



Survival Pattern Changes of Korean Establishments Across the Asian Financial Crisis

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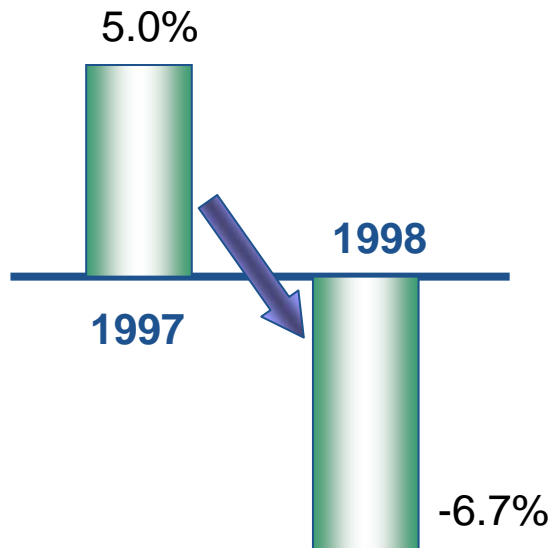
1. Introduction

1. Introduction (1)

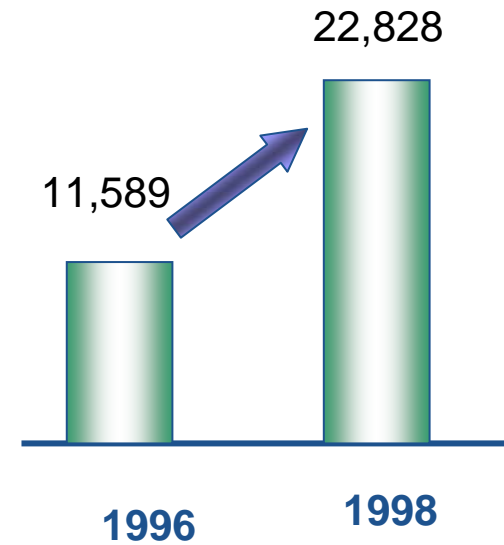
- **Asian Financial Crisis (hereafter AFC)**

- ✓ **since the end of 1997**

- ✓ **the exit of LSEs (ex. Hanbo steel, Kia motors)**



[real GDP growth rate]



[the no. of bankruptcy]

Data : Bank of Korea

1. Introduction (2)

- **Intensive restructuring process in corporate sector**
 - ✓ Promotion of venture firms (Aug. 1997)
 - ✓ Obligatory preparation of the top 30th firms for consolidated financial statement (Feb. 1998)
 - ✓ Improvement of the accounting standards in line with international best practices (Dec. 1998)
 - ✓ External board of directors (Dec. 1999)
 - ✓ Debt-equity ratio under 200% until the end of 1999
 - ✓ Revival of the ceiling on equity investment (Dec. 1999)

- **AFC as a restructuring process**

- ✓ expel insolvent firms
- ✓ promote the entry of venture firms

- **Not same pattern of changes between SMEs and LSEs**

- ✓ never considered in previous studies



- **Survival analysis approach is needed**



- **Distinction between SMEs and LSEs is needed**



2. Previous Literatures

2. Previous literatures (1)

- ✓ Crotty, J. and K. Lee, Is financial liberalization good for developing nations?: The case of South Korea in the 1990s, *Review of Radical Political Economics* 34, 2002,
- ✓ Lee, C.H., The Political Economy of Institutional Reform in Korea, *Journal of the Asia Pacific Economy*, 10(3), 2005, pp.257–277.
- ✓ Jo, S.W., Empirical Analysis on Performance of Policies on Chaebol after Financial Crisis, *KDI Policy Research* 2001-15, 2001.
- ✓ Kang, D. S, J. K. Kim, and Y. S. Choi, Empirical Analysis on Performance of Firm Restructuring in Korea, *KDI Policy Research* 2004-04, 2004.
- ✓ Kim, J.K., and J.I. In, Performance Evaluation of Restructuring after Financial Crisis: Profitability and Financial Soundness, *KDI Policy Forum* 168, 2004-01, 2004.

2. Previous literatures (2)

- Common facts and limits of previous literatures

First

- ✓ **Some changes in firm characteristics** can be observed
- ✓ These are significantly correlated with **newly introduced institutions** after AFC.

