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Size Impact and Productivity Growth in Korea's Export-leading Industries*

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This study attempts to measure the impact from changes in the share of small and medium-sized establishments (SMEs) on the productivity growth of 29 export-leading industries and 13 other exporting industries during 1995-2014 in Korea. An increase in the share of SMEs promoted productivity growth in 21 export-leading industries, and that was significant in eight industries with the most in assembled vehicles, while it slowed productivity in seven industries, most considerably in coke, briquettes, and refined petroleum products. An increase in the share of SMEs in export-leading industries promoted productivity growth three times more than that in other exporting industries.

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1. INTRODUCTION

Through a “selection and concentration” industrial policy that targeted export-driven growth, Korea’s economy fared well in passing through the developmental phases that countries typically undergo when transitioning from low-income to high-income economies. As a result, Korea’s industrial structure reached an advanced phase through changes in growth-leading industries: light industries (textiles and footwear) in the 1960s, heavy machinery and chemical industries (iron and steel, machinery, and chemicals) in the 1970s, assembled and processed industries (electric home appliances, shipbuilding, and automobile) from the 1980s to present-day, and finally, cutting-edge technology-based industries (information and communication technology, semiconductors, computers, telecommunication apparatuses, and flat display boards as well as the next generation growth engines of artificial intelligence and biotechnology).

However, in the process of championing this “selection and concentration” industrial policy, the government strategically supported large conglomerates to save transaction costs and enhance efficiency in the global market, while leaving small- and medium-sized firms to form as subcontracting partners according to their specific industrial structure.

Consequently, core export-leading industries still retain an unparalleled and unprecedented hierarchy of vertical integration: the automobile industry being the most significant, followed by the electronics industry, and then the general machinery industry.

Therefore, as one of the key industrial policies, shared-growth between the large conglomerates and the small and medium-sized firms has been persistently pursued.

As a result, Nugent (1996) found that the trend of size distribution of manufacturing firms and establishments in Korea increasingly skewed toward large sizes; however, he found a significant trend reversal since the mid-1970s; that is, the employment and value-added shares of large establishments (LEs) soared sharply from 1963 to 1976 and then fell until 1988.

Nugent (2002) also emphasized that the dramatic change in Korea's industrial structure reflected much higher shares of SMEs in employment and value-added as well as their contribution to the major transformation of the Korean economy since 1975, especially in exports, foreign investment, and productivity performance.

In terms of firm size and efficiency, Diaz and Sanchez (2008) used a sample case study of small- and medium-sized manufacturing firms from 1995 to 2001 to show that these firms tend to be less inefficient than their large firm counterparts.

Regarding firm size and productivity, Schiersch (2013) used a large and representative dataset of firms within the German mechanical engineering industry, which is increasingly dominated by SMEs, and found that small and large firms are the most efficient firms, while medium-sized firms have the greatest inefficiencies.

As for the relationship between productivity and exporting, Arnold and Hussinger (2005) found a causal link between high productivity and presence in foreign markets, thus indicating that high-productivity firms self-select into export markets, while the strategy of exporting itself does not play a significant role in the productivity of German manufacturing firms.

In the more recent literature, Pai (2016a) verified that the Korean government's "selection and concentration" policy was implemented based on technical progress (*TP*) and productivity growth in the targeted industries, using an establishment-level dataset of Korea's 37 growth-leading industries from 1995 to 2012. Furthermore, Pai (2016c) showed that the recent institutional push by the Korean government ensured that the productivity growth of firms that are not vertically integrated with capital-share in Korea's core growth-leading industries reached their highest levels in 2010. Consequently, Pai (2016b) specified policy guidelines for firms that are vertically integrated with capital share to share growth with their counterparts, additionally finding that causality runs from higher productivity to larger export share in the global market for Korea's core growth-leading industries.

Despite the preceding literature, no studies attempted to measure the extent

of impact from changes in a share of SMEs among the total number of establishments on the productivity growth of industries.

In order to fill this research gap, this study attempts to measure the extent to which the impact of changes in a share of SMEs affects the productivity growth of industries within the bounds of export volume, maturity, technology specification, and specific industrial structure of the industries. Using the earliest feasible data from 1995 to 2014, the study focuses on two market exogenous shocks, the 1997 Asian financial crisis and the 2008 global financial crisis, to measure this impact.

Eventually, this study attempts to give insights into a more efficient resource reallocation between SMEs and LEs that will promote the global competitiveness of the export-leading industries for Korea's sustainable long-run economic growth.

The remainder of this paper is organized as follows. Section 2 explains the estimation model used herein, section 3 describes the data used, and section 4 discusses the empirical results. Then, section 5 presents the conclusions with policy implications.

The appendix elaborates on the 42 exporting industries based on the Korean Standard Industrial Classification (KSIC) codes, the coefficients of the variable *SME* (*being a SME*) in the stochastic frontier production function (SFPF) and the respective summary statistics for 42 exporting industries from 1995 to 2014 follows.

2. MODEL

Based on Kumbhakar (2000), this study applies a translog SFPF model to an unbalanced establishment-level panel dataset of Korea's 42 exporting industries by industry.

$$\begin{aligned}\ln VA_{it} &= \alpha_0 + \alpha_L \ln L_{it} + \alpha_K \ln K_{it} + \alpha_T t + \frac{1}{2}\alpha_{LL}(\ln L_{it})^2 + \frac{1}{2}\alpha_{KK}(\ln K_{it})^2 \\ &+ \frac{1}{2}\alpha_{TT}t^2 + \alpha_{LK}\ln L_{it}\ln K_{it} + \alpha_{TL}t\ln L_{it} + \alpha_{TK}t\ln K_{it} \\ &+ \varphi_{SME}SME + (v_{it} - u_{it}),\end{aligned} \tag{1}$$

where VA_{it} is the real value-added of the *i*-th establishment for the *t*-th period; $f(L_{it}, K_{it}, t, SME)$ is the production frontier, where L_{it} and K_{it} are the production inputs of labor and capital, *t* is the time trend as a proxy for technical changes, and *SME* stands for *being an SME*. Eventually, establishment-specific technical inefficiency u_{it} identifies the actual production loss against the production frontier, $f(L_{it}, K_{it}, t, SME)$, and is expressed according to Battese and Coelli (1992) as follows.

$$u_{it} = \eta_{it}u_i = \exp(-\eta(t-T)u_i, \quad u_{it} \geq 0, \tag{2}$$

$$\gamma = \sigma_u^2 / \sigma^2, \quad \sigma^2 = \sigma_u^2 + \sigma_v^2. \tag{3}$$

In equation (2), u_i is assumed to have a flexible nonnegative truncated normal distribution, $N(\mu, \sigma_u^2)$ and η is a parameter with the same technological catch-up rate. Thus, a positive value of η indicates that technical efficiency (*TE*) improves over time at an increasing rate.

In equation (3), parameter γ represents variances of technical inefficiency over variances of composed error, $(v_{it} - u_{it})$, and therefore, γ has a value between 0 and 1.

Finally, all parameters in equations (1), (2), and (3) are estimated using the FRONTIER 4.1 built by Coelli (1996).

Second, Kumbhakar (2000) introduced a formula to decompose total factor productivity (*TFP*) growth ($\dot{TFP}$) into its sources. $\ln VA_{it}$ in equation (1) is differentiated with respect to time *t*, omitting the subscript *it*.

$$\frac{d\ln VA}{dt} = \dot{VA} = \frac{d\ln f(L,\ K,\ t,\ SME)}{dt} - \frac{du}{dt} = \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial t}\frac{dt}{dt} + \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial L}\frac{dL}{dt} + \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial K}\frac{dK}{dt} + \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial SME}\frac{dSME}{dt} - \frac{du}{dt}. \quad (4)$$

In equation (4), $\frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial t}$ refers to a change in the frontier output wrought by an exogenous change in *TP*, which shifts up the production frontier for a given input level.

$\frac{\partial nf(L,\ K,\ t,\ SME)}{\partial L}\frac{dL}{dt} + \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial K}\frac{dK}{dt}$ indicates changes in the frontier output originating from changes in the input use of labor and capital.

The respective real value-added elasticities for inputs *L* and *K* are $\varepsilon_L = \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial \ln L}$ and $\varepsilon_K = \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial \ln K}$, herefrom $\frac{\partial nf(L,\ K,\ t,\ SME)}{\partial L}\frac{dL}{dt} + \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial K}\frac{dK}{dt} = \varepsilon_L \dot{L} + \varepsilon_K \dot{K}$. Similarly, the real value-added elasticity with respect to the variable *SME* is $\varepsilon_{SME} = \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial \ln SME}$, herefrom $\frac{\partial \ln f(L,K,t,\ SME)}{\partial SME}\frac{dSME}{dt} = \varepsilon_{SME}\dot{SME} = \varphi_{SME} SME\,\dot{SME}$.

Finally, the *TE* level for establishment *i* at time *t* is defined as the ratio of the actual output $f(L_{it},\ K_{it},\ t,\ SME)\exp(-u_{it})$ to the potential output $f(L_{it},\ K_{it},\ t,\ SME)$.

Then $TE_{it} = \frac{f(L_{it},\ K_{it},\ t,\ SME_{it})\exp(-u_{it})}{f(L_{it},\ K_{it},\ t,\ SME_{it})} = \exp(-u_{it})$, $-\frac{du}{dt} = \frac{d\ln TE}{dt} = \dot{TE}$.

Taken together, the change in real value added $(\dot{VA})$ is composed of the *TP* rate, changes in the two input uses $(\varepsilon_L \dot{L} + \varepsilon_K \dot{K})$, changes in the impact of SMEs $(\varepsilon_{SME}\dot{SME})$, and finally, changes in *TE* $(\dot{TE})$. Thus, equation (4) is built as follows:

$$\dot{VA} = TP + \varepsilon_L \dot{L} + \varepsilon_K \dot{K} + \varepsilon_{SME} \dot{SME} + \dot{TE}. \quad (5)$$

Third, let $\dot{TFP}$ be *TFP* growth, which is defined as output growth not explained by input growth according to Solow (1956), and, here, output growth is replaced by real value- added growth.

$$\begin{aligned}
\dot{TFP} &= \dot{VA} - (S_L \dot{L} + S_K \dot{K}) \\
&= TP + \varepsilon_L \dot{L} + \varepsilon_K \dot{K} + \varepsilon_{SME} \dot{SME} + \dot{TE} - (S_L \dot{L} + S_K \dot{K}) \\
&= TP + \dot{TE} + (\varepsilon_L - S_L)\dot{L} + (\varepsilon_K - S_K)\dot{K} + \varepsilon_{SME} \dot{SME} \\
&= TP + \dot{TE} + (RTS - 1)(\varphi_L \dot{L} + \varphi_K \dot{K}) + (\varphi_L - S_L)\dot{L} + (\varphi_K - S_K)\dot{K} \\
&\quad + \varepsilon_{SME} \dot{SME} \\
&= TP + \dot{TE} + SC + AE + SME_{impact},
\end{aligned} \quad (6)$$

where S_L and S_K are shares of labor and capital costs in total costs, and *RTS* indicates estimated returns to scale; $RTS = \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial \ln L} + \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial \ln K} = \varepsilon_L + \varepsilon_K$.

φ_L and φ_K respectively represent shares of the real value-added elasticity of *L* and *K* out of the total real value-added elasticity; $\varphi_L = \frac{\varepsilon_L}{(\varepsilon_L + \varepsilon_K)} = \frac{\varepsilon_L}{RTS}$; and $\varphi_K = \frac{\varepsilon_K}{(\varepsilon_L + \varepsilon_K)} = \frac{\varepsilon_K}{RTS}$. Supposing positive input growth, the scale component, $SC = (RTS - 1)(\varphi_L \dot{L} + \varphi_K \dot{K}) > 0$ if *RTS* is increasing returns to scale (IRS), $SC = 0$ if *RTS* is constant returns to scale (CRS), and $SC < 0$ if *RTS* is decreasing returns to scale (DRS). *SC* identifies the effect of input use on output growth, and the scale economy vanishes when *SC* goes to zero or negative.

Changes in allocative efficiency (*AE*), $AE = (\varphi_L - S_L)\dot{L} + (\varphi_K - S_K)\dot{K}$, to measure the efficiency of resource allocation, and any deviation in input prices from the market value of their marginal products causes negative *AE*.

Finally, SME_{impact} clarifies the extent of the impact from changes in a share of SMEs contribute to promoting the productivity of their own industry.

$$SME_{impact} = \frac{\partial \ln f(L,\ K,\ t,\ SME)}{\partial SME}\frac{dSME}{dt} = \varepsilon_{SME}\ \dot{SME} = \varphi_{SME} SME\ \dot{SME}.$$

Accordingly, SME_{impact} turns positive (negative) when an increase in the share of SMEs is associated with a positive (negative) φ_{SME}, while SME_{impact} turns negative (positive) when a decrease in the share of SMEs is associated with a positive (negative) φ_{SME}.

