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Study for selection of industrial areas suitable to small and medium-sized enterprises (SMEs) in Korea

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Abstract

In this study, the investigation into basic methodology for selecting the industrial areas suitable to the small and medium-sized enterprises (SMEs) in Korea was performed by using the statistical data about the corporations (2010 ~ 2012) as the quantitative evidences containing the number of companies, the number of workers, the annual sales, and the indices of market concentration and growth potential. From the Statistics Korea and the KISTI Market Analysis and Prediction System (K-MAPS), the statistical data organized by the Korean Standard Industrial Classification (KSIC) were obtained to conduct this research through the following procedure. First of all, the numbers of enterprises and employees and the annual sales of all industries were investigated and the largest number of workers and the highest annual sales were found in the sector of manufacturing among all sectors of KSIC. Secondly, the top three divisions with the highest annual sales in all divisions of manufacturing sector were selected. Thirdly, the subclasses having high values of annual sales and SMEs proportions among all subclasses in the top three divisions of the previous step were chosen as the candidates of SMEs-recommendable fields. Fourthly, the degree of market concentration was analyzed by using three-firm concentration ratio (CR3) and Herfindahl-Hirschman index (HHI) of the selected subclasses. Finally, the study for growth potential of chosen subclasses was performed through the analysis of compound annual growth rate (CAGR). After the overall process of this study was carried out with the synthetic consideration of the above-mentioned factors, the three subclasses of KSIC as industrial areas suitable to the SMEs could be found: (1) Manufacture of printed circuit boards, (2) Manufacture of parts and accessories for motor engines, and (3) Manufacture of parts and accessories for motor vehicle body. From this result, it was found that the values of annual sales, CR3, HHI, and CAGR can be very useful factors to discover the recommendable industry fields to the SMEs.

Keywords: Small and medium-sized enterprises (SMEs), SMEs-suitable areas, Three-firm concentration ratio (CR3), Herfindahl-Hirschman index (HHI), Compound annual growth rate (CAGR)

Introduction

Promising industry and emerging technology have attracted much attention by government and companies because the innovation of industry and technology is being made with rapid progress under the globalization of world economy. For this reason, government and corporations should find the promising industry and technology appropriate to

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the future demand by obtaining the competitiveness in order to maintain the sustainable growth. To achieve this purpose, the studies for innovation have been widely performed in recent years (Guan and Ma, 2003; Martensen et al., 2007; Tura et al., 2008; Forsman, 2009; Paalanen et al., 2009; Damanpour, 2010; Forsman and Rantanen, 2011; Oganisjana, 2015; Yusr, 2016; Yun et al., 2016). In addition, the effect of research and development (R&D) support has been studied with great attention (Belderbos et al., 2004; Cassiman and Veugelers, 2005; Czarnitzki et al., 2007; Aerts and Schmidt, 2008; Hussinger, 2008; Czarnitzki and Hottenrott, 2011; Takalo et al., 2013; Kang and Cho, 2016; Kim et al., 2016). In order to accomplish the innovation capability and the R&D support in the perspective of small and medium-sized enterprises (SMEs) for finding the prospective areas, they depends on the announcement of promising industry and technology from government and public institutions. Since the SMEs have the limitations of manpower and resources, it is difficult for them to search for the promising fields autonomously. However, many fields of industry and technology which are not suitable to the SMEs are included in the prospective areas presented by government and public institutions. This is because the procedure to choose the promising industry and technology by government and public institutions is mostly dependent on the opinion of experts (ex. Delphi method). Also, in Korea, the polarization between large corporations and SMEs has not been solved yet. It is induced by rapid expansion of business field for major companies. Therefore, for the survival of SMEs in present and future market, it is necessary to develop the basic methodology of finding the SMEs-recommendable areas.

Hottenrott and Lopes-Bento (2014) investigated the impact and the influence of targeted public R&D support in the level of company and they observed the effect of policy-induced R&D investment on the sales from the market novelties in the viewpoint of international collaborators and SMEs. In addition, they found the contribution of R&D support from public subsidies to innovation performance of SMEs. Saunila and Ukko (2014) studied the intangible factors in the innovation capability of SMEs by utilizing a web-based questionnaire. The results from their research demonstrated that the intangible aspects in the innovation capability of SMEs are not influenced by their size and industry. Due to this reason, the SMEs are able to have a higher potential for innovation than major companies. Ahmedova (2015) carried out the research for the factors to improve the competitiveness of SMEs. In this reference, the reason for the focal point on the SMEs was that their business areas are very significant to develop the national economics. It is because the SMEs have the great potential of flexible adaptation to market situation. The author found the main features helpful to enhance the competitiveness of companies: access to finance, innovation activities, internationalization, and so on.