Second

- ✓ Previous researches offer us **mixed evidence** on changes after AFC.

Good

- improvement of financial structure
- restructuring was activated

Bad

- not compatible with Korean indigenous institutions
- government-led compulsory restructuring

2. Previous literatures (3)

- Common facts and limits of previous literature

Third

- ✓ Dealing with specific firm groups, such as **listed firms or statutory audit firm**
- ✓ Not free from **sample bias** problem
- ✓ Do not consider the **heterogeneity** between LSEs and SMEs

Fourth

- ✓ **Intertemporal comparisons of financial ratios and bankruptcies** across the AFC only shows a small part of firm changes from the specific perspectives
- ✓ **Dynamic change due to AFC is not fully explained**



3. Methodologies : Survival Analysis

3. Methodologies (1)

■ Kaplan-Meire survival analysis

- ✓ Developed to investigate differences in the survival curve of firms by treatment variables.

Survival function :
$$\hat{S}(T_k) = \prod_{i=1}^k \frac{n_i - h_i}{n_i}$$

Hazard function :
$$\hat{\lambda}(T_k) = \frac{h_k}{n_k}$$

T_k : k distinct survival time

n_k : the number of individuals with at least T_k duration

h_k : the number of spells completed at time T_k

3. Methodologies (2)

- **Cox proportional model with time independent variables**

$$\lambda(t_i) = \lambda_0(t_i) \exp(x' \beta)$$

λ : hazard rate

λ_0 : baseline hazard

x_i : covariates of firm characteristics

- ✓ A conditional operations in the Cox's partial likelihood allows for estimation of β without requiring information on the baseline hazard

- **Cox proportional hazard model with time dependent variables**

- ✓ If x is time dependent variable, **integration problem** occurs
- ✓ **Counting process format** can easily accommodate time-dependent covariates in SAS system (Ake and Carpenter, 2003).

3. Methodologies (3)

■ **Industry effect control : Stratified Cox proportional hazard model**

- ✓ The strata divide the subjects into disjoint groups (industry sectors), each of which has a **distinct (arbitrary) baseline** hazard function but **common values for the coefficient**

$$\lambda(t_i) = \lambda_o^k(t_i) \exp(x' \beta)$$

- ✓ The partial likelihood for the stratified data is the product of the partial likelihood for each stratum.

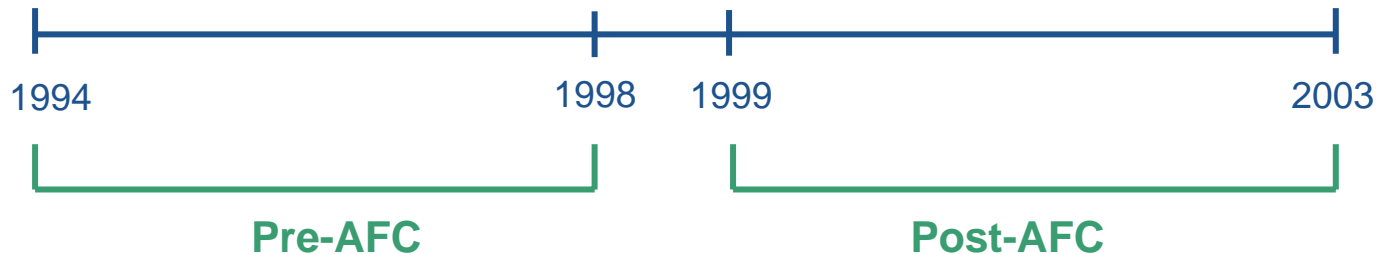


4. Data and Variables

4. Data and variables (1)

- **Mining and Manufacturing Census**

- ✓ **By National Statistical Office**
- ✓ **Annual data**
- ✓ **For all the establishments with 5 or more employees**
- ✓ **From 1993 to 2003**



4. Data and variables (2)

- **Data issues**

- ✓ **Establishment level data**

- Establishments is a minimal unit for significant production
- Entry/exit of establishments is also important managerial strategy
- In Cox regression, the whole possible structural problems are considered including multi-plant firms

- ✓ **Survey threshold**

- Assumed that biases with missing establishments are small in the description of economic change after the AFC

	The whole est. (A)	Eat. with 4 or less employees (B)	Ratio (B/A)
# of establishments	302,721	189,424	0.63
Sales	693,639,478	18,901,923	0.03
Value added	266,955,260	9,736,567	0.04