3. DATA

An unbalanced establishment-level panel data for establishments with more than 10 employees from *The Report on Mining and Manufacturing Survey*: *Industry-National Area* from 1995 to 2014 are used.

The real value added (*VA*), real value of tangible fixed assets for capital (*K*), and number of workers for labor (*L*) are calculated for each establishment.

The 42 individual, exporting-industry-specific, value-added deflators issued by the Bank of Korea are applied to obtain the real *VA* for each industry. Here, tangible fixed assets comprise land and individual assets such as buildings, structures, machinery, equipment, cars, ships, and durable delivery equipment, which are converted to the real values using the 2010 producers' constant price issued by the Bank of Korea.

The labor cost (C_L) comprises employee remuneration such as wages, retirement compensation, and welfare costs, and the capital cost (C_K) is measured as the sum of capital rents, depreciation costs, and interests. Therefore, the total cost (*C*) is the sum of the labor cost (C_L) and capital cost (C_K), and the respective shares of labor and capital in total costs are $S_L = C_L / C$ and $S_K = C_K / C$.

In tables A4-A5, "total number of observations" stands for the number of

establishments engaging in production processes at least once during 1995-2014, and "total number of establishments" indicates the number of establishments with unique names during this period.

4. RESULTS

4.1. Size Impact and Productivity Growth by Industry

As shown in table A1, the 42 exporting industries are dichotomized into 10 export-leading industrial sectors composed of 29 export-leading industries and 13 other exporting industries collectively based on their rank in export volume during 2015.

According to Korea's GDP growth rate and manufacturing operation ratio, 10 selected time periods are identified from 1995 to 2014: during 1996-1997, prior to the Asian financial crisis that occurred at the end of 1997; the economic depression in 1998 in the aftermath of the 1997 Asian financial crisis; resurrection of the Korean manufacturing industries in 1999; the economic recovery during 2000-2003; the sustaining economic upturn during 2004-2007; the 2008 global financial crisis; the economic downturn in 2009 wrought by the 2008 global financial crisis; the mild economic recovery in 2011; and the economic upturn during 2012-2014.

Table 1 presents the averages of SME_{impact}, the extent of impact from changes in a share of SMEs — the number of SMEs among the total number of establishments- on the productivity growth of 29 export-leading industries, over the selected time periods, and table A3 demonstrates the coefficient of the variable, *SME* (*being a SME*), in the SFPF of the 29 export-leading industries, φ_{SME}.

First, SME_{impact} varied extensively across time periods and industries, and a positive SME_{impact} with a positive φ_{SME} appeared in the 21 export-leading industries, and the most significant in assembled vehicles (5.09%), and significant in semiconductors (0.056%), synthetic rubbers and plastics in

Table 1 SME_{impact} **for the Export-leading Industries**

	IT Parts and Components				IT Products			
	Semiconductors	Flat display boards	Other electronic components	Batteries	Telecommunication apparatus	Electric home appliances	Electronic video and audio equipment	Computers
1996-1997	–0.157	NA	–0.007	0.046	0.035	–0.014	0.001	0.238
1998	–0.165	NA	–0.022	0.030	–0.076	–0.001	0.012	–0.401
1999	0.092	–0.644	0.008	0.224	–0.033	–0.028	–0.035	–0.035
2000-2003	0.282	–0.076	0.015	0.015	–0.004	0.010	0.011	–0.041
2004-2007	0.001	–0.052	0.001	0.014	0.002	–0.003	0.004	–0.111
2008	0.131	0.111	0.014	–0.081	–0.035	0.033	–0.028	0.006
2009	–0.160	–0.085	–0.006	0.086	–0.022	–0.039	0.040	0.085
2011	0.255	–0.062	0.006	0.062	–0.004	0.001	0.021	0.000
2012-2014	0.015	–0.033	–0.002	–0.029	–0.007	0.018	0.003	–0.023
1995-2014	0.056	–0.086	0.002	0.025	–0.007	0.001	0.005	–0.030
1995-2014	0.056	–0.086	0.002	0.025	–0.007	0.001	0.005	–0.030

	Machinery				Petrochemicals		
	Special purpose machinery	General purpose machinery	Electrical equipment	Fabricated metal products	Basic chemicals	Synthetic rubbers and plastics in primary forms	Coke, briquettes, and refined petroleum products
1996-1997	0.006	0.000	0.000	0.020	–0.006	–0.585	1.766
1998	–0.017	0.001	0.002	–0.015	–0.007	1.014	–4.720
1999	–0.007	0.000	0.001	0.002	–0.022	0.405	–0.657
2000-2003	0.000	0.000	0.001	0.008	–0.007	0.064	–0.711
2004-2007	0.001	0.000	0.001	0.001	–0.007	0.034	–0.479
2008	0.004	–0.001	0.000	–0.007	–0.002	–0.001	–0.637
2009	–0.003	0.000	0.001	0.004	–0.004	–0.072	–0.611
2011	0.001	0.000	0.000	–0.001	0.034	–0.006	0.000
2012-2014	0.000	0.000	0.000	–0.001	–0.006	0.024	–0.242
1995-2014	–0.0004	0.0001	0.001	0.003	–0.005	0.035	–0.477

	Automobile		Shipbuilding	Basic Metal Products		
	Assembled vehicles	Automobile parts and components		Basic iron and steel	Non-ferrous metals	Metal casting
1996-1997	–1.747	0.038	0.035	0.002	0.035	0.033
1998	89.275	0.012	0.000	–0.002	0.056	0.063
1999	0.062	0.013	0.002	0.022	–0.034	0.071
2000-2003	–0.972	0.001	0.024	0.009	–0.004	0.014
2004-2007	2.372	–0.005	–0.009	0.008	0.001	–0.010
2008	2.330	0.001	0.033	0.000	0.028	–0.085
2009	1.842	0.024	–0.007	0.000	–0.011	0.040
2011	–2.653	–0.015	0.012	0.006	–0.006	0.013
2012-2014	–0.440	–0.001	–0.009	0.000	0.005	0.013
1995-2014	5.091	0.005	0.008	0.005	0.006	0.012

	Textiles and Clothing			Fine Chemicals			Precision Instruments	
	Fibers	Man-made fibers	Clothing apparel	Fertilizers and nitrogen compounds	Other chemical products	Pharmaceuticals	Precision instruments	Medical devices
1996-1997	0.028	–0.545	0.024	0.042	–0.013	0.044	–0.004	0.118
1998	0.017	–0.206	0.073	–0.091	0.066	–0.211	0.014	–0.473
1999	0.044	0.751	–0.033	0.079	0.003	–0.019	–0.002	0.400
2000-2003	0.031	–0.496	–0.005	0.021	0.038	–0.022	0.001	0.083
2004-2007	0.017	–0.492	0.001	0.004	0.009	–0.083	–0.002	0.000
2008	0.027	0.179	0.038	0.001	0.007	0.057	0.008	0.000
2009	–0.001	–0.567	–0.067	–0.002	–0.010	0.051	0.003	–0.069
2011	0.002	0.336	0.062	0.004	–0.136	–0.084	–0.002	0.011
2012-2014	0.003	0.114	0.001	0.015	0.018	–0.003	0.000	0.002
1995-2014	0.019	–0.233	0.006	0.012	0.008	–0.031	0.001	0.025

primary forms (0.035%), batteries (0.025%), medical devices (0.025%), metal casting (0.012%), fibers (0.019%), and fertilizers and nitrogen compounds (0.012%), indicating that an increase in the share of SMEs promoted *TFP*

growth.

In contrast, a negative SME_{impact} with negative φ_{SME} appeared in eight industries, and the most negative in coke, briquettes, and refined petroleum products (–0.477%), followed by man-made fibers (–0.233%), flat display boards (–0.086%), pharmaceuticals (–0.031%), and computers (–0.030%), indicating that an increase in the share of SMEs slowed the productivity growth.

Second, for the selected time periods, during the 1998 economic depression, a decrease in the share of SMEs predominantly slowed *TFP* growth in the semiconductors industry (–0.165%), while an increase in the share of SMEs considerably slowed *TFP* growth in the computers (–0.401%) and pharmaceuticals (–0.211%) industries.

During the following 1999 resurrection of Korean manufacturing industries, an increase in the share of SMEs substantially slowed *TFP* growth in the flat display boards industry (–0.644%), but considerably promoted it in the man-made fibers industry (0.751%).

In particular, during the 2009 economic downturn wrought by the 2008 global financial crisis, an increase in the share of SMEs slowed *TFP* growth in the man-made fibers industry (–0.567%), and finally, during the 2011 mild economic recovery, a decrease in the share of SMEs slowed *TFP* growth in the other chemical products industry (–0.136%).

Tables 2-5 present the averages of *TP*, $\dot{TE}$, *SC*, *AE*, and $\dot{TFP}$ for the 29 export-leading industries over the selected time periods.

TFP growth was driven mainly by high *TP* although *TP* rates declined continuously except for the increasing *TP* in the special purpose machinery industry. The computers industry achieved the highest *TFP* growth and *TP* (18.2% and 19.8%), semiconductors, the second highest *TFP* growth and *TP* (16.6% and 17.9%), and assembled vehicles, the third highest *TFP* growth and *TP* (16.3% and 12.7%). However, the basic iron and steel industry posted the lowest *TFP* growth and *TP* (–0.7% and 1.8%), non-ferrous metals, second to lowest (0.0% and 2.3%), and fabricated metal products, third to lowest (0.9% and 2.5%).

Table 2 *TP*, $\dot{TE}$, *SC*, *AE*, $\dot{TFP}$, *TE*, and *RTS* for the IT Manufacturing Industries

		IT Parts and Components				IT Products			
		Semiconductors	Flat display boards	Other electronic components	Batteries	Telecommunication apparatus	Electric home appliances	Electronic video and audio equipment	Computers
TP	1996-1997	20.0	NA	9.0	10.3	15.3	14.3	16.1	23.7
	1998	19.5	NA	8.7	9.7	14.8	14.0	15.8	23.1
	1999	19.3	12.9	8.5	9.4	14.5	13.9	15.8	22.7
	2000-2003	18.6	12.5	8.0	8.9	13.7	13.5	15.1	21.1
	2004-2007	17.6	11.7	7.2	7.8	12.6	12.7	14.4	19.4
	2008	16.9	11.1	6.6	7.2	11.8	12.3	13.9	18.1
	2009	16.6	10.9	6.4	7.4	11.5	12.0	13.6	17.6
	2011	16.4	10.7	6.2	7.4	11.2	11.9	13.5	17.1
	2012-2014	16.0	10.4	5.7	6.9	10.6	11.5	13.1	16.2
	1995-2014	17.9	11.6	7.3	8.3	12.9	12.9	14.6	19.8
$\dot{TE}$	1996-1997	0.6	NA	–0.1	2.5	–0.9	–3.0	–3.1	–4.5
	1998	–1.3	NA	–1.7	1.5	–3.8	–4.9	–4.5	–8.4
	1999	–1.5	6.6	–1.8	–4.7	–3.1	–1.8	–5.5	–1.8
	2000-2003	–1.3	–1.8	0.6	–2.4	–0.4	–2.9	–1.6	1.5
	2004-2007	0.8	–0.5	0.7	1.7	1.2	–3.5	–0.7	–0.8
	2008	–0.9	0.5	–0.4	8.8	–0.3	–2.7	–1.2	–2.9
	2009	–0.1	–0.5	–0.2	–2.7	0.4	–7.3	–4.5	0.5
	2011	–0.6	3.0	–0.6	4.0	–3.0	–2.7	–7.2	–2.1
	2012-2014	–0.7	0.5	–0.3	0.0	–0.7	–6.8	–1.8	–2.6
	1995-2014	–0.4	0.1	0.0	0.5	–0.6	–4.0	–2.4	–1.6
SC	1996-1997	0.2	NA	–0.9	–0.3	–0.8	0.8	0.2	–7.8
	1998	0.0	NA	–3.9	–0.3	0.7	0.8	0.8	1.9
	1999	–0.8	7.5	0.8	–0.6	0.8	0.3	0.1	1.3
	2000-2003	–0.4	0.3	1.1	0.2	–0.3	–0.1	0.0	0.5
	2004-2007	0.1	–0.3	0.8	–1.1	–0.3	–0.2	–0.1	2.6
	2008	–0.1	–2.0	0.6	14.0	–0.1	0.1	–10.1	0.8
	2009	0.1	–1.0	–1.2	0.4	–0.9	0.5	–0.3	–1.2
	2011	0.1	–4.6	0.4	–1.5	0.7	0.0	1.6	–1.9
	2012-2014	0.0	0.3	–0.2	0.0	0.5	0.0	1.6	1.6
	1995-2014	–0.1	0.1	0.1	0.4	–0.1	0.1	–0.2	0.2
AE	1996-1997	–2.5	NA	–0.2	–2.8	1.5	–0.6	0.9	1.6
	1998	–6.8	NA	–2.6	–4.4	0.2	–0.7	–0.5	1.1
	1999	0.9	3.7	0.5	2.4	–0.2	–0.5	0.0	0.9
	2000-2003	–0.5	1.7	0.0	–7.9	–0.1	–0.4	0.1	0.0
	2004-2007	–0.7	–1.8	0.2	1.5	0.3	–0.1	–0.4	0.2
	2008	–0.7	1.9	–0.6	–22.3	0.5	–1.2	–4.0	–1.8
	2009	2.1	–8.9	0.8	2.3	0.5	–0.2	0.3	–1.8
	2011	1.0	3.1	–2.6	–7.6	0.2	–3.0	–0.6	–8.7
	2012-2014	–0.7	1.0	–0.7	0.9	–0.1	0.0	–0.6	1.2
	1995-2014	–0.9	0.1	–0.3	–3.2	0.3	–0.5	–0.3	–0.2
$\dot{TFP}$	1996-1997	18.2	NA	7.8	9.8	15.2	11.5	14.1	13.1
	1998	11.1	NA	0.5	6.5	11.9	9.2	11.5	17.4
	1999	17.9	30.0	8.1	6.8	11.9	11.8	10.4	23.0
	2000-2003	16.8	12.7	9.7	–1.1	13.0	10.0	13.6	23.2
	2004-2007	17.8	9.0	8.8	9.9	13.7	8.9	13.3	21.2
	2008	15.3	11.5	6.1	7.6	11.9	8.6	–1.4	14.2
	2009	18.5	0.5	5.9	7.6	11.5	5.0	9.2	15.1
	2011	17.2	12.1	3.5	2.3	9.1	6.2	7.3	4.3
	2012-2014	14.5	12.1	4.6	7.8	10.3	4.8	12.3	16.4
	1995-2014	16.6	11.8	7.1	6.0	12.5	8.6	11.6	18.2
TE	1995-2014	58.4	66.4	68.6	59.2	36.0	40.2	35.6	30.4
RTS	1995-2014	1.043 (0.133)	0.795 (0.150)	0.855 (0.058)	1.091 (0.291)	0.883 (0.073)	1.086 (0.098)	0.929 (0.085)	0.824 (0.145)