The goal of this research is the establishment of basic methodology for selecting the candidates of promising fields appropriate to the SMEs in Korea systemically by utilizing the statistical data as the quantitative evidences. For achievement of this purpose, annual sales, three-firm concentration ratio (CR3), Herfindahl-Hirschman index (HHI), and compound annual growth rate (CAGR) of corporations were used and the analyses for those factors were performed with the Korean Standard Industrial Classification (KSIC).

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Data and methodology

Data

Two kinds of statistical data were used in this study: (1) public data (2010) gained in the Statistics Korea and (2) processed data (2010 ~ 2012) in the KISTI Market Analysis and Prediction System (K-MAPS). Both data are based on the KSIC. The KSIC is the systematic classification for industrial activities of Korean corporations according to their similarity. There are 5 levels in the KSIC composed of sector (1-digit level, alphabet), division (2-digit level), group (3-digit level), class (4-digit level), and subclass (5-digit level) and the numbers of each level are 21, 76, 228, 487, and 1,145, respectively. The statistical data of all firms in Korea including their data (ex. the number of companies, the number of employees, the annual sales, the business profits, and so on) could be obtained from the Korean Statistical Information Service (KOSIS) which is a core service site of the Statistics Korea. For the production of this public data, the Economic Census for investigation of all enterprises by the Statistics Korea is being performed in every 5 years. Therefore, the statistical data for 2010 is the newest now and the data about 2015 will be provided in 2017 after the survey for all enterprises of Korea in 2016. For this reason, the public data for all companies of 2010 was used in this research. Furthermore, the data for subclass level of manufacturing sector of KSIC related to market analysis (ex. annual sales, CR3, and HHI) could be gained from the K-MAPS site. Those data about market analysis from 2010 to 2012 were produced by utilizing the database of corporate finance (about 370,000 companies in the manufacturing sector) provided by the Korea Enterprise Data (KED).

Methodology

In this research, four factors (annual sales, three-firm concentration ratio (CR3), Herfindahl-Hirschman index (HHI), compound annual growth rate (CAGR) of sales) having effects on the selection of industrial areas suitable to the SMEs were considered and they are listed with their definition and usefulness (Table 1). By taking account of those factors synthetically, the industrial areas appropriate for the SMEs in Korea were chosen through the following process. First of all, the number of enterprises, the number of workers, and the annual sales of all KSIC sectors in 2010 were utilized to find the industrial area with the highest values of those factors because they can be the typical indicators for measuring the market size of each industrial field. Secondly, among all divisions of manufacturing sector found as the industrial area having the largest number of employees and the highest annual sales, top three divisions with the

Table 1 Introduction to various factors influencing the selection of SMEs-recommendable industry areas based on the KSIC

Factor	Definition	Usefulness
Annual sales	Amount of income from selling goods or providing services during 1 year	One of the representative indicators for the market size of industry
Three-firm concentration ratio (CR3)	Total market share (%) of top three companies	Evidence for the degree of market concentration
Herfindahl-Hirschman Index (HHI)	Sum of squared value of market share percentage	Evidence for the degree of market concentration
Compound Annual Growth Rate (CAGR) of sales	Mean annual growth rate of sales over a specified period of time	Evidence for the growth potential of industry

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highest value of annual sales were selected. Thirdly, the annual sales and the SMEs proportions were used as indices to choose the industrial areas among all subclasses in the top three divisions. Fourthly, the values of CR3 and HHI from 2010 to 2012 were employed for analyzing the market concentration of chosen subclasses in the manufacturing sector of KSIC. The details of CR3 and HHI will be explained in the next section. Finally, the CAGR of sales (period of time: 2010 ~ 2012) was used to figure out the growth potential of selected subclasses. After the procedure of this basic methodology, it was possible to find the SMEs-recommendable industrial areas.