4. Data and variables (3)

- Variables for the estimation of Cox hazard function**

Variables	Notation	Definition
Size of the firm	worker	Log of the number of employees
Productivity	relative TFP ^{a)}	TFP normalized by the 3–digit sector mean
Propensity to growth	investment	Dummy (investment = 1, no investment = 0)
Others	R&D	Dummy for R&D activity
	export	Dummy for export activity
	multi–plant	Dummy for multi–plant
	incumbent	Dummy for incumbent
	LSE	Dummy for LSEs
Industry Classification		Stratification at 3–digit level

a) TFP is normalized by industrial average based on KSIC (Korean Standard Industrial Classification) 3-digit code. In the calculation of TFP, Hahn (2000) is referenced.

4. Data and variables (4)

- Data description of 'pre-AFC establishments'

year (number of observations)	1994 (88,345)	1995 (67,534)	1996 (56,311)	1997 (46,129)	1998 (35,432)
<i>Number of employees</i>					
average	31.32	36.36	38.88	41.32	40.69
standard deviation	219.13	257.54	301.59	511.90	272.94
<i>TFP</i>					
average	1.00	0.99	0.98	0.97	0.96
standard deviation	0.55	0.48	0.46	0.43	0.51
<i>R&D (dummy)</i>					
average	0.06	0.07	0.07	0.07	0.10
standard deviation	0.24	0.25	0.26	0.25	0.30
<i>Export (dummy)</i>					
average	0.12	0.13	0.14	0.16	0.19
standard deviation	0.32	0.34	0.34	0.36	0.39
<i>Multi-plant (dummy)</i>					
average	0.07	0.08	0.09	0.09	0.03
standard deviation	0.26	0.27	0.28	0.29	0.17
<i>Investment (dummy)</i>					
average	0.49	0.49	0.54	0.51	0.46
standard deviation	0.50	0.50	0.50	0.50	0.50
<i>Incumbent (dummy)</i>					
average	0.76	0.80	0.81	0.82	0.83
standard deviation	0.43	0.40	0.39	0.39	0.37

4. Data and variables (5)

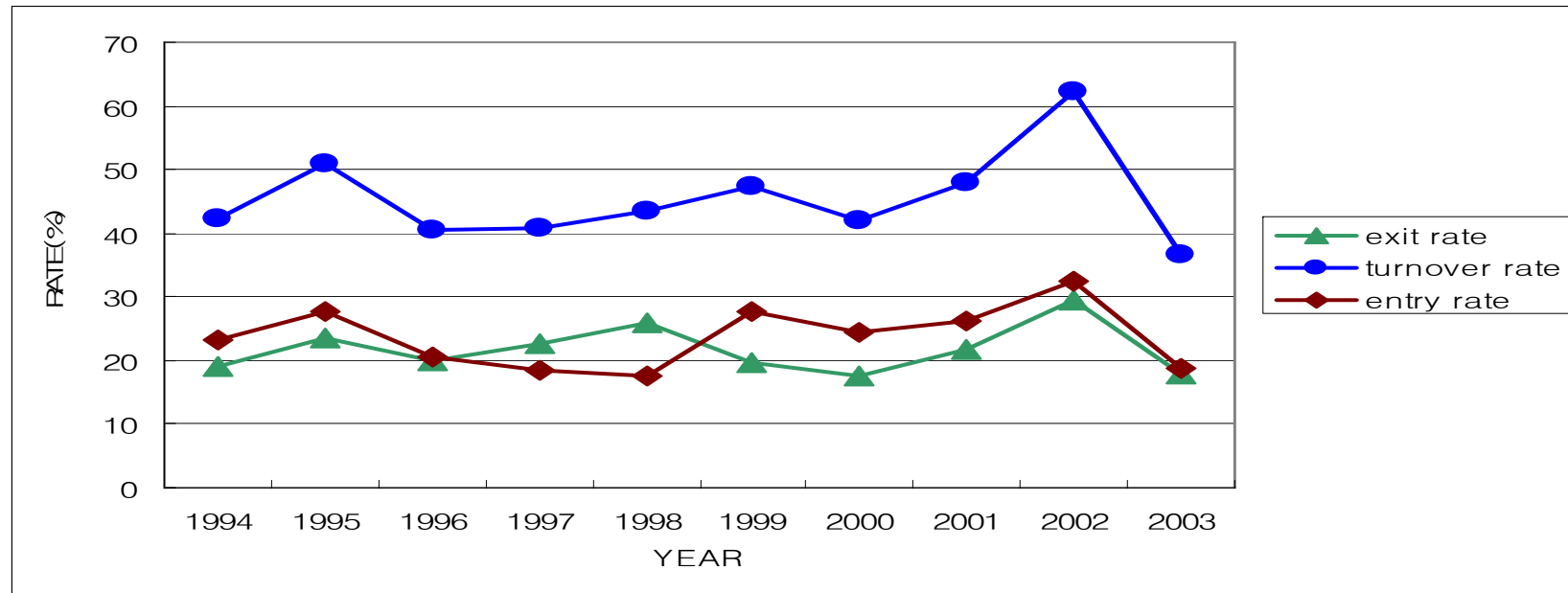
- Data description of 'post-AFC establishments'