Note: *TE* and *RTS* by year are available from the author, and asymptotic standard errors are in parentheses.

Table 3 ***TP*, $\dot{TE}$, *SC*, *AE*, $\dot{TFP}$, *TE*, and *RTS* for the Machinery and Petrochemicals Industries**

		Machinery				Petrochemicals		
		Special purpose machinery	General purpose machinery	Electrical equipment	Fabricated metal products	Basic chemicals	Synthetic rubbers and plastics in primary forms	Coke, briquettes, and refined petroleum products
TP	1996-1997	4.8	7.2	7.7	4.6	10.3	9.7	8.6
	1998	4.9	7.0	7.4	4.2	10.0	9.1	8.4
	1999	5.0	6.9	7.3	4.0	9.7	8.8	8.3
	2000-2003	5.1	6.5	6.9	3.3	9.1	7.8	8.0
	2004-2007	5.3	6.0	6.4	2.3	8.2	6.3	7.5
	2008	5.4	5.7	6.0	1.6	7.7	5.4	7.2
	2009	5.4	5.6	5.8	1.3	7.5	5.0	7.1
	2011	5.5	5.4	5.7	1.1	7.3	4.7	6.9
	2012-2014	5.6	5.2	5.4	0.5	6.8	3.9	6.7
	1995-2014	5.2	6.1	6.5	2.5	8.5	6.7	7.6
$\dot{TE}$	1996-1997	–0.5	–2.2	–2.4	–0.2	–0.8	4.8	0.6
	1998	–0.8	–3.5	–1.3	–1.9	–1.9	–6.9	–4.4
	1999	–0.8	–1.2	–2.3	–1.6	–2.5	2.6	–4.4
	2000-2003	–1.9	–1.1	–1.1	–0.7	–2.0	–2.1	–5.4
	2004-2007	–1.2	–1.7	–2.0	–0.4	–3.9	–2.7	–3.1
	2008	–0.8	–1.4	–1.5	–0.8	–2.7	–0.2	–0.7
	2009	–1.9	–2.7	–2.0	–1.6	–3.1	–1.4	–5.3
	2011	–1.2	–2.5	–2.3	–2.7	–4.0	–2.5	–7.5
	2012-2014	–2.5	–2.5	–2.1	–0.1	–2.9	–0.2	–2.0
	1995-2014	–1.5	–1.9	–1.8	–0.8	–2.7	–1.0	–3.4
SC	1996-1997	–0.1	0.1	–0.2	0.5	0.0	3.8	–3.1
	1998	0.6	–0.1	0.2	–0.6	–0.6	–2.8	13.6
	1999	0.7	0.0	0.3	–0.5	0.3	–1.6	6.6
	2000-2003	0.0	0.0	0.2	–0.3	0.1	–0.6	3.2
	2004-2007	–0.1	0.0	0.1	0.0	0.2	–0.8	1.3
	2008	–0.6	–0.1	–0.4	0.1	0.1	–0.1	1.8
	2009	0.0	0.0	–0.1	0.1	0.4	0.9	1.4
	2011	–0.8	–0.1	–0.4	0.1	–1.8	0.1	0.1
	2012-2014	0.0	0.0	0.1	0.0	0.1	–0.1	2.3
	1995-2014	0.0	0.0	0.0	–0.1	0.0	–0.1	2.3
AE	1996-1997	–0.9	–1.3	–1.1	–0.4	–4.8	–7.6	–15.7
	1998	–1.1	–1.8	–3.0	–6.0	–20.5	–2.6	–13.7
	1999	2.2	–0.6	0.3	0.2	–0.1	–1.5	–6.4
	2000-2003	–0.5	0.3	0.1	0.1	1.6	0.8	0.3
	2004-2007	–0.5	–0.3	–0.3	–0.7	–0.4	1.2	0.4
	2008	–2.7	–2.0	–1.0	–3.0	–1.4	–2.4	–6.3
	2009	–0.7	–1.1	–0.5	–1.1	–0.1	–1.3	0.3
	2011	–0.9	–0.2	–1.2	–1.1	–9.9	–2.2	–14.9
	2012-2014	–0.3	–0.4	–0.1	–0.5	–0.5	–0.6	–2.8
	1995-2014	–0.5	–0.5	–0.5	–0.9	–2.1	–1.0	–4.3
$\dot{TFP}$	1996-1997	3.3	3.7	4.0	4.5	4.8	10.1	–7.9
	1998	3.5	1.6	3.4	–4.3	–13.1	–2.1	–0.9
	1999	7.0	5.1	5.6	2.0	7.4	8.6	3.5
	2000-2003	2.6	5.7	6.1	2.5	8.9	6.1	5.4
	2004-2007	3.6	4.0	4.2	1.1	4.2	4.1	5.6
	2008	1.2	2.2	3.1	–2.1	3.6	2.6	1.4
	2009	2.8	1.8	3.2	–1.4	4.7	3.2	2.9
	2011	2.7	2.7	1.8	–2.6	–8.4	0.0	–15.3
	2012-2014	2.7	2.2	3.3	0.0	3.4	3.1	4.0
	1995-2014	3.2	3.7	4.2	0.9	3.7	4.6	1.8
TE	1995-2014	50.9	45.9	35.8	44.1	34.9	43.0	32.2
RTS	1995-2014	0.917 (0.045)	0.993 (0.042)	0.914 (0.010)	1.060 (0.029)	0.933 (0.184)	1.102 (0.189)	0.586 (0.460)

Table 4 *TP*, $\dot{TE}$, *SC*, *AE*, $\dot{TFP}$, *TE*, and *RTS* for the Automobile, Shipbuilding, and Basic Metal Products Industries

		Automobile		Shipbuilding	Basic Metal Products		
		Assembled vehicles	Automobile parts and components		Basic iron and steel	Non-ferrous metals	Metal casting
TP	1996-1997	13.4	7.9	5.3	3.1	4.6	7.1
	1998	13.9	7.7	5.1	2.8	4.2	6.6
	1999	13.6	7.6	4.9	2.7	3.9	6.2
	2000-2003	13.1	7.3	4.5	2.3	3.2	5.3
	2004-2007	12.7	6.9	3.9	1.7	2.0	4.0
	2008	12.4	6.6	3.5	1.3	1.3	3.2
	2009	12.1	6.5	3.3	1.1	1.0	2.9
	2011	12.2	6.4	3.2	1.0	0.7	2.6
	2012-2014	11.5	6.2	2.9	0.7	0.1	1.9
	1995-2014	12.7	7.0	4.1	1.8	2.3	4.4
$\dot{TE}$	1996-1997	0.6	–1.3	–0.4	–0.1	–1.5	–0.8
	1998	–1.3	–2.9	–4.2	–0.3	–2.5	–1.9
	1999	–0.3	–2.2	0.4	–0.9	–0.7	–1.3
	2000-2003	–1.5	–1.5	1.9	–0.7	0.1	–0.5
	2004-2007	–6.3	–1.4	–0.3	–2.9	–2.6	–2.1
	2008	–3.7	0.5	–1.0	–3.0	–4.1	–0.4
	2009	1.8	–1.8	–0.2	–1.3	–0.4	–2.1
	2011	–4.0	–0.8	–4.8	–1.2	–5.4	–4.1
	2012-2014	3.0	–2.5	1.2	–1.2	–0.7	–0.2
	1995-2014	–1.6	–1.6	0.0	–1.4	–1.6	–1.2
SC	1996-1997	2.7	–4.7	0.2	0.0	0.0	0.2
	1998	–15.0	5.2	–0.5	–0.1	0.0	–0.1
	1999	–0.3	0.2	0.4	–0.2	0.0	0.2
	2000-2003	5.6	0.0	0.3	–0.1	0.0	0.1
	2004-2007	–0.5	–0.1	0.2	0.0	0.1	0.1
	2008	–2.8	–0.3	0.1	0.0	0.2	–1.3
	2009	–0.8	–0.5	0.0	0.0	–0.3	0.4
	2011	4.0	0.0	0.8	0.0	–0.1	–0.3
	2012-2014	0.7	0.1	0.3	0.0	0.1	0.2
	1995-2014	0.7	–0.3	0.2	0.0	0.0	0.0
AE	1996-1997	–5.3	3.8	0.0	–3.8	–0.7	–1.7
	1998	–0.9	–11.1	–0.5	–1.7	–6.2	–0.9
	1999	–0.3	2.0	0.1	–1.0	–0.3	1.3
	2000-2003	0.0	0.0	0.1	–0.4	–0.3	–0.6
	2004-2007	0.0	–0.3	–0.1	–0.4	–0.2	–0.5
	2008	0.2	–2.6	–0.3	–0.4	–0.9	–2.8
	2009	0.6	0.1	–0.9	–1.6	–0.8	–1.3
	2011	0.0	–0.3	–0.3	–4.2	–1.1	–1.3
	2012-2014	0.1	–0.3	0.2	0.0	0.0	0.1
	1995-2014	–0.6	–0.4	0.0	–1.1	–0.7	–0.7
$\dot{TFP}$	1996-1997	9.7	5.7	5.2	–0.8	2.4	4.8
	1998	85.9	–1.1	0.0	0.7	–4.5	3.8
	1999	12.7	7.6	5.8	0.7	2.9	6.5
	2000-2003	16.2	5.8	6.9	1.1	3.0	4.4
	2004-2007	8.3	5.0	3.7	–1.7	–0.7	1.4
	2008	8.5	4.1	2.4	–2.1	–3.4	–1.4
	2009	15.5	4.3	2.3	–1.8	–0.6	0.0
	2011	9.5	5.2	–1.1	–4.4	–5.9	–3.1
	2012-2014	14.8	3.5	4.6	–0.5	–0.5	2.0
	1995-2014	16.3	4.7	4.2	–0.7	0.0	2.5
TE	1995-2014	32.7	44.9	70.7	44.7	39.4	44.9
RTS	1995-2014	1.148 (0.565)	0.866 (0.040)	0.903 (0.046)	1.008 (0.079)	0.969 (0.152)	0.902 (0.141)

Note: *TE* and *RTS* by year are available from the author, and asymptotic standard errors are in parentheses.