CR3 and HHI

The value for CR is the sum of market shares from a specified number of companies (Calkins, 1983). In this research, the CR3 (CR value of three largest firms in the market share) was utilized and this can be gained by using the following equation.

$$CR3\,(\%) \; = \; \sum_{i=1}^{3} MS_i \qquad (1)$$

In this formula, the MS_i means the market share of individual enterprise with the ith highest value. The higher value of CR3 for a certain market area indicates that the market is more concentrated. However, the value of CR3 has a limitation in its application for analyzing the market concentration because the remaining corporates excluding top 3 firms are not considered (Sys, 2009). To compensate this deficiency of CR3, the value of HHI is also used in the analysis of the market concentration and it can be calculated from the following equation (Calkins, 1983).

$$HHI \; = \; \sum_{i=1}^{n} MS_i^2 \qquad (2)$$

In this equation, n is the number of companies and the unit of MS_i value is the percentage. As presented in Equation (2), the market shares of all enterprises are considered in obtaining the value of HHI. Thus, both CR3 and HHI should be taken into account for analyzing the market concentration. Furthermore, the HHI value can be utilized as a criterion showing the degree of market concentration (Calkins, 1983; Sys, 2009; Titilayo and Victor, 2014). (1) When the HHI value is lower than 1,000, the market is unconcentrated. (2) The value of HHI between 1000 and 1800 indicates the moderate concentration of market. (3) When the HHI value is 1800 or more, it means that the market is highly concentrated. In order to find the SMEs-recommendable industry areas by using the statistical data about companies, the values of CR3 and HHI showing the degree of market concentration were utilized in this research.

Results and discussion

Investigation into the statistical data for all enterprises in the levels of sector and division of the KSIC

The numbers of companies and employees and the annual sales of all industries and 21 sectors of KSIC could be obtained by using the statistical data of 2010 from the KOSIS of the Statistics Korea (Table 2). In addition, the proportions for those components were calculated. As presented in Table 2, the most numerous employees (3,417,698

Table 2 Numbers of companies and employees and annual sales of all industries and sectors (2010)

KSIC code	Sector of KSIC in all industries	(a) Number of companies	Ratio of (a) (%)	(b) Number of employees	Ratio of (b) (%)	(c) Annual sales (Million won)	Ratio of (c) (%)
	All industries	3,355,470	100.00	17,647,028	100.00	4,332,292,658	100.00
A	Agriculture, forestry, and fishing	2354	0.07	30,418	0.17	9,207,983	0.21
B	Mining and quarrying	1770	0.05	16,377	0.09	3,650,007	0.08
C	Manufacturing	326,813	9.74	3,417,698	19.37	1,464,336,545	33.80
D	Electricity, gas, steam, and water supply	1499	0.04	66,267	0.38	120,556,744	2.78
E	Sewerage, waste management, materials recovery, and remediation activities	5402	0.16	69,132	0.39	14,474,084	0.33
F	Construction	96,833	2.89	1,180,659	6.69	271,063,929	6.26
G	Wholesale and retail trade	876,654	26.13	2,617,891	14.83	819,828,179	18.92
H	Transportation	347,179	10.35	992,546	5.62	147,571,423	3.41
I	Accommodation and food service activities	634,500	18.91	1,766,290	10.01	77,682,506	1.79
J	Information and communications	26,375	0.79	468,585	2.66	115,566,239	2.67
K	Financial and insurance activities	39,353	1.17	706,859	4.01	744,138,697	17.18
L	Real estate activities and renting and leasing	126,081	3.76	440,556	2.50	64,305,803	1.48
M	Professional, scientific, and technical activities	70,601	2.10	750,393	4.25	117,677,853	2.72
N	Business facilities management and business support services	35,910	1.07	788,674	4.47	36,393,804	0.84
O	Public administration and defense; compulsory social security	11,929	0.36	663,673	3.76	97,290,425	2.25
P	Education	165,964	4.95	1,420,892	8.05	84,001,584	1.94
Q	Human health and social work activities	107,012	3.19	1,084,758	6.15	69,552,877	1.61
R	Arts, sports, and recreation related services	102,948	3.07	322,881	1.83	34,228,991	0.79
S	Membership organizations, repair, and other personal services	376,293	11.21	842,479	4.77	40,764,985	0.94
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	N/A	N/A	N/A	N/A	N/A	N/A
U	Activities of extraterritorial organizations and bodies	N/A	N/A	N/A	N/A	N/A	N/A