year (number of observations)	1999 (61,533)	2000 (48,162)	2001 (41,561)	2002 (36,014)	2003 (31,076)
<i>Number of employees</i>					
average	17.58	20.36	20.93	22.67	24.59
standard deviation	68.87	79.15	82.45	93.43	105.87
<i>TFP</i>					
average	1.02	1.02	1.00	0.99	0.97
standard deviation	0.61	0.57	0.56	0.46	0.37
<i>R&D (dummy)</i>					
average	0.09	0.09	0.09	0.08	0.09
standard deviation	0.28	0.29	0.29	0.28	0.28
<i>Export (dummy)</i>					
average	0.11	0.12	0.12	0.14	0.13
standard deviation	0.31	0.33	0.33	0.34	0.33
<i>Multi-plant (dummy)</i>					
average	0.06	0.06	0.06	0.06	0.07
standard deviation	0.23	0.24	0.23	0.24	0.26
<i>Investment (dummy)</i>					
average	0.48	0.43	0.42	0.49	0.54
standard deviation	0.50	0.49	0.49	0.50	0.50
<i>Incumbent (dummy)</i>					
average	0.62	0.66	0.67	0.68	0.69
standard deviation	0.49	0.47	0.47	0.47	0.46



5. Empirical Results

5.1. The entry and exit rates



※ Source : Calculated from mining and manufacturing census

- ✓ Although exit rate shows a tendency to increase from 1997 to 1998, then the exit rate decreased
- ✓ Entry was suppressed from 1997 to 1998, and later entry rate barely increased to pre-AFC levels.

The entry and exit of establishments were not activated after AFC

5.2. Market screening function (1)

- **Restructuring process** during AFC had the purpose of market screening function : the expulsion of insolvent firms
- To verify whether the restructuring process during AFC **expelled more inferior establishments** from market
 - The inferiority of exiting est. across AFC needs to be compared
 - ✓ 1st : Partition data into cells by no. of employees (SSE, MSE, LSE) and the first three digits of KSCI code
 - ✓ 2nd : Define **the inferiority of exiting est.** as the value of exiting est. divided by the avg. of the cell where they belonged to in the previous year
 - ex) value < 1 : exiting est. was inferior to surviving est.
 - ✓ 3rd : Compare the inferiority of exiting est. after the AFC with that before the AFC → t-test