Table 5 ***TP***, $\dot{TE}$, ***SC***, ***AE***, $\dot{TFP}$, ***TE***, **and** ***RTS*** **for the Textiles and Clothing, Fine Chemicals, and Precision Instruments Industries**

		Textiles and Clothing			Fine Chemicals			Precision Instruments	
		Fibers	Man-made fibers	Clothing apparel	Fertilizers and nitrogen compounds	Other chemical products	Pharmaceuticals	Precision instruments	Medical devices
TP	1996-1997	7.6	19.5	9.0	15.5	9.5	8.2	7.2	8.7
	1998	7.3	18.3	8.8	14.8	9.0	8.1	7.2	8.6
	1999	7.1	17.1	8.6	14.3	8.7	8.1	7.3	8.6
	2000-2003	6.7	14.6	8.2	12.8	7.9	8.1	7.3	8.6
	2004-2007	6.1	11.3	7.6	10.6	6.5	8.0	7.4	8.4
	2008	5.6	9.0	7.2	9.4	5.7	7.8	7.4	8.3
	2009	5.4	8.1	7.0	8.9	5.3	7.8	7.4	8.3
	2011	5.2	6.9	6.9	8.4	5.0	7.7	7.4	8.2
	2012-2014	4.8	5.0	6.5	7.3	4.2	7.6	7.4	8.1
	1995-2014	6.2	12.0	7.7	11.2	6.8	7.9	7.3	8.4
$\dot{TE}$	1996-1997	–1.8	–1.2	–5.2	–0.2	–2.7	–1.6	0.2	–0.1
	1998	–1.6	2.2	–6.9	–0.1	–1.4	–1.1	–2.9	0.8
	1999	–1.8	3.0	–3.9	–1.4	–2.4	–3.2	1.9	–1.8
	2000-2003	–1.2	0.1	0.0	–0.5	–2.7	–3.6	–0.7	–1.8
	2004-2007	–1.0	–2.6	–2.0	–1.3	–2.6	–3.6	0.6	–0.3
	2008	–1.6	1.8	–4.4	–1.2	–1.3	–2.6	2.0	–1.0
	2009	–2.2	–5.7	–2.3	0.7	–3.5	–3.9	–1.9	–1.1
	2011	–2.3	0.5	–8.0	–1.0	–3.7	–4.8	–0.2	0.1
	2012-2014	–1.8	1.1	–4.2	–0.5	–1.3	–2.8	–1.0	–0.9
	1995-2014	–1.5	–0.4	–3.1	–0.7	–2.4	–3.1	–0.2	–0.8
SC	1996-1997	0.2	–2.1	0.4	–2.4	0.7	–1.7	0.0	–0.2
	1998	0.5	–0.4	1.3	1.7	–1.1	–1.5	0.0	0.3
	1999	0.4	–0.3	–0.2	–2.2	–0.2	1.3	0.0	–0.9
	2000-2003	0.8	–0.6	–0.1	–0.3	–0.4	–1.5	0.0	–0.1
	2004-2007	0.6	–0.1	0.5	–0.3	0.0	–0.8	–0.1	0.0
	2008	–0.1	0.0	–1.1	0.1	0.1	–0.4	0.2	–0.1
	2009	–0.1	–0.1	–0.7	0.0	0.0	2.7	0.1	–0.1
	2011	–0.8	–1.2	0.1	0.0	0.0	–1.1	–0.2	0.0
	2012-2014	0.3	–0.4	0.1	0.0	0.0	0.6	0.0	–0.1
	1995-2014	0.4	–0.5	0.1	–0.4	–0.1	–0.6	0.0	–0.1
AE	1996-1997	–0.7	–16.8	0.2	1.0	–0.7	–2.8	–2.4	–1.1
	1998	–0.9	–8.1	0.0	–8.3	–0.6	–2.8	1.1	–0.7
	1999	0.3	0.8	0.1	1.7	–2.1	–2.4	0.1	0.5
	2000-2003	–0.1	–0.9	0.1	–0.3	0.1	0.4	–0.1	–0.1
	2004-2007	–0.3	–0.3	0.0	0.5	0.0	–1.4	–1.3	0.0
	2008	–0.9	–2.9	–0.6	–5.6	–0.7	–3.4	1.0	–2.0
	2009	–0.3	0.8	–0.2	–6.1	–0.4	–1.8	0.2	–0.6
	2011	–1.4	–2.4	–0.9	0.4	–1.0	–8.0	–1.7	–2.8
	2012-2014	0.0	2.2	0.0	–0.5	–0.1	–0.5	–0.5	–0.1
	1995-2014	–0.4	–2.4	–0.1	–0.9	–0.4	–1.7	–0.6	–0.5
$\dot{TFP}$	1996-1997	5.3	–1.1	4.4	13.9	6.7	2.2	5.0	7.4
	1998	5.2	11.7	3.3	8.0	6.0	2.5	5.5	8.5
	1999	6.1	21.4	4.6	12.4	4.0	3.9	9.3	6.8
	2000-2003	6.2	12.7	8.2	11.8	4.9	3.3	6.5	6.6
	2004-2007	5.4	7.7	6.1	9.5	3.9	2.0	6.6	8.2
	2008	3.0	8.1	1.3	2.7	3.7	1.4	10.6	5.2
	2009	2.8	2.5	3.8	3.4	1.4	4.7	5.8	6.4
	2011	0.8	4.2	–1.9	7.8	0.0	–6.3	5.3	5.5
	2012-2014	3.3	7.9	2.5	6.2	2.8	4.9	5.9	7.0
	1995-2014	4.7	8.4	4.7	9.2	4.0	2.6	6.5	7.1
TE	1995-2014	39.0	39.1	30.6	60.6	31.8	27.4	39.9	38.2
RTS	1995-2014	0.832 (0.043)	0.990 (0.270)	0.733 (0.053)	1.081 (0.355)	1.053 (0.092)	1.283 (0.197)	0.972 (0.080)	1.011 (0.1421)

Second, *TE* deteriorated continuously across industries and time periods. High *TE* with a small improving rate $\dot{TE}$ appeared in four industries, shipbuilding, 70.7% (0.0%), other electronic components, 68.6% (0.0%), flat display boards, 66.4% (0.1%), and batteries, 59.2% (0.5%), while high *TE* with a slow deteriorating rate showed in the semiconductors, 58.4% (–0.4%), and fertilizers and nitrogen compounds, 60.6% (–0.7%). However, low *TE* with a fast deteriorating rate was found in the coke, briquettes, and refined petroleum products, 32.2% (–3.4%), clothing apparel, 30.6% (–3.1%), and pharmaceuticals, 27.4% (–3.1%).

Substantially large *TE* losses occurred concurrently in the IT manufacturing industry during the 1998 severe depression: semiconductors (–1.3%), other electronic components (–1.7%), telecommunication apparatus (–3.8%), electric home appliances (-4.9%), electronic video and audio equipment (–4.5%), and computers (–8.4%).

The following large-scale industrial restructuring of the Korean manufacturing industries during 1999 brought about significant technical inefficiency simultaneously: semiconductors (–1.5%), other electronic components (–1.8%), batteries (–4.7%), telecommunication apparatus (–3.1%), electric home appliances (–1.8%), electronic video and audio equipment (–5.5%), and computers (–1.8%).

Furthermore, during the 2011 economic recovery after the 2009 economic recession triggered by the 2008 global financial crisis, considerable *TE* losses occurred in the IT products industry: telecommunication apparatus (–3.0%), electric home appliances (–2.7%), electronic video and audio equipment (–7.2%), and computers (–2.1%).

Therefore, significant *TE* losses arose in the IT manufacturing industry in the aftermath of the two market exogenous shocks, the 1997 financial crisis and the 2008 global financial crisis.

Moreover, *TFP* growth of the shipbuilding industry was 0.0% during the 1998 economic depression mainly because of a negative $\dot{TE}$ of −4.2%. Similarly, *TFP* growth turned negative, −1.1%, during the 2011 economic recovery because of a negative $\dot{TE}$, –4.8%.

Third, *SC* fluctuated widely across time periods especially for the coke, briquettes, and refined petroleum products and assembled vehicles industries. The scale effects mostly tapered off across the industries, but the coke, briquettes, and refined petroleum products industry achieved significant scale economies.

For the specified time periods, during 1996-1997, significant scale diseconomies showed in the computers (–7.8%); during the 1998 economic depression, significant scale diseconomies were in other electronic components (–3.9%) and assembled vehicles (–15.0%), but significant scale economies were in the automobile parts and components (5.2%); during 1999, scale economies appeared in flat display boards (7.5%); during the 2000-2003 economic recovery, and again during the 2011 economic recovery, the assembled vehicles industry eventually achieved substantial scale economies, 5.6% and 4.0%, respectively; during 2008, substantial scale economies showed in the batteries (14.0%) industry, while substantial scale diseconomies appeared in the electronic video and audio equipment (–10.1%); finally, during 2011, significant scale diseconomies appeared in the flat display boards industry (–4.6%).

As a result, significant scale diseconomies arose mostly in the aftershock of the 1997 financial crisis and the 2008 global financial crisis.

Forth, *AE* varied extensively across the industries and time periods, especially, the significant allocative efficiency losses were identified in batteries (–3.2%), basic chemicals (–2.1%), coke, briquettes, and refined petroleum products (–4.3%), man-made fibers (–2.4%), and pharmaceuticals (–1.7%) industries.

For the specified time periods, during the 1998 depression, considerably large allocative efficiency losses were found in the semiconductors (–6.8%), fabricated metal products (–6.0%), basic chemicals (–20.5%), coke, briquettes, and refined petroleum products (–13.7%), and automobile parts and components (–11.1%) industries. Following economic recovery during 2000-2003, another significant allocative efficiency loss was found in the batteries industry (–7.9%).

Considerable allocative efficiency losses again prevailed across the industries during the 2008 global financial crisis: batteries (–22.3%), electronic video and audio equipment (–4.0%), special purpose machinery (–2.7%), general purpose machinery (–2.0%), fabricated metal products (–3.0%), and automobile parts and components (–2.6%).

Allocative efficiency losses were also found in the flat display boards industry (–8.9%) during the 2009 economic downturn, as well as in the other electronic components (–2.6%), batteries (–7.6%), electric home appliances (–3.0%), and computers (–8.7%) industries during the 2011 economic recovery.

Obviously, the considerable allocative efficiency losses were set off by two market exogenous shocks — the 1997 financial crisis and 2008 global financial crisis — which triggered the severe market distortions.

Lastly, *T*-test for the null hypothesis of CRS technology against the alternative hypotheses of not CRS technology was conducted on the average estimates of *RTS* at the 1% significance level. As a result, the other electronic components, electrical equipment, automobile parts and components, fibers, and clothing apparel industries exhibited DRS, while the remaining 24 export-leading industries exhibited CRS, given translog SFPF.

Next, table 6 presents the averages of SME_{impact} of 13 other exporting industries, over the selected time periods, and table A3 demonstrates the coefficient of the variable, *SME* (*being an SME*), in the SFPF of 13 other exporting industries, φ_{SME}. Tables 7-7.1 present the averages of *TP*, $\dot{TE}$, *SC*, *AE*, $\dot{TFP}$, *TE*, and *RTS* for 13 other exporting industries over the selected time periods.

First, SME_{impact} was significantly small, but an increase in the share of SMEs promoted productivity growth the most in tobacco (0.615%), followed by beverages (0.049%).

Second, relatively low *TFP* growth was driven largely by *TP*, however, negative *TFP* growth was found in the five industries of beverages, rubber products, leather goods and footwear, tobacco, and printing, and even worse, strikingly negative *TP* was detected in tobacco (–25.5% and –25.5%).

Table 6 SME_{impact} for the Other Exporting Industries

	Plastic Products	Food	Beverages	Rubber Products	Paper	Other Manufacturing	Leather Goods and Footwear
1996-1997	0.007	–0.004	0.215	0.019	–0.015	–0.007	0.037
1998	0.008	–0.006	0.439	–0.044	0.049	–0.010	0.021
1999	–0.011	–0.003	–0.469	0.066	–0.009	0.002	–0.034
2000-2003	0.004	–0.001	0.102	0.007	0.021	–0.012	–0.003
2004-2007	–0.003	–0.002	–0.002	0.035	0.002	0.000	0.017
2008	0.010	0.001	–0.022	–0.090	0.003	–0.009	–0.002
2009	–0.004	–0.002	0.087	0.074	0.008	0.000	0.026
2011	0.004	0.001	–0.213	–0.035	0.029	0.008	0.029
2012-2014	–0.006	–0.001	0.076	0.010	0.002	–0.003	0.009
1995-2014	0.0002	–0.002	0.049	0.012	0.008	–0.004	0.011

	Glass	Furniture	Tobacco	Cement	Printing	Wood and Wood Products
1996-1997	–0.028	0.010	–0.397	–0.033	–0.028	–0.018
1998	–0.005	0.032	3.611	0.000	0.068	–0.076
1999	0.016	–0.044	0.000	–0.065	–0.014	0.044
2000-2003	0.000	0.017	0.521	–0.038	–0.002	0.004
2004-2007	–0.025	0.009	0.673	–0.009	0.006	0.016
2008	0.038	–0.005	1.356	0.002	–0.021	–0.018
2009	0.001	–0.014	–2.825	–0.002	0.022	–0.001
2011	–0.018	0.000	4.728	–0.090	0.000	0.177
2012-2014	–0.012	–0.001	0.075	0.024	0.000	0.002
1995-2014	–0.009	0.005	0.615	–0.019	0.001	0.010

Third, *TE* deteriorated across industries and time periods, especially, the food, beverages, and leather goods and footwear industries exposed the low *TE* with a fast deteriorating rate.

However, the glass industry retained the highest *TE* with a slow deteriorating rate, 68.1% (–0.5%), and printing, high *TE* with a zero deteriorating rate, 55.9% (0.0%), furthermore, tobacco attained a modest *TE* with a fast improving rate, 47.2% (4.2%).

