max	10	10	10	10	10
Year dummies	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes

Additional channel

Pattern?

6. Empirical Analysis (3): Sub-sample Analysis

	(1)	(2)	(3)	(4)
	NEW_EXP _REGION	NEW_EXP _REGION	NEW_EXP _REGION	NEW_EXP _REGION
	Small Size High TFP	Small Size Low TFP	Large Size High TFP	Large Size Low TFP
Extensive Margin (t)	dy/dx	dy/dx	dy/dx	dy/dx
F_SIZE (t-5)	0.3678 ***	0.3222 ***	0.1281 ***	0.1716 ***
	(0.0776)	(0.0754)	(0.0189)	(0.0327)
F_CASH (t-5)	0.3963 *	1.0322 ***	0.4704 ***	0.5303 ***
	(0.2257)	(0.2546)	(0.1384)	(0.2041)
F_LISTED (t-5)	-0.0604	0.1541	-0.0112	0.1306
	(0.1389)	(0.1563)	(0.0711)	(0.1084)
F_NEARBYEXP (t-5)	0.0123 **	0.0222 ***	0.0096 ***	0.0082 *
	(0.0059)	(0.0074)	(0.0030)	(0.0046)
B_SIZE (t-5)	0.0180	0.0114	0.0227	0.0286
	(0.0266)	(0.0288)	(0.0153)	(0.0230)
B_CAP (t-5)	12.1648 **	5.9954	-2.6204	2.2425
	(6.1701)	(6.2942)	(3.7955)	(4.8678)
B_LTD (t-5)	-0.1089	-0.0590	0.0224	-0.0652
	(0.1502)	(0.1751)	(0.0429)	(0.0653)
TFP (t-5)	0.2934	-0.0617	0.0234	-0.6299 **
	(0.3705)	(0.3810)	(0.2154)	(0.2829)
BANKINFO (t-5)	1.9296 ***	1.5614 **	0.8021 **	0.8878 *
	(0.6374)	(0.6823)	(0.3278)	(0.5094)
# Obs	7,565	9,752	12,828	7,253
# Groups	3073	3770	4367	3027
Obs per group: min	1	1	1	1
avg	2.5	2.6	2.9	2.4
max	7	7	7	7
Year dummies	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes

Non-linearity

Difference in the importance?

7. Discussion

- Estimation for intensive margin (impact of BANKINFO for fixed & variable costs)
- Other channels of information sharing
  - Trade partners (i.e., suppliers and clients, #(obs) is largely reduced)
  - Trade companies (“Shosha”)
- Endogneity issue
  - Event study: M&A of mainbank, bank failure, change in bank regulation, Two financial crisis
  - Identify the causal link from BANKINFO to export dynamics
  - Fe estimation through conditional logit
- JICA, JBIC, and other public financial institutions

8. Some More…

- Extensions for the Future research (Other projects)

  A) Survival-type analysis for the duration of staying in export markets

  ⇔Besedes & Prusa (JIE 2006, CJE 2006), Nitsch (Rev World Econ 2009), Besedes & Blyde (WP 2010) etc.

  ⇒Mainly imports and based on Country level-data (i.e., not firm-level) analyses

  ⇒ Something can done

  B) Experimental exports or sequential exporting: Firms start exporting at a very small scale and some of them stop exporting in next period while others increase the export volume

  ⇔Albornoz et al. 2011, Creusen and Lejour 2011

  ⇒Framework?

  ⇒Direct estimation of Markov transition matrix (esp. for different shocks)

E.g., State equation：#Non export (NE), #Low export (LE), #Hi export (HE)

$$\begin{pmatrix} NE_{t+1} \\ LE_{t+1} \\ HE_{t+1} \end{pmatrix} = \begin{pmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{pmatrix} \begin{pmatrix} NE_t \\ LE_t \\ HE_t \end{pmatrix} + \boldsymbol{\sigma} \Delta \mathbf{W}_t$$

Thank you and comments are welcome!

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