5.2. Market screening function (2)

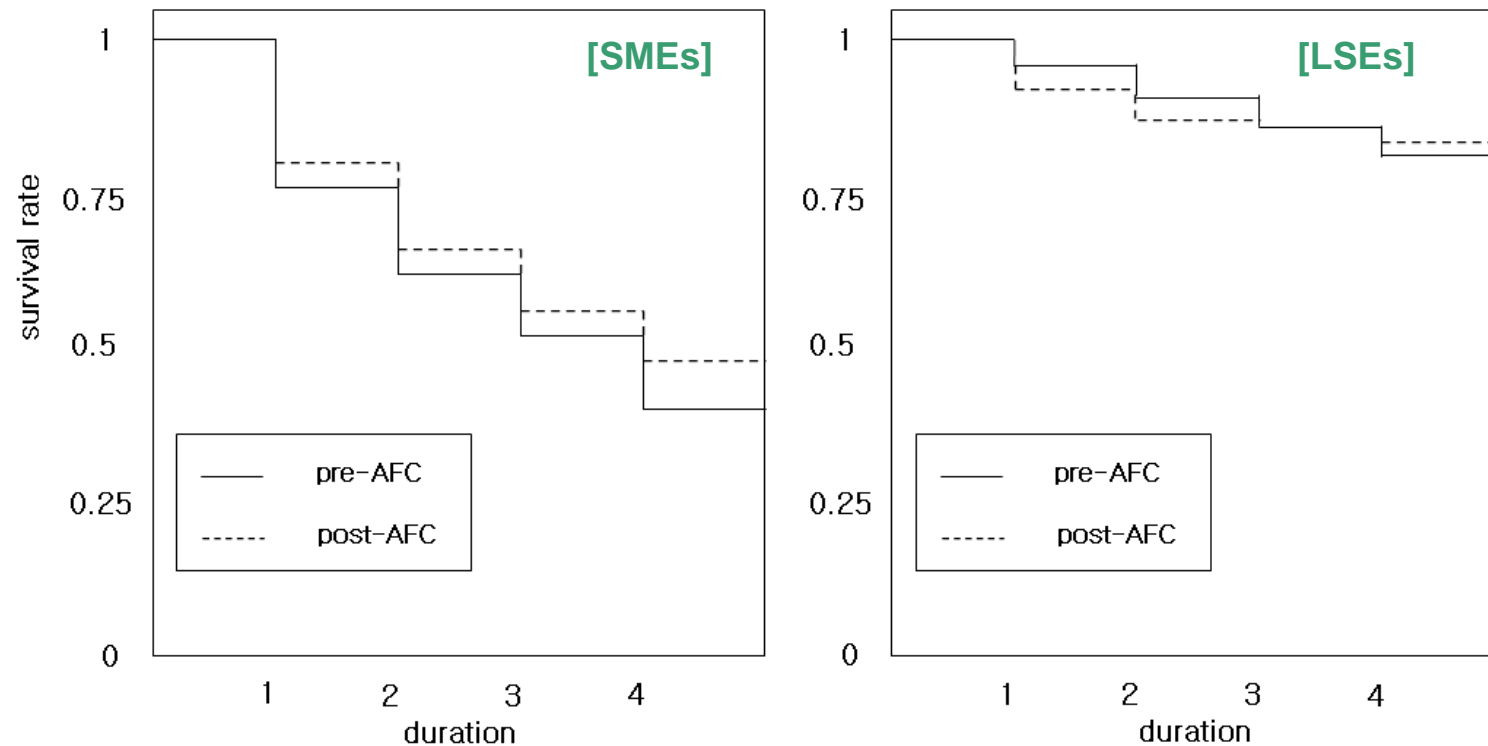
	exit year	worker	R&D	export	TFP	value-added ratio	investment
	1994	0.856	0.852	0.859	1.051	1.026	0.845
	1995	0.852	0.779	0.864	1.037	1.023	0.725
pre-AFC	1996	0.833	0.682	0.804	1.034	1.040	0.652
	1997	0.808	0.726	0.678	1.032	1.037	0.643
	1998	0.810	0.715	0.696	1.025	1.038	0.686
	1999	0.807	0.704	0.700	1.038	1.031	0.735
	2000	0.805	0.724	0.742	1.037	1.059	0.671
post-AFC	2001	0.818	0.821	0.548	1.030	1.042	0.921
	2002	0.787	0.761	0.660	1.028	1.051	1.043
	2003	0.791	0.672	0.732	1.034	1.047	0.624
	t-value	0.038	0.722	0.086	0.637	0.051	0.352

※ Source : Calculated from mining and manufacturing census

it can not be said that market screening function has been improved after AFC.

5.3. Result of Kaplan-Meier curve (1)

- Result of Kaplan-Meier curve



- In the case of SMEs, the survival rate has increased after AFC.
- In the case of LSEs, the survival rate, especially for the early stage, decreased.