Fourth, *SC* continuously vanished across time periods, except for the most widely fluctuating *SC* for the tobacco industry, followed by that for the beverages industry.

Fifth, *AE* varied across the industries and time periods, however, the tobacco industry showed the most varying *AE* followed by the glass industry.

Finally, the *T*-test for the null hypothesis of CRS technology against the alternative hypotheses of IRS or DRS technology at the 1% significance level identified that the 13 other exporting industries all exhibited CRS technology, given the translog SFPF.

Table 7 *TP*, $\dot{TE}$, *SC*, *AE*, $\dot{TFP}$, *TE*, and *RTS* for the Other Exporting Industries

		Plastic Products	Food	Beverages	Rubber Products	Paper	Other Manufacturing	Leather Goods and Footwear
TP	1996-1997	3.2	5.5	3.6	0.8	2.8	6.2	–0.5
	1998	3.2	5.4	3.7	0.8	2.9	6.2	0.0
	1999	3.2	5.4	3.7	0.8	2.9	6.1	0.1
	2000-2003	3.2	5.2	3.8	0.8	3.0	6.1	0.8
	2004-2007	3.1	5.0	3.8	0.8	3.2	6.1	1.9
	2008	3.1	4.8	3.8	0.8	3.3	6.1	2.7
	2009	3.1	4.7	3.7	0.8	3.3	6.1	2.9
	2011	3.1	4.7	3.7	0.8	3.3	6.1	3.1
	2012-2014	3.1	4.5	3.7	0.8	3.4	6.0	3.7
	1995-2014	3.1	5.0	3.7	0.8	3.1	6.1	1.6
$\dot{TE}$	1996-1997	–0.5	–1.9	–2.0	–1.2	–0.5	–3.3	–3.4
	1998	–1.1	–2.4	–1.8	–1.5	–0.9	–2.1	–4.8
	1999	–1.5	–3.0	–3.9	–1.8	–2.3	–2.7	–2.4
	2000-2003	–1.0	–1.2	–3.0	–0.8	–0.7	–1.4	–0.1
	2004-2007	–0.9	–1.6	–2.7	–1.1	–0.5	–2.3	–2.1
	2008	0.2	–2.1	–1.3	–2.1	0.0	–3.0	–5.0
	2009	–1.1	–2.9	–2.6	–0.8	–1.7	–2.1	–4.4
	2011	–2.7	–4.0	–4.5	–2.5	–1.3	–6.6	–0.6
	2012-2014	–1.3	–3.4	–1.8	–1.6	–2.1	–5.0	–4.5
	1995-2014	–1.0	–2.2	–2.6	–1.3	–1.0	–2.9	–2.6
SC	1996-1997	–0.1	–0.2	–2.7	–0.2	0.1	–0.5	0.1
	1998	–0.1	–0.2	–7.5	0.0	–0.2	0.6	0.0
	1999	0.2	–0.1	7.0	0.2	–0.1	–0.2	0.0
	2000-2003	0.0	–0.2	–2.8	0.3	–0.1	–0.3	0.1
	2004-2007	0.0	0.0	–0.4	0.1	–0.1	–0.4	0.2
	2008	0.0	0.0	1.3	–0.7	0.0	–0.3	0.0
	2009	0.0	0.0	3.1	0.6	0.0	0.5	0.1
	2011	0.0	–0.1	1.4	–1.1	0.0	0.0	0.1
	2012-2014	0.0	0.1	0.0	0.1	0.0	0.0	0.0
	1995-2014	0.0	–0.1	–0.7	0.0	0.0	–0.2	0.1
AE	1996-1997	–1.6	–1.2	–3.2	–1.2	–3.3	–0.1	2.2
	1998	0.7	–1.6	–2.4	–0.4	–3.0	–0.7	–0.1
	1999	0.3	–1.5	2.2	–0.4	–0.9	–0.1	1.1
	2000-2003	0.1	0.4	–0.4	0.1	0.2	0.0	0.5
	2004-2007	–0.4	–0.3	0.2	0.0	0.1	0.0	0.5
	2008	–1.7	–1.2	–0.4	–0.4	–1.2	–0.1	0.3
	2009	0.2	–0.3	–2.7	0.0	–0.3	–0.4	0.1
	2011	–1.5	–1.4	–0.6	0.0	–0.8	0.1	0.0
	2012-2014	–0.2	0.0	–0.5	–0.2	0.2	0.0	0.0
	1995-2014	–0.4	–0.4	–0.7	–0.2	–0.6	–0.1	0.5
$\dot{TFP}$	1996-1997	1.1	2.2	–4.1	–1.7	–0.8	2.3	–1.4
	1998	2.6	1.2	–7.5	–1.1	–1.2	4.0	–4.9
	1999	2.2	0.8	8.5	–1.2	–0.4	3.2	–1.2
	2000-2003	2.2	4.3	–2.3	0.5	2.5	4.3	1.2
	2004-2007	1.8	3.2	0.9	–0.3	2.7	3.5	0.4
	2008	1.6	1.5	3.4	–2.6	2.2	2.8	–2.0
	2009	2.2	1.6	1.6	0.6	1.4	4.1	–1.3
	2011	–1.1	–0.9	–0.2	–2.8	1.3	–0.4	2.6
	2012-2014	1.6	1.2	1.4	–0.9	1.5	1.0	–0.7
	1995-2014	1.7	2.4	–0.2	–0.7	1.5	2.9	–0.3
TE	1995-2014	44.6	29.0	25.9	43.0	39.3	36.5	32.4
RTS	1995-2014	1.019 (0.045)	1.017 (0.05)	1.614 (0.283)	0.906 (0.091)	1.040 (0.070)	1.104 (0.088)	0.940 (0.088)

Table 7-1 *TP*, $\dot{TE}$, *SC*, *AE*, $\dot{TFP}$, *TE*, and *RTS* for the Other Exporting Industries

		Glass	Furniture	Tobacco	Cement	Printing	Wood and Wood Products
TP	1996-1997	3.9	7.1	–35.9	8.0	–1.3	7.0
	1998	4.1	7.0	–34.0	7.9	–1.1	6.6
	1999	4.3	6.9	–32.6	7.6	–1.0	6.3
	2000-2003	4.8	6.8	–29.0	7.1	–0.8	5.6
	2004-2007	5.4	6.5	–23.8	6.1	–0.5	4.5
	2008	5.7	6.4	–21.0	5.3	–0.3	3.8
	2009	5.9	6.3	–19.2	5.0	–0.2	3.5
	2011	6.1	6.2	–19.2	4.7	–0.1	3.2
	2012-2014	6.4	6.1	–16.7	4.1	0.0	2.7
	1995-2014	5.2	6.6	–25.5	6.2	–0.6	4.8
$\dot{TE}$	1996-1997	–1.2	–2.9	5.6	0.2	2.5	0.3
	1998	–1.3	–5.1	9.3	1.1	5.3	–0.8
	1999	–0.4	–1.2	–6.5	0.0	–3.5	–2.7
	2000-2003	0.0	–1.4	2.8	–0.2	–1.4	0.2
	2004-2007	–0.6	–2.3	5.3	–0.9	–0.2	0.7
	2008	–2.0	–1.8	6.5	–0.8	1.9	–0.5
	2009	–0.3	–3.2	9.8	–0.7	0.5	–2.1
	2011	1.2	–3.5	–0.4	–1.0	0.4	–0.5
	2012-2014	–0.6	–4.3	4.3	–0.7	–1.1	–0.6
	1995-2014	–0.5	–2.7	4.2	–0.4	0.0	–0.2
SC	1996-1997	–1.7	0.0	–3.3	–0.7	–0.2	–0.1
	1998	–0.6	–0.5	–16.0	–1.9	0.7	–0.1
	1999	–0.8	–0.3	–4.2	–0.4	–0.1	0.1
	2000-2003	–0.4	–0.2	1.6	–0.4	0.0	0.1
	2004-2007	0.1	0.0	–8.5	–0.1	0.2	0.1
	2008	1.5	0.1	37.1	0.0	–1.3	–0.2
	2009	0.5	0.2	12.0	–0.1	0.0	0.1
	2011	–0.2	0.1	–38.0	0.2	–0.4	–0.4
	2012-2014	–0.4	0.0	2.5	–0.3	–0.2	0.1
	1995-2014	–0.3	–0.1	–2.0	–0.4	–0.1	0.0
AE	1996-1997	–4.3	–1.4	–2.7	–3.7	–2.4	–0.6
	1998	–7.9	–2.4	–10.2	–7.9	0.2	–1.9
	1999	4.0	0.6	0.3	0.1	–0.2	–0.3
	2000-2003	–0.5	–0.2	–3.6	0.1	–1.0	0.0
	2004-2007	–2.0	–0.3	–1.4	0.2	–0.4	–0.2
	2008	–2.7	–1.0	3.9	–0.3	–2.7	–1.1
	2009	0.7	–1.3	0.1	–1.0	–0.3	–1.1
	2011	–5.6	–0.2	–4.3	–3.5	–0.9	–2.9
	2012-2014	–1.1	0.0	–4.8	0.9	–0.6	0.1
	1995-2014	–1.8	–0.5	–2.8	–0.9	–0.9	–0.5
$\dot{TFP}$	1996-1997	–3.2	2.8	–36.8	3.7	–1.4	6.6
	1998	–5.7	–0.9	–47.3	–0.8	5.2	3.8
	1999	7.2	6.1	–42.9	7.2	–4.9	3.6
	2000-2003	3.9	5.1	–27.7	6.6	–3.1	5.9
	2004-2007	2.8	3.9	–27.8	5.2	–0.9	5.1
	2008	2.5	3.6	27.8	4.2	–2.4	2.0
	2009	6.7	2.0	–0.1	3.3	0.0	0.5
	2011	1.5	2.7	–57.1	0.4	–1.0	–0.5
	2012-2014	4.2	1.7	–14.6	4.0	–1.8	2.3
	1995-2014	2.5	3.4	–25.5	4.5	–1.5	4.1
TE	1995-2014	65.9	34.3	59.5	31.6	55.9	40.4
RTS	1995-2014	1.165 (0.116)	1.082 (0.075)	2.464 (1.652)	1.034 (0.100)	0.851 (0.250)	0.942 (0.115)

4.2. Size Impact and Productivity Growth by Industrial Sector

Table 8 presents the averages of $\dot{TFP}$, TP, $\dot{TE}$, SC, AE, SME_{impact}, and TE for 10 export-leading industrial sectors based on the ranking of $\dot{TFP}$ over the selected time periods.

First, *TFP* growth for the IT products industry ranked the top and that for the basic metal products industry ranked at the bottom: *TFP* growth and *TP* for the IT products were (12.7% and 15.0%), followed by automobile (10.5% and 9.8%), IT parts and components (10.4% and 11.3%), precision instruments (6.8% and 7.9%), textiles and clothing (5.9% and 8.7%), fine chemicals (5.3% and 8.7%), shipbuilding (4.2% and 4.1%), petrochemicals (3.3% and 7.6%), machinery (3.0% and 5.1%), and finally, basic metal products (0.6% and 2.8%).

Therefore, the cutting-edge technology-based industries of IT Products and IT parts and components occupied the top rank of *TFP* growth, but the mature target industries of petrochemicals, machinery, and basic metal products ranked the lowest, throughout the specified time periods.

The precision instruments (medical devices included) industry retained its upper high rank of *TFP* growth except during 2000-2003, while fine chemicals (pharmaceuticals included) maintained middling *TFP* growth. Thus, active R&D investment in the medical devices and pharmaceuticals industries in the framework of “selection and concentration” brought about considerable progress in the bio-industry.

Second, the automobile industry maintained upper-high *TFP* growth with sizable fluctuating SME_{impact} because of unparalleled strong vertical integration despite continuously deteriorating *TE*, while the shipbuilding industry had a below middling *TFP* growth because of flagging *TP*. Astonishingly, in 1998, the automobile industry recorded the top *TFP* growth because of the large benefit from SME_{impact} when “big deal” industrial restructuring was actively in progress in the aftermath of the 1997 financial crisis, indicating that the share of SMEs in the automobile industry soared sharply.