Since the properties of sector T and U are not applicable to compute the numbers of companies and employees and the sales, the values for them were not provided by the Statistics Korea

Data source: Economic Census, Korean Statistical Information Service (KOSIS) which is a core service site of the Statistics Korea (http://kosis.kr)

people, 19.37 %) and the highest annual sales (1,464,336,545 million won, 33.80 %) of Korea in 2010 were found in the sector of manufacturing. From this statistical data, it is expected that the industrial area concerned with the manufacturing was the main field of Korea industry in 2010. Therefore, the manufacturing sector of KSIC was chosen to research for the basic methodology to discover the appropriate industry area of SMEs in Korea.

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To find the top 3 divisions having the highest annual sales in 2010 among all divisions in the manufacturing sector, the values of their annual sales were compared (Table 3). The division in the first place for the annual sales was the KSIC code 26 (Manufacture of electronic components, computer, radio, television, and communication equipment and apparatuses, 17.98 %). As the second place, the KSIC code 30 (Manufacture of motor vehicles, trailers, and semitrailers) was observed (10.39 %). The KSIC code 24 (Manufacture of basic metal products) was in the third place (10.11 %). By utilizing these results, those three divisions were chosen for studying the proportion of SMEs in the annual sales.

Research for the selected subclasses of manufacturing sector

In order to examine the ratio of SMEs in the annual sales of 2010 among all subclasses contained in the top three divisions selected from Table 3, the values of annual sales

Table 3 Annual sales and their ratio of manufacturing sector and its 24 divisions (2010)

KSIC code	Division in the manufacturing sector of KSIC	Annual sales (Million won)	Ratio (%)
C	Manufacturing	1,464,336,545	100.00
10	Manufacture of food products	66,303,956	4.53
11	Manufacture of beverages	8,047,923	0.55
12	Manufacture of tobacco products	3,100,366	0.21
13	Manufacture of textiles, except apparel	26,372,142	1.80
14	Manufacture of wearing apparel, clothing accessories, and fur articles	23,015,703	1.57
15	Tanning and dressing of leather, manufacture of luggage and footwear	5,958,998	0.41
16	Manufacture of wood and of products of wood and cork; except furniture	6,603,706	0.45
17	Manufacture of pulp, paper and paper products	22,855,447	1.56
18	Printing and reproduction of recorded media	7,914,757	0.54
19	Manufacture of coke, hard-coal and lignite fuel briquettes, and refined petroleum products	113,218,854	7.73
20	Manufacture of chemicals and chemical products except pharmaceuticals and medicinal chemicals	124,063,180	8.47
21	Manufacture of pharmaceuticals, medicinal chemicals, and botanical products	14,210,794	0.97
22	Manufacture of rubber and plastic products	60,710,165	4.15
23	Manufacture of other non-metallic mineral products	37,852,453	2.58
24	Manufacture of basic metal products	148,078,592	10.11
25	Manufacture of fabricated metal products, except machinery and furniture	82,730,945	5.65
26	Manufacture of electronic components, computer, radio, television, and communication equipment and apparatuses	263,295,000	17.98
27	Manufacture of medical, precision, optical instruments, and watches and clocks	18,242,154	1.25
28	Manufacture of electrical equipment	70,066,678	4.78
29	Manufacture of other machinery and equipment	107,261,402	7.32
30	Manufacture of motor vehicles, trailers, and semitrailers	152,108,349	10.39
31	Manufacture of other transport equipment	83,082,252	5.67
32	Manufacture of furniture	12,359,000	0.84
33	Other manufacturing	6,883,729	0.47

Data source: Economic Census, Korean Statistical Information Service (KOSIS) which is a core service site of the Statistics Korea (http://kosis.kr)

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were computed by using the analysis service of K-MAPS and the subclasses with relatively high annual sales were listed in Table 4. The reason for utilizing analysis service of the K-MAPS is that it provides the annual sales of individual corporates operating in the industrial fields related to the manufacturing sector of KSIC by using the business finance database of about 370,000 companies purchased from the KED. Furthermore, the value of market share for each company can be calculated by utilizing its annual sales (In the next section, the analysis for market concentration will be discussed.). Also, the values of annual sales for individual corporates are not provided in the KOSIS. For these reasons, the analysis of statistical data about each company in the K-MAPS was performed instead of that in the KOSIS. In addition, the number of workers was utilized to distinguish the SMEs in this study. The criterion number of employees in the manufacturing sector in order to separate the SMEs from the large enterprises is 300 people by applying the Basic Law for SMEs of Korea from 2010 to 2012. In other words, the number of employees in a corporate should be less than 300 people to be recognized as a SME of Korea in the sector of manufacturing from 2010 to 2012.