5.3. Result of Kaplan-Meier curve (2)

- Statistical confirmation of survival pattern change

Tests for homogeneity	<u>Pr > Chi-square</u>	
	SMEs	LSEs
Log-rank	< 0.001	0.709
Wilcoxon	<0.001	0.811
-2Log(LR)	<0.001	0.686

- Ho: Survival rate between before and after AFC are not homogeneous
- Tests reveal that survival pattern for LSEs had changed , while that of SMEs did not

While restructuring process raised the risk of failure for LSEs, the same mechanism does not work for SMEs

5.4. Result of Cox regression (1)

Variable	<u>Before the financial crisis</u>		<u>After the financial crisis</u>	
	(standard error)	Exp(B)	(standard error)	Exp(B)
log(worker)	-0.419***	0.658	-0.479***	0.619
investment(dummy)	-0.121***	0.886	-0.138***	0.871
LSE*investment	-0.210	0.811	2.018**	7.525
relative TFP	0.077***	1.080	0.062***	1.064
LSE* relative TFP	0.110	1.116	-1.496*	0.224
R&D	-0.141***	0.868	-0.114***	0.892
LSE * R&D	-0.006	0.994	0.249	1.283
Export	-0.069***	0.933	-0.099***	0.906
LSE * export	-0.018	0.982	-0.252	0.777
multi-plant	0.142***	1.152	0.228***	1.256
LSE * multi-plant	-0.089	0.915	-0.161	0.851
incumbent(dummy)	-0.238***	0.788	-0.228***	0.796
LSE * incumbent	0.455	1.576	0.114	1.120

※ exp(β) : odd ratio, relative risk.

5.4. Result of Cox regression (2)

- **The Size, investment, R&D, and export** turn out to have positive effect on establishment survival.
- **TFP** did not affect the survival of an est. especially for SMEs.
- **Interaction term with dummy for LSES**
 - ✓ **LSE*investment** : positive value → LSEs with higher propensity to investment have higher probability of exit
 - ✓ **LSE*TFP** : positive but not statistically significant (before AFC)
→ negative and statistically significant (after AFC)
 - ✓ Before AFC, productivity is not the main concern for management, but after AFC, productivity became one of the most important factors for the survival of LSEs.

5.4. Result of Cox regression (3)

< Cox regression results before the financial crisis >

Variable	<u>Before the financial crisis</u>			
	Model 1	Model 2	Model 3	Model 4
log(worker)	-0.415*** (0.006)	-0.437*** (0.006)	-0.438*** (0.006)	-0.419*** (0.006)
investment(dummy)	-0.121*** (0.009)	-0.105*** (0.009)	-0.105*** (0.009)	-0.121*** (0.009)
LSE*investment		0.167 (0.143)	0.160 (0.199)	-0.210 (0.299)
relative TFP	0.077*** (0.007)	0.084*** (0.007)	0.083*** (0.007)	0.077*** (0.007)
LSE* relative TFP		0.142 (0.088)	0.142 (0.089)	0.110 (0.097)
R&D	-0.138*** (0.022)	-0.145*** (0.023)	-0.139*** (0.022)	-0.141*** (0.023)
LSE * R&D		0.001 (0.167)	0.002 (0.170)	-0.006 (0.001)
Export	-0.068*** (0.016)		-0.080*** (0.016)	-0.069*** (0.016)
LSE * export			0.032 (0.184)	-0.018 (0.009)
multi-plant	0.144*** (0.020)		0.152*** (0.016)	0.142*** (0.020)
LSE * multi-plant			0.032 (0.184)	-0.089 (0.164)
incumbent(dummy)	-0.238*** (0.010)			-0.238*** (0.010)
LSE * incumbent				0.455 (0.288)

5.4. Result of Cox regression (4)

< Cox regression results after the financial crisis >

Variable	<u>After the financial crisis</u>			
	Model 1	Model 2	Model 3	Model 4
log(worker)	-0.476*** (0.010)	-0.504*** (0.001)	-0.507*** (0.010)	-0.479*** (0.010)
investment(dummy)	-0.138*** (0.012)	-0.122*** (0.012)	-0.121*** (0.012)	-0.138*** (0.012)
LSE*investment		1.936*** (0.714)	2.152** (0.816)	2.018** (0.868)
relative TFP	0.062*** (0.005)	0.064*** (0.005)	0.064*** (0.005)	0.062*** (0.005)
LSE* relative TFP		-1.450* (0.779)	-1.490* (0.779)	-1.496* (0.774)
R&D	-0.112*** (0.025)	-0.117*** (0.025)	-0.106*** (0.025)	-0.114*** (0.025)
LSE * R&D		0.174 (0.413)	0.234 (0.426)	0.249 (0.427)
Export	-0.098*** (0.022)		-0.109*** (0.022)	-0.099*** (0.022)
LSE * export			-0.235 (0.464)	-0.252 (0.464)
multi-plant	0.230*** (0.028)		0.220*** (0.028)	0.228*** (0.028)
LSE * multi-plant			-0.153 (0.425)	-0.161 (0.143)
incumbent(dummy)	-0.228*** (0.011)			-0.228*** (0.011)
LSE * incumbent				0.114 (0.498)