Table 8 $\dot{TFP}$, TP, $\dot{TE}$, SC, AE, SME_{impact}, and TE by Industrial Sector

	$\dot{TFP}$	Rank	TP	$\dot{TE}$	SC	AE	SME_{impact}	TE
1996-1997								
IT products	13.5	1	17.3	–2.9	–1.9	0.8	0.065	42.1
IT parts and components	11.9	2	13.1	1.0	–0.3	–1.8	–0.039	63.9
Automobile	7.7	3	10.6	–0.4	–1.0	–0.7	–0.855	45.3
Fine chemicals	7.6	4	11.1	–1.5	–1.2	–0.8	0.024	45.8
Precision instruments	6.2	5	8.0	0.1	–0.1	–1.8	0.057	41.1
Shipbuilding	5.2	6	5.3	–0.4	0.2	0.0	0.035	70.8
Machinery	3.9	7	6.1	–1.4	0.1	–0.9	0.007	49.3
Textiles and Clothing	2.9	8	12.0	–2.8	–0.5	–5.8	–0.164	40.3
Petrochemicals	2.3	9	9.5	1.5	0.2	–9.4	0.392	45.3
Basic metal products	2.1	10	4.9	–0.8	0.1	–2.1	0.024	47.8
1998								
Automobile	42.4	1	10.8	–2.1	–4.9	–6.0	44.643	43.9
IT products	12.5	2	16.9	–5.4	1.1	0.0	–0.117	39.0
Precision instruments	7.0	3	7.9	–1.0	0.1	0.2	–0.229	40.5
Textiles and Clothing	6.8	4	11.5	–2.1	0.5	–3.0	–0.038	38.8
IT parts and components	6.0	5	12.6	–0.5	–1.4	–4.6	–0.053	63.4
Fine chemicals	5.5	6	10.6	–0.9	–0.3	–3.9	–0.079	45.2
Machinery	1.0	7	5.9	–1.9	0.0	–3.0	–0.007	48.1
Basic metal products	0.0	8	4.5	–1.6	–0.1	–2.9	0.039	46.7
Shipbuilding	0.0	9	5.1	–4.2	–0.5	–0.5	0.000	67.3
Petrochemicals	–5.4	11	9.2	–4.4	3.4	–12.3	–1.237	43.4
1999								
IT parts and components	15.7	1	12.5	–0.3	1.7	1.9	–0.080	64.1
IT products	14.3	2	16.7	–3.1	0.6	0.0	–0.033	37.8
Textiles and Clothing	10.7	3	10.9	–0.9	0.0	0.4	0.254	38.5
Automobile	10.1	4	10.6	–1.3	–0.1	0.9	0.038	43.3
Precision instruments	8.1	5	8.0	0.0	–0.4	0.3	0.199	40.5
Fine chemicals	6.8	6	10.3	–2.3	–0.4	–0.9	0.021	44.3
Petrochemicals	6.5	7	8.9	–1.4	1.7	–2.7	–0.091	42.8
Shipbuilding	5.8	8	4.9	0.4	0.4	0.1	0.002	67.6
Machinery	4.9	9	5.8	–1.5	0.1	0.5	–0.001	47.4
Basic metal products	3.3	10	4.2	–1.0	0.0	0.0	0.020	46.2
2000-2003								
IT products	15.0	1	15.9	–0.9	0.0	–0.1	–0.006	36.9
Automobile	11.0	2	10.2	–1.5	2.8	0.0	–0.486	41.3
IT parts and components	9.5	3	12.0	–1.2	0.3	–1.7	0.059	62.2
Textiles and Clothing	9.1	4	9.8	–0.4	0.1	–0.3	–0.157	38.3
Shipbuilding	6.9	5	4.5	1.9	0.3	0.1	0.024	70.1
Petrochemicals	6.8	6	8.3	–3.1	0.9	0.9	–0.218	40.1
Fine chemicals	6.7	7	9.6	–2.3	–0.7	0.1	0.012	42.0
Precision instruments	6.6	8	7.9	–1.2	0.0	–0.1	0.042	39.1
Machinery	4.2	9	5.5	–1.2	0.0	0.0	0.002	45.7
Basic metal products	2.8	10	3.6	–0.4	0.0	–0.4	0.006	45.8
2004-2007								
IT products	14.3	1	14.8	–0.9	0.5	0.0	–0.027	35.3
IT parts and components	11.4	2	11.1	0.6	–0.1	–0.2	–0.009	62.4
Precision instruments	7.4	3	7.9	0.2	0.0	–0.6	–0.001	38.6
Automobile	6.6	4	9.8	–3.9	–0.3	–0.1	1.183	37.6
Textiles and Clothing	6.4	5	8.3	–1.9	0.3	–0.2	–0.158	36.4
Fine chemicals	5.1	6	8.4	–2.5	–0.4	–0.3	–0.023	39.2
Petrochemicals	4.6	7	7.4	–3.2	0.3	0.4	–0.151	35.0
Shipbuilding	3.7	8	3.9	–0.3	0.2	–0.1	–0.009	73.5
Machinery	3.2	9	5.0	–1.3	0.0	–0.4	0.000	43.9
Basic metal products	–0.3	11	2.6	–2.6	0.0	–0.3	–0.001	42.9

2008								
IT parts and components	10.1	1	10.4	2.0	3.1	–5.5	0.043	63.6
IT products	8.3	2	14.0	–1.8	–2.3	–1.6	–0.006	34.1
Precision instruments	7.9	3	7.8	0.5	0.0	–0.5	0.004	39.0
Automobile	6.3	4	9.5	–1.6	–1.6	–1.2	1.165	34.9
Textiles and Clothing	4.1	5	7.3	–1.4	–0.4	–1.4	0.081	34.6
Fine chemicals	2.6	7	7.6	–1.7	–0.1	–3.3	0.021	37.0
Petrochemicals	2.6	8	6.8	–1.2	0.6	–3.4	–0.213	32.9
Shipbuilding	2.4	9	3.5	–1.0	0.1	–0.3	0.033	71.2
Machinery	1.1	10	4.7	–1.1	–0.3	–2.2	–0.001	42.3
Basic metal products	–2.3	11	1.9	–2.5	–0.4	–1.4	–0.019	40.0
2009								
IT products	10.2	1	13.7	–2.7	–0.5	–0.3	0.016	33.1
Automobile	9.9	2	9.3	0.0	–0.6	0.4	0.933	34.7
IT parts and components	8.1	3	10.3	–0.9	–0.4	–0.9	–0.041	63.1
Precision instruments	6.1	4	7.8	–1.5	0.0	–0.2	–0.033	38.4
Petrochemicals	3.6	5	6.5	–3.2	0.9	–0.3	–0.229	31.9
Fine chemicals	3.2	6	7.3	–2.3	0.9	–2.8	0.013	36.5
Textiles and Clothing	3.0	7	6.8	–3.4	–0.3	0.1	–0.212	33.4
Shipbuilding	2.3	8	3.3	–0.2	0.0	–0.9	–0.007	71.1
Machinery	1.6	10	4.5	–2.0	0.0	–0.9	0.001	41.4
Basic metal products	–0.8	11	1.7	–1.3	0.0	–1.2	0.010	39.5
2011								
IT parts and components	8.8	1	10.2	1.4	–1.4	–1.5	0.065	63.9
Automobile	7.4	2	9.3	–2.4	2.0	–0.2	–1.334	34.0
IT products	6.7	3	13.4	–3.8	0.1	–3.0	0.005	31.9
Precision instruments	5.4	4	7.8	–0.1	–0.1	–2.2	0.005	38.4
Machinery	1.1	5	4.4	–2.1	–0.3	–0.8	0.000	40.6
Textiles and Clothing	1.0	6	6.3	–3.2	–0.6	–1.6	0.133	32.4
Fine chemicals	0.5	7	7.0	–3.2	–0.4	–2.9	–0.072	35.6
Shipbuilding	–1.1	8	3.2	–4.8	0.8	–0.3	0.012	67.7
Basic metal products	–4.5	10	1.4	–3.6	–0.1	–2.2	0.004	38.1
Petrochemicals	–7.9	11	6.3	–4.7	–0.5	–9.0	0.009	30.5
2012-2014								
IT products	10.9	1	12.9	–3.0	0.9	0.1	–0.002	30.3
IT parts and components	9.7	2	9.8	–0.1	0.0	0.1	–0.012	63.7
Automobile	9.1	3	8.8	0.3	0.4	–0.1	–0.220	33.8
Precision instruments	6.4	4	7.7	–0.9	0.0	–0.3	0.001	37.7
Fine chemicals	4.6	5	6.4	–1.5	0.2	–0.4	0.010	34.7
Shipbuilding	4.6	6	2.9	1.2	0.3	0.2	–0.009	70.2
Textiles and Clothing	4.6	7	5.5	–1.6	0.0	0.7	0.039	31.6
Petrochemicals	3.5	8	5.8	–1.7	0.8	–1.3	–0.075	29.5
Machinery	2.1	9	4.2	–1.8	0.0	–0.3	0.000	39.2
Basic metal products	0.3	10	0.9	–0.7	0.1	0.0	0.006	37.6
1995-2014								
IT products	12.7	1	15.0	–2.1	0.0	–0.2	–0.008	35.6
Automobile	10.5	2	9.8	–1.6	0.2	–0.5	2.548	38.8
IT parts and components	10.4	3	11.3	0.0	0.1	–1.1	–0.001	63.2
Precision instruments	6.8	4	7.9	–0.5	–0.1	–0.6	0.013	39.1
Textiles and Clothing	5.9	5	8.7	–1.7	0.0	–1.0	–0.069	36.2
Fine chemicals	5.3	6	8.7	–2.1	–0.4	–1.0	–0.003	39.9
Shipbuilding	4.2	7	4.1	0.0	0.2	0.0	0.008	70.7
Petrochemicals	3.3	8	7.6	–2.4	0.7	–2.5	–0.149	36.7
Machinery	3.0	9	5.1	–1.5	0.0	–0.6	0.001	44.1
Basic metal products	0.6	10	2.8	–1.4	0.0	–0.8	0.008	43.0

Third, machinery ranked near the bottom of *TFP* growth except for 1998 and 2011. However, it recorded the third largest export volume in 2015,

which obscures the "self-selection" as well as the causality between high productivity growth and large export volume.

Lastly, *TE* mostly deteriorated across industries, *SC* largely tapered off, and AE fluctuated and was negative across industries and time periods. In particular, substantial allocative efficiency loss continued in the petrochemicals industry.

Therefore, new frontier technology is needed to raise *TP* for the mature target industries of petrochemicals, machinery, basic metal products, and shipbuilding to promote their productivity growth.

4.3. Export-leading Industries Versus Other Exporting Industries

Table 9 presents the averages of *TP*, $\dot{TE}$, *SC*, *AE*, SME_{impact}, and $\dot{TFP}$ for the 29 export-leading industries and 13 other exporting industries over the selected time periods during 1995-2014.

First, the estimate of SME_{impact} for both export-leading industries and other exporting industries varied widely across time periods. Finally, the average SME_{impact} for export-leading industries reached 0.154%, while that for other exporting industries was 0.052%, which is one-third of the average SME_{impact} for export-leading industries.

As a consequence, an increase in the share of SMEs for the export-leading industries promoted productivity growth three times more than that for the other exporting industries throughout 1995-2014.

Second, during 1996-1997, SME_{impact} for both export-leading industries and other exporting industries was around –0.020%, because the negative impact from the decrease in the share of SMEs on *TFP* growth surpassed the positive impact from the increase in the share of SMEs on *TFP* growth.

Third, during the 1998 severe economic recession, SME_{impact} for the export-leading industries soared sharply to 3.0% because of the industrial restructuring of the assembled vehicles industry in the aftermath of the 1997 financial crisis: the positive impact from the increase in the share of SMEs on *TFP* growth overwhelmingly surpassed the negative impact from the decrease

Table 9 The Averages of *TP*, $\dot{TE}$, *SC*, *AE*, SME_{impact}, and $\dot{TFP}$ for the Export-leading Industries and the Other Exporting Industries

Export-leading Industries							
	$\dot{TFP}$	*TP*	$\dot{TE}$	*SC*	*AE*	SME_{impact}	*TE*
1996-1997	6.5	10.3	–0.9	–0.5	–2.3	–0.020	47.8
1998	6.8	10.0	–2.4	0.0	–3.7	3.008	46.3
1999	9.1	9.8	–1.3	0.5	0.1	0.022	46.5
2000-2003	8.0	9.3	–1.2	0.3	–0.2	–0.059	45.1
2004-2007	6.7	8.4	–1.5	0.1	–0.2	0.042	43.2
2008	4.5	7.8	–0.9	–0.1	–2.4	0.073	41.8
2009	4.9	7.5	–1.9	0.0	–0.7	0.015	41.1
2011	2.0	7.3	–2.5	–0.2	–2.5	–0.074	40.3
2012-2014	5.7	6.9	–1.3	0.3	–0.1	–0.020	39.5
1995-2014	6.5	8.6	–1.4	0.1	–0.9	0.154	43.6
Other Exporting Industries							
	$\dot{TFP}$	*TP*	$\dot{TE}$	*SC*	*AE*	SME_{impact}	*TE*
1996-1997	–2.4	0.8	–0.6	–0.7	–1.8	–0.019	44.2
1998	–4.0	1.0	–0.5	–2.0	–2.9	0.314	43.9
1999	–0.9	1.1	–2.4	0.1	0.4	–0.040	42.9
2000-2003	0.3	1.3	–0.6	–0.2	–0.3	0.048	42.3
2004-2007	0.0	1.7	–0.7	–0.7	–0.3	0.055	41.5
2008	3.4	1.9	–0.8	2.9	–0.7	0.096	40.7
2009	1.7	2.0	–0.9	1.3	–0.5	–0.202	40.5
2011	–4.3	2.0	–2.0	–2.9	–1.7	0.355	39.9
2012-2014	0.1	2.1	–1.7	0.1	–0.5	0.013	38.6
1995-2014	–0.4	1.6	–1.0	–0.3	–0.7	0.052	41.5

in the share of SMEs on *TFP* growth.