6. Conclusion

6. Conclusion (1)

■ Main findings

SMEs

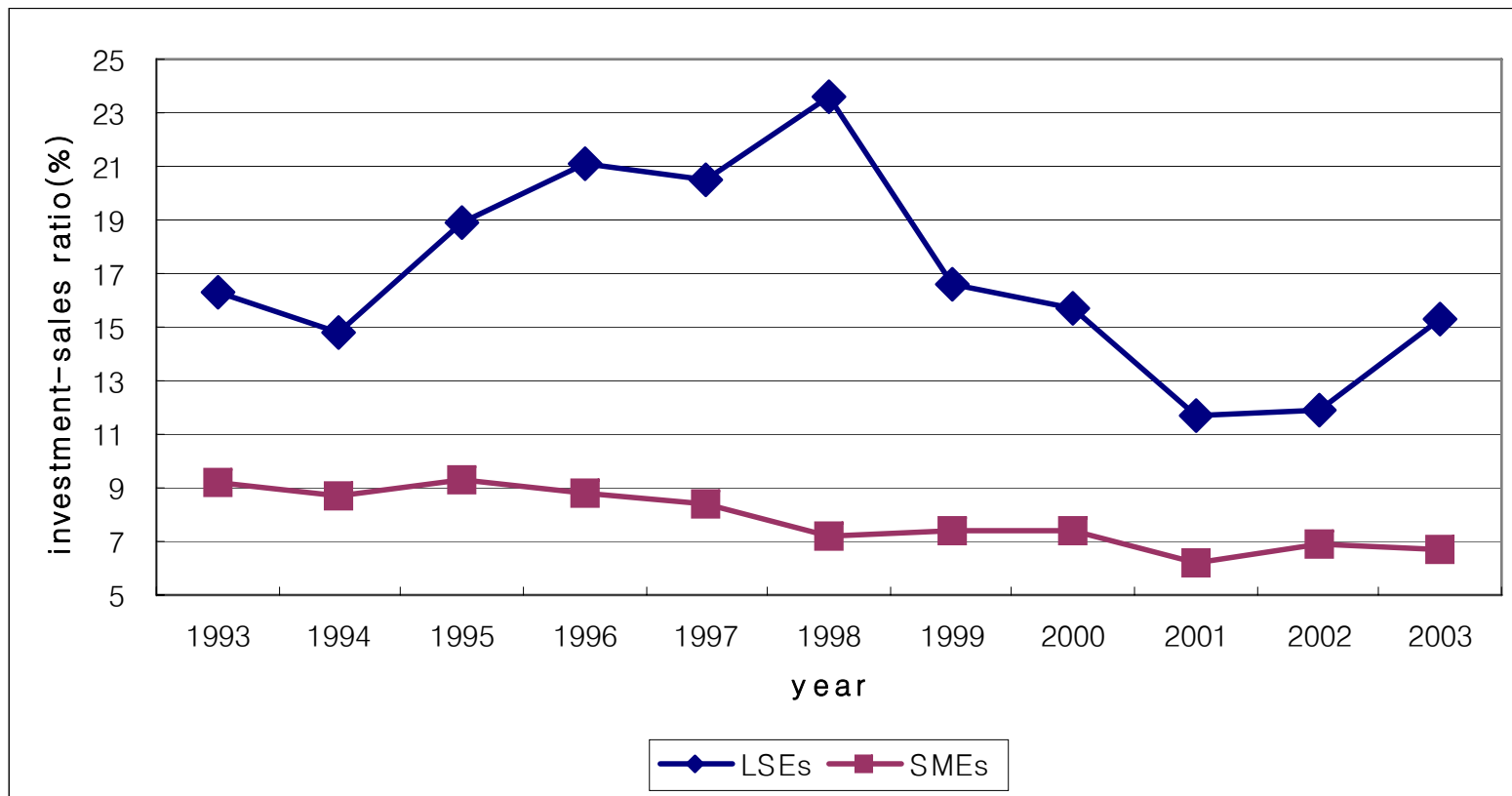
- ✓ Environmental changes after AFC failed to expel insolvent SMEs and improve their competitiveness.
 - survival rate of SMEs increased rather after AFC than before AFC
 - the establishments with low TFP had benefit for survival both before and after AFC