Similarly, SME_{impact} for the other exporting industries turned to a large positive at 0.314%, because a wide range of industrial restructuring was under way in the aftermath of the 1997 financial crisis: the positive impact from the increase in the share of SMEs on *TFP* growth outdid the negative impact from the decrease in the share of SMEs on *TFP* growth.

Fourth, during the 1999 resurrection of Korean manufacturing, SME_{impact} for the export-leading industries retained a positive at 0.022%, while it fell to

a negative at –0.040% for the other exporting industries. For export-leading industries, the positive impact from the increase in the share of SMEs on *TFP* growth surpassed the negative impact from the decrease in the share of SMEs, while it was the opposite for the other exporting industries.

Fifth, during the 2000-2003 economic recovery, SME_{impact} for the export-leading industries fell to a negative at –0.059%, while that for the other exporting industries turned to a positive at 0.048%. During the 2004-2007 modest economic upturn and 2008 global financial crisis, SME_{impact} for both export-leading (0.042% and 0.073%) and other exporting (0.055% and 0.096%) industries sustained positives. During the 2009 economic downturn, SME_{impact} for export-leading industries sustained a positive at 0.015%, but plummeted to a negative at –0.202% for the other exporting industries.

It was because, during the 2000-2003 economic recovery, both an increase and decrease in the share of SMEs slowed productivity growth in the export-leading industries, while an increase in the share of SMEs promoted it in the other exporting industries. During the following 2004-2007 economic upturn and 2008 global financial crisis, an increase in the share of SMEs promoted productivity growth for both export-leading and other exporting industries.

However, during the 2009 economic downturn triggered by the 2008 global financial crisis, an increase in the share of SMEs steadily promoted productivity growth in the export-leading industries, while a decrease in the share of SMEs dominantly slowed it in the other exporting industries.

Sixth, during the 2011 economic recovery from the aftershock of the 2008 global financial crisis, SME_{impact} for the export-leading industries plummeted to a negative at –0.074%, and it continued to fall to –0.020% during the 2012-2014 economic upturn. However, SME_{impact} for other exporting industries turned to a positive at 0.355% and remained positive at 0.013%.

It was because, during the 2011 economic recovery, a decrease in the share of SMEs dominantly slowed productivity growth in the export-leading industries; in contrast, an increase in the share of SMEs dominantly promoted

it in the other exporting industries.

However, in the following 2012-2014 economic upturn, both an increase and decrease in the share of SMEs slightly slowed productivity growth in the export-leading industries and slightly promoted it in the other exporting industries.

Seventh, export-leading industries retained high *TFP* growth driven primarily by high *TP*, although *TFP* growth fluctuated and *TP* rates declined continuously. The other exporting industries had *TFP* growth ranging from negative to positive with very low *TP*, although *TP* rates increased continuously.

Eighth, during the 1998 deep depression triggered by the 1997 financial crisis, the export-leading industries reached *TFP* growth of 6.8%, mainly because of steady *TP* at 10.0% and SME_{impact} at 3.0%, although there existed negative $\dot{TE}$ (–2.4%) and *AE* (–3.7%). However, the other exporting industries demonstrated negative *TFP* growth of –4.0% because of sluggish *TP* (1.0%), negative *SC* (–2.0%), and negative *AE* (–2.9%).

Ninth, during the 1999 resurrection of the Korean manufacturing in the wake of the 1998 deep depression, the export-leading industries bounced to record high *TFP* growth of 9.1%, driven mainly by *TP* at 9.8%, although $\dot{TE}$ was –1.3%. The *TFP* growth of the other exporting industries improved to –0.9% with sluggish *TP* (1.1%) and negative $\dot{TE}$ (–2.4%).

Tenth, during the following economic upturns in 2000-2003 and 2004-2007, the export-leading industries achieved the respective *TFP* growth of 8.0% and 6.7%, driven primarily by the respective *TP* of 9.3% and 8.4%, even with negative $\dot{TE}$ (–1.2% and –1.5%, respectively).

The other exporting industries achieved the respective *TFP* growth of 0.3% and 0.0%, led by the respective *TP* of 1.3% and 1.7%.

Eleventh, during the 2008 global financial crisis, the export-leading industries showed the second least *TFP* growth of 4.5%, led primarily by *TP* of 7.8% but slowed by negative *AE* (–2.4%).

The other exporting industries achieved record high *TFP* growth of 3.4%, driven mainly by *TP* of 1.9% and *SC* of 2.9%.

In the following economic downturn during 2009 in the aftermath of the 2008 global financial crisis, the export-leading industries showed *TFP* growth of 4.9%, driven mainly by *TP* of 7.5% but slowed by negative $\dot{TE}$ (–1.9%). For the other exporting industries, *TFP* growth fell to half at 1.7%, led primarily by *TP* of 2.0% and *SC* of 1.3%.

Twelfth, during the 2011 mild economic recovery, both the export-leading industries and other exporting industries concurrently showed record low *TFP* growth: it was 2.0% for the export-leading industries, driven mainly by *TP* of 7.3% but slowed by $\dot{TE}$ and *AE* of –2.5%, while it was –4.3% the other exporting industries, driven mainly by *TP* of 2.0% but slowed by negative $\dot{TE}$, *SC*, and *AE* (–2.0%, –2.9%, and –1.7%, respectively).

In the following 2012-2014 economic upturn, the export-leading industries showed that *TFP* growth bounced to 5.7%, driven primarily by *TP* of 6.9% but still slowed by a negative $\dot{TE}$ of –1.3%. In the other exporting industries, *TFP* growth increased to 0.1% with *TP* of 2.1%, but it was slowed by a negative $\dot{TE}$ of –1.7%.

Eventually, throughout 1995-2014, for the export-leading industries, *TFP* grew at an annual rate of 6.5%, driven mainly by *TP* of 8.6% but held back by $\dot{TE}$ of –1.3% and *AE* of –0.9%. For the other exporting industries, *TFP* was retarded at an annual rate of –0.4%, led by low *TP* of 1.6% and slowed by $\dot{TE}$ of –1.0%.

What captures our attention the most in this study is that the resilience of the productivity growth of export-leading industries (6.8%) during the 1998 depression was mainly because of steady *TP* (10.0%) and that an increase in the impact of SMEs (3.0%), which tapered off to result in record low productivity growth for the export-leading industries (2.0%) during the 2011 mild economic recovery, mainly due to slower *TP* (7.3%).

In contrast, the productivity growth of other exporting industries during the 1998 depression (–4.0%) with low *TP* (1.0%) was similar to the record low productivity growth during the 2011 mild economic recovery (–4.3%) with double *TP* (2.0%).

In comparison with export-leading industries, the other exporting industries

showed considerably varying and low *TFP* growth and low *TP*, although *TP* increased continuously throughout 1995-2014. However, other exporting industries revealed lesser deteriorating *TE* and *AE* but more vanishing scale effects.

This finding verifies that causality runs from higher productivity growth to larger export share, which aligns with the findings of Pai (2016c).

Eventually, all these findings are contingent on the export-leading industries and other exporting industries in Korea that from 1995 to 2014.

5. CONCLUSION

Firstly, an increase in the share of SMEs promoted *TFP* growth in 21 export-leading industries, and that was significant in eight industries with the most in assembled vehicles, while it slowed *TFP* growth in seven industries, most considerably in coke, briquettes, and refined petroleum products and man-made fibers. Accordingly, this study gives insights for a more efficient resource reallocation between SMEs and LEs specific to their industry that will promote the global competitiveness of Korea's export-leading industries for the country's sustainable long-run economic growth.

Secondly, the cutting-edge technology-based IT manufacturing industry occupied the top rank of *TFP* growth, however, the mature target industries of petrochemicals, machinery, and basic metal products ranked at the bottom, because of flagging *TP* and deteriorating *TE*. In particular, machinery ranked close to the lowest *TFP* growth, but it posted the third largest export volume in 2015, which obscures the "self-selection" as well as the causality between high productivity growth and large export volume.

Therefore, new frontier technology to raise *TP* and the efficient use of current technology to catch up to frontier technology are urgently needed for the mature target industries of petrochemicals, machinery, and basic metal products, to promote their productivity growth.

Thirdly, the automobile industry maintained high *TFP* growth with a sizable

increase in the share of SMEs because of strong vertical integration despite continuously deteriorating *TE*, however, the shipbuilding industry had a below middling *TFP* growth mainly due to flagging *TP*.

Taken as a whole, an increase in the share of SMEs for the export-leading industries promoted productivity growth three times more than that for the other exporting industries.

Export-leading industries retained high *TFP* growth, driven primarily by high *TP*, although *TP* rates declined continuously, while the other exporting industries had *TFP* growth ranging from negative to positive with very low *TP*, although *TP* rates increased continuously.

Eventually, the slow productivity growth caused by flagging *TP* and deteriorating *TE* calls for new policy frameworks to support the export-leading industries, especially for the mature target industries.

APPENDIX

Table A1 Rank of Export Volume in 2015 by Industrial Sector and R&D in 2014

Export-leading Industries				
Rank	Industrial sector	Industry	Exports (US$100million)	R&D (KRW million)
1	IT parts and components	Semiconductors	603.9	16,805,070
		Flat display boards	205.9	
		Other electronic components	59.1	4,341,756 (flat display boards, other electronic components, and batteries)
		Batteries	44.8	
		Total	913.7	
2	IT products	Telecommunication apparatus	305.7	4,253,107
		Electric home appliances	116.9 (Electric and electronic home appliances)	262,248 (Electric and electronic home appliances)
		Electronic video and audio equipment		
		Computers	55.3	188,404
		Total	477.9	
	IT manufacturing Total		1,391.6	25,850,585
3	Machinery	Special purpose machinery	233.0	2,823,968 (general purpose machinery and special purpose machinery)
		General purpose machinery	228.8	
		Electrical equipment	224.8	1,114,000
		Fabricated metal products	147.3	507,028
		Total	833.9	4,444,996
4	Petrochemicals	Basic chemicals	412.8 (basic chemicals, and	2,375,763 (petrochemicals and fine chemicals)
		Synthetic rubbers and plastics in primary forms	synthetic rubbers and plastics in primary forms)	
		Coke, briquettes, and refined petroleum products	322.6	238,443
		Total	735.4	
5	Automobile		702.1	5,876.27
6	Shipbuilding		351.0	556,133

7	Basic metal products	Basic iron and steel	212.5	529,214
		Non-ferrous metals	100.0	82,392
		Metal casting	2.9	37,053
		Total	315.4	
8	Textiles and Clothing	Fibers and man-made fibers	116.5	129,297
		Clothing apparel	20.3	197,788
		Total	136.8	
9	Fine chemicals	Fertilizers and nitrogen compounds	96.5	
		Other chemical products		
		Pharmaceuticals	26.1	1,122,203
		Total	122.6	
10	Precision instruments		114.6	874,434
The other exporting industries				
		Plastic products	86.5	
		Food and beverages	52.6	458,855
		Rubber products	43.8	769,776 (plastic and rubber products)
		Paper	27.7	58,706
		Other manufacturing	22.9	74,908
		Leather goods and footwear	16.2	42,029
		Glass	13.7	
		Furniture	9.9	86,588
		Tobacco	8.8	30,126
		Cement	3.1	Non-metallic mineral 23,827 (ceramic, cement, glass etc.)
		Printing	2.1	36,980
		Wood and wood products	0.9	13,150
		Total	288.2	

Source: Korea Customs Service, Korea Institute of Science & Technology Evaluation and Planning (KISTEP).