LSEs

- ✓ Restructuring process for LSEs was activated after AFC, meanwhile contraction-oriented strategies of LSEs are concerned about their long-term growth.
 - large scale of exit while making TFP more valuable for their survival.
 - Improvement of TFP was correlated to the reduction of investment.
- ⇒ Improvement of TFP by not innovation but scaling down investment can cause problems in long-term competitiveness and growth momentum.

6. Conclusion (2)

- Investment-sales ratio of LSEs and SMEs



※ Source : Calculated from mining and manufacturing census

6. Conclusion (3)

■ Policy implications

SMEs

- ✓ Liquidation of uncompetitive establishments should be reinforced.
 - SME policy has focused not on improvement of market screening function, but prolonging the life of SMEs at risk
 - Although the government should still support SMEs suffering from short-term shortage of financial resources, more cautions are required not to prolong uncompetitive SMEs

LSEs

- ✓ Mitigation of regulation which suppresses investment by LSEs should be reconsidered.
 - Some regulations, such as the ceiling on debt ratio and equity investment, caused the shrinking of investment while contributing to financial stability.

6. Conclusion (4)

- **Issues as future research**
 - ✓ This research needs to be extended to firm level data.
 - ✓ **Various managerial strategies (ex. M&A, diversification, vertical integration)** should be considered. Under the environmental changes, firms are not confined to dichotomous problem ; exit or continue
 - ✓ **International comparison** of survival pattern after is worth analyzing. Thailand chose different policies from Korea, thus international comparison can contribute to evaluate the effectiveness of policies.



Thank You !

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TFP Measurement

- **Chained-multilateral index developed in Good (1985), and Good, Nadiri, and Sickles (1996)**

- ✓ **It uses a separate reference point for each cross-section of observations and then chained-links the reference point together over time as in Tornqvist-Theil index.**

$$\ln TFP_{it} = (\ln Y_{it} - \overline{\ln Y_t}) + \sum_{\tau=2}^t (\overline{\ln Y_t} - \overline{\ln Y_{\tau-1}})$$

$$- \left\{ \sum_{n=1}^N \frac{1}{2} (S_{nit} + \overline{S_{nt}}) (\ln X_{nit} - \overline{\ln X_{nt}}) + \sum_{\tau=2}^t \sum_{n=1}^N \frac{1}{2} (\overline{S_{n\tau}} + \overline{S_{n\tau-1}}) (\overline{\ln X_{n\tau}} - \overline{\ln X_{n\tau-1}}) \right\}$$



- **Output**

- ✓ The gross production of each establishment was used as a measure of output. Output was deflated by the producer price index at the first three digit industry level.

- **Capital Stock**

- ✓ The average book value of capital stocks was used at the beginning and end of the year, deflated by the capital goods deflator, because the survey data does not provide any variables that can proxy annual investment data and initial capital stock.
- ✓ However, Bailey *et al.* (1992) reported little difference between productivity results with the book value of capital and those using carefully constructed capital series.



- **Labor**

- ✓ The number of workers was used, this includes paid employees (production and non-production workers), working proprietors and unpaid family workers.
- ✓ The qualitative differential between production workers and all the other types of workers was accommodated. The labor quality index of the latter was calculated as the ratio of non-production workers' and production workers' cumulative wage, divided by the number of workers involved in non-production and production activities for each year.



- **Intermediate input**

- ✓ The “major production costs” plus “other production cost” was used in the survey.
- ✓ Major production costs covered costs arising from materials and parts, fuel, electricity, water, outsourced manufactured goods and maintenance.
- ✓ Other production costs covered outsourced services, such as advertising, transportation, communication and insurance.
- ✓ The estimated intermediate input was deflated by the intermediate input price index.

- **Labor and intermediate input elasticity**

- ✓ They were measured as the average cost of shares in the five-digit industry in a given year.
- ✓ The cost of shares was calculated by the share of respective input factors of the total cost of capital, labor and materials.