Table A2 42 Manufacturing Industries under the KSIC (Korean Standard Industrial Classification) System

Export-leading Industries	
IT parts and Components	
Semiconductors	Manufacture of semiconductors (KSIC 261)
Flat display boards	Manufacture of flat display boards (KSIC 2621)
Other electronic components	Manufacture of printed circuit boards and loaded electronic components onto PCB (KSIC 2622); manufacture of other electronic components, except for semiconductors and electronic integrated circuits (KSIC 2629)
Batteries	Manufacture of primary cells, batteries, and accumulators (KSIC 282)
IT Products	
Telecommunications equipment	Manufacture of telecommunications and broadcasting equipment (KSIC 264)
Electric home appliances	Manufacture of domestic appliances (KSIC 2851)
Electronic video and audio equipment	Manufacture of electronic video and audio equipment (KSIC 265)
Computers	Manufacture of computers and peripheral equipment (KSIC 263)
Machinery	
Special-purpose machinery	Manufacture of special-purpose machinery (KSIC 292)
General-purpose machinery	Manufacture of general-purpose machinery (KSIC 291)
Electrical equipment	Manufacture of electric motors, generators, transforming, distributing and controlling apparatus of electricity (KSIC 281); Manufacture of insulated wires and cables, including insulated code sets (KSIC 283); Manufacture of other electrical equipment (KSIC 289)
Fabricated metal products	Manufacture of fabricated metal products, except for machinery and furniture (KSIC 25)
Petrochemicals	
Basic chemicals	Manufacture of basic chemicals (KSIC 201)
Synthetic rubbers and Plastic products in primary forms	Manufacture of synthetic rubber and plastic products in primary forms (KSIC 203)
Coke, briquettes, and refined petroleum products	Manufacture of coke, hard-coal and lignite fuel briquettes, and refined petroleum products (KSIC 19)
Automobile	
Assembled vehicles	Manufacture of motor vehicles and engines for motor vehicles (KSIC 301)
Automobile parts and components	Manufacture of bodies for motor vehicles and manufacture of trailers and semitrailers (KSIC 302); Manufacture of parts and accessories for motor vehicles and engines (KSIC 303)
Shipbuilding	Building of ships and boats (KSIC 311)
Basic Metal Products	
Basic iron and steel	Manufacture of basic iron and steel (KSIC 241)
Non-ferrous metals	Manufacture of basic precious and non-ferrous metals (KSIC 242)
Metal casting	Cast of metals ((KSIC 243)
Textiles & Clothing	
Fibers	Manufacture of textiles, except for apparel(KSIC 13)
Man-made fibers	Manufacture of man-made fibers (KSIC 205)
Apparel	Manufacture of clothing apparel, clothing accessories, and fur articles (KSIC 14)
Fine Chemicals	
Fertilizer and nitrogen compounds	Manufacture of fertilizer and nitrogen compounds (KSIC 202)
Other chemical products	Manufacture of other chemical products (KSIC 204)
Pharmaceuticals	Manufacture of pharmaceuticals, medical chemicals, and botanical products (KSIC 21)
Precision Instruments	
Precision instruments	Manufacture of measuring, testing, navigation, control, and other precision instruments (KSIC 2721); manufacture of spectacles (KSIC 2731); manufacture of optical instruments and photographic equipment (KSIC 2732); manufacture of watches, clocks, and parts(KSIC 274)
Medical devices	Manufacture of radiation apparatus and electro-diagnostic apparatus (KSIC 2711); manufacture of other medical and surgical equipment and orthopedic appliances (KSIC 2719)
The Other Exporting Industries	
Plastic products	Manufacture of plastic products (KSIC 222)
Food	Manufacture of food products (KSIC 10)
Beverages	Manufacture of beverages (KSIC 11)
Rubber products	Manufacture of rubber products (KSIC 221)
Paper	Manufacture of pulp, paper, and paper products (KSIC 17)
Other manufacturing	Other manufacturing (KSIC 33)
Leather goods and footwear	Tanning and dressing of leather; manufacture of luggage and footwear (KSIC 15)
Glass	Manufacture of glass products(KSIC 231)
Furniture	Manufacture of furniture ((KSIC 32)
Tobacco	Manufacture of tobacco products (KSIC 12)
Cement	Manufacture of cement, lime, and plaster products (KSIC 233)
Printing	Printing and reproduction of recorded media (KSIC 18)
Wood and wood products	Manufacture of wood and products of wood and cork; except furniture (KSIC 16)

Table A3 φ_{SME} in the SFPF for the Export-leading Industries and the Other Exporting Industries for 1995-2014

Export-leading Industries			
	φ_{SME}		φ_{SME}
IT Parts and Components		**Automobile**	
Semiconductors	0.178 (2.65)	Assembled vehicles	0.230 (0.78)
Flat display boards	–0.047 (–0.60)	Automobile parts and components	0.083 (3.05)
Other electronic components	0.032 (0.76)	**Shipbuilding**	0.099 (1.55)
Batteries	0.034 (0.26)	**Basic Metal Products**	
IT Products		Basic iron and steel	0.034 (0.48)
Telecommunication apparatus	–0.064 (–1.12)	Non-ferrous metals	0.051 (0.67)
Electric home appliances	0.133 (1.44)	Metal casting	0.193 (1.81)
Electronic video and audio equipment	0.043 (0.60)	**Textiles and Clothing**	
Computers	–0.237 (–2.18)	Fibers	0.242 (6.49)
Machinery		Man-made fibers	–0.114 (–1.05)
Special purpose machinery	–0.049 (–1.15)	Clothing apparel	0.286 (4.95)
General purpose machinery	0.004 (0.10)	**Fine Chemicals**	
Electrical equipment	0.015 (1.66)	Fertilizers and nitrogen compounds	0.072 (0.34)
Fabricated metal products	0.133 (3.83)	Other chemical products	0.128 (2.12)
Petrochemicals		Pharmaceuticals	–0.231 (–3.24)
Basic chemicals	–0.040 (–0.48)	**Precision Instruments**	
Synthetic rubbers and plastics in primary forms	0.177 (1.62)	Precision instruments	0.042 (0.55)
Coke, briquettes, and refined petroleum products	–1.279 (–3.27)	Medical devices	0.382 (2.64)

The Other Exporting Industries					
	φ_{SME}		φ_{SME}		φ_{SME}
Plastic products	0.144 (3.46)	Other manufacturing	–0.083 (–0.97)	Tobacco	0.254 (1.01)
Food	–0.018 (–0.50)	Leather goods and footwear	0.195 (2.48)	Cement	–0.551 (–5.93)
Beverages	0.248 (2.62)	Glass	–0.106 (–1.30)	Printing	0.143 (0.45)
Rubber products	0.155 (2.21)	Furniture	0.143 (2.07)	Wood and wood products	0.450 (3.43)
Paper	0.134 (2.81)				

Table A4 Summary Statistics for the Export-leading Industries from 1995 to 2014

	IT Parts and Components				IT Products			
	Semiconductors	Flat display boards	Other electronic components	Batteries	Telecommunications equipment	Electric home appliances	Electronic video and audio equipment	Computers
Value-added	77.7 (797.0)	89.4 (597.7)	5.0 (34.0)	17.6 (104.5)	15.4 (317.4)	4.7 (41.1)	4.9 (60.7)	6.3 (66.3)
Labor	337.4 (1,615.0)	300.1 (1,119.2)	61.9 (228.1)	119.2 (348.5)	63.5 (331.6)	52.6 (196.6)	77.1 (604.9)	68.5 (433.6)
Capital	123.1 (941.4)	119.4 (736.0)	6.0 (37.0)	18.7 (80.3)	4.9 (43.8)	4.9 (39.4)	4.7 (55.2)	5.2 (48.1)
Labor share	0.766 (0.177)	0.766 (0.187)	0.804 (0.145)	0.774 (0.159)	0.833 (0.128)	0.838 (0.119)	0.845 (0.116)	0.828 (0.129)
Total number of establishments	1,542	970	6,698	325	6,331	2,806	3,815	2,602
Total number of observations	4,954	2,863	21,278	1,166	19,051	8,547	11,099	6,827
Total number of SMEs	4,350	2,451	20,733	1,063	18,629	8,391	10,817	6,709
Total number of LEs	604	412	545	103	422	156	282	118

	Machinery				Petrochemicals		
	Special-purpose machinery	General-purpose machinery	Electrical equipment	Fabricated metal products	Basic chemical	Synthetic rubbers and Plastic products in primary forms	Coke, briquettes, and refined petroleum products
Value-added	2.6 (14.7)	3.6 (28.1)	6.0 (102.5)	3.1 (31.4)	22.7 (150.2)	18.9 (77.7)	138.0 (736.5)
Labor	30.4 (75.1)	35.9 (91.1)	44.0 (278.6)	29.5 (114.9)	61.8 (120.7)	56.0 (134.9)	124.2 (458.2)
Capital	2.7 (16.9)	3.2 (16.4)	6.2 (104.8)	2.5 (19.9)	38.0 (166.8)	27.1 (145.3)	167.4 (769.5)
Labor share	0.829 (0.119)	0.839 (0.118)	0.819 (0.142)	0.822 (0.131)	0.691 (0.212)	0.741 (0.178)	0.734 (0.188)
Total number of establishments	19,916	17,450	241,091	34,766	1,397	1,673	298
Total number of observations	73,196	65,211	1,066,444	124,488	7,755	6,155	1,546
Total number of SMEs	72,794	64,646	1,053,435	123,984	7,482	5,996	1,454
Total number of LEs	402	565	13,009	504	273	159	92

	Automobile		Shipbuilding	Basic Metal Products		
	Assembled vehicles	Automobile parts and components		Basic iron and steel	Non-ferrous metals	Metal casting
Value-added	608.8 (1,398.4)	4.9 (18.2)	19.6 (243.3)	21.8 (229.1)	12.0 (55.4)	5.1 (9.6)
Labor	2858.4 (5,527.3)	57.1 (416.5)	126.4 (1,031.3)	70.5 (395.8)	49.8 (97.8)	
Capital	598.0 (1,050.4)	5.9 (21.9)	20.5 (243.0)	30.9 (326.5)	10.7 (50.5)	
Labor share	0.766 (0.179)	0.801 (0.148)	0.899 (0.147)	0.763 (0.168)	0.772 (0.158)	0.813 (0.130)
Total number of establishments	166	13,455	4,790	4,757	2,125	1,670
Total number of observations	553	51,816	14,696	19,301	9,348	7,908
Total number of SMEs	265	50,727	14,438	18,817	9,127	7,876
Total number of LEs	288	1,089	258	484	221	32

	Textiles and Clothing			Fine Chemicals			Precision Instruments	
	Fibers	Man-made fibers	Clothing apparel	Fertilizer and nitrogen compounds	Other chemical products	Pharmaceuticals	Precision instruments	Medical devices
Value-added	2.2 (7.0)	35.2 (76.2)	1.9 (13.5)	5.2 (22.4)	8.6 (40.9)	15.9 (35.5)	2.6 (10.4)	2.5 (7.1)
Labor	36.3 (73.3)	163.9 (339.7)	29.9 (54.7)	30.7 (70.0)	43.6 (134.0)	77.4 (108.4)	35.4 (76.4)	31.4 (40.5)
Capital	2.8 (14.4)	55.7 (125.7)	0.8 (6.2)	7.6 (37.3)	6.3 (25.6)	10.3 (26.9)	2.2 (11.8)	1.9 (5.7)
Labor share	0.811 (0.136)	0.715 (0.196)	0.883 (0.090)	0.751 (0.501)	0.789 (0.150)	0.774 (0.154)	0.858 (0.109)	0.847 (0.114)
Total number of establishments	16,460	294	21,858	521	4,150	6,841	5,769	2,094
Total number of observations	72,051	1,126	69,090	2,321	19,969	1,094	19,729	7,936
Total number of SMEs	71,522	940	68,664	2,297	19,701	6,621	19,573	7,919
Total number of LEs	529	186	426	24	268	220	156	17

Notes: Value-added and Capital are measured in billion KRW, Labor, in number of workers. All values are mean values, with standard deviations in parentheses.

Table A5 Summary Statistics for the Other Exporting Industries from 1995 to 2014

	Plastic Products	Food	Beverages	Rubber Products	Paper	Other Manufacturing	Leather Goods and Footwear
Value-added	2.7 (11.9)	4.5 (15.9)	19.5 (53.6)	7.5 (49.7)	3.6 (14.1)	1.6 (4.4)	2.1 (7.9)
Labor	32.1 (52.8)	41.7 (80.1)	55.1 (94.6)	57.7 (210.2)	35.0 (56.0)	28.9 (58.1)	32.6 (56.4)
Capital	2.9 (14.7)	4.0 (14.6)	16.7 (53.5)	6.1 (40.1)	6.5 (33.5)	1.3 (5.4)	1.0 (4.7)
Labor share	0.804 (0.137)	0.808 (0.153)	0.741 (0.190)	0.825 (0.118)	0.798 (0.144)	0.852 (0.112)	0.871 (0.100)
Total number of establishments	72,390	15,083	837	2,673	6,074	5,860	6,100
Total number of observations	330	67,976	4,972	11,672	27,634	19,339	19,086
Total number of SMEs	13,857	67,130	4,851	11,395	27,335	19,253	18,977
Total number of LEs	11,911	846	121	277	299	86	109

	Glass	Furniture	Tobacco	Cement	Printing	Wood and wood products
Value-added	9.5 (89.9)	1.9 (7.5)	381.2 (599.2)	5.0 (16.1)	1.6 (3.0)	1.8 (5.2)
Labor	55.8 (158.2)	28.1 (70.7)	245.2 (172.7)	30.3 (47.0)	23.0 (25.8)	23.8 (48.5)
Capital	12.5 (97.4)	1.6 (5.8)	61.3 (67.7)	7.6 (52.1)	1.4 (3.8)	2.5 (14.2)
Labor share	0.788 (0.165)	0.854 (0.109)	0.709 (0.177)	0.722 (0.181)	0.794 (0.135)	0.842 (0.122)
Total number of establishments	1,790	7,108	28	3,529	6,358	4,345
Total number of observations	7,147	22,433	224	21,680	22,848	15,545
Total number of SMEs	6,935	22,284	153	21,539	22,827	15,469
Total number of LEs	212	149	71	141	21	76

Notes: Value-added and Capital are measured in billion KRW, Labor, in number of workers. All values are mean values, with standard deviations in parentheses.

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