As listed in Table 4, most subclasses showed higher ratio of SMEs than 20 % in the annual sales but the subclasses having very low proportions of SMEs in the annual sales were also found. From these results, total 5 subclasses with very low ratios of SMEs were excluded in the further analysis of market concentration: the KSIC code (1) 24211 (Manufacture of smelting, refining, and alloys of copper, 6 %), (2) 26120 (Manufacture of diodes, transistors, and similar semi-conductor devices, 13 %), (3)

Table 4 Annual sales and their proportion of SMEs for the chosen subclasses (2010)

KSIC code	Subclass in the manufacturing sector of KSIC	Annual sales (Million won)	Proportion of SMEs (%)
24121	Manufacture of hot rolled, drawn, and extruded iron or steel products	6,425,208	23
24132	Manufacture of pipes and tubes of non-cast iron or steel	13,902,211	22
24191	Manufacture of guilt, coloration, surface processing steel materials	2,162,861	24
24211	Manufacture of smelting, refining, and alloys of copper	8,945,571	6
24221	Manufacture of rolled, drawn, and folded products of copper	6,033,576	26
24222	Manufacture of rolled, drawn, and folded products of aluminum	7,151,018	34
26110	Manufacture of electronic integrated circuits	6,346,772	27
26120	Manufacture of diodes, transistors, and similar semi-conductor devices	24,335,270	13
26211	Manufacture of liquid crystal flat display boards	51,354,130	4
26221	Manufacture of printed circuit boards	6,579,265	44
26422	Manufacture of mobile phone	148,261,264	0.4
26511	Manufacture of television	2,972,917	21
30121	Manufacture of passenger motor vehicles	80,394,434	0.01
30310	Manufacture of parts and accessories for motor engines	9,379,206	32
30320	Manufacture of parts and accessories for motor vehicle body	9,071,525	59
30391	Manufacture of power transmission for motor vehicles	6,849,358	31
30392	Manufacture of electrical equipment for motor vehicles	1,446,523	50

The selected subclasses showed high annual sales among all subclasses contained in the top 3 divisions with the largest annual sales in Table 3 (2010): (1) Manufacture of electronic components, computer, radio, television, and communication equipment and apparatuses (17.98 %, KSIC code 26), (2) Manufacture of motor vehicles, trailers, and semitrailers (10.39 %, KSIC code 30), and (3) Manufacture of basic metal products (10.11 %, KSIC code 24)
In Korea, to be recognized as a SME in the manufacturing sector, the number of employees should be less than 300 people (Application of the Basic Law for SMEs of Korea from 2010 to 2012)
Data source: Analysis of market concentration, KISTI Market Analysis and Prediction System
(K-MAPS) (http://kmaps.kisti.re.kr)

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26211 (Manufacture of liquid crystal flat display boards, 4 %), (4) 26422 (Manufacture of mobile phone, 0.4 %), and (5) 30121 (Manufacture of passenger motor vehicles 0.01 %). Also, the subclasses with "other" term in their designations were also excluded (not shown in Table 4) because they include so many kinds of industrial areas which cannot be classified elsewhere in the subclasses of KSIC: the KSIC code (1) 24199 (Manufacture of other basic iron and steel n. e. c.), (2) 26429 (Manufacture of other wireless telecommunication apparatuses), and (3) 30399 (Manufacture of other parts and accessories for motor vehicles n. e. c.). Through the above-mentioned process, total 12 subclasses were selected for the analysis of their market concentration.

Analysis of the market concentration for the selected subclasses

For studying the market concentration from 2010 to 2012 based on the annual sales of individual enterprises in the level of KSIC subclass, the processed data for the values of CR3 and HHI computed by utilizing the market share of individual corporates in the K-MAPS were used. As listed in Table 5, there were four subclasses showing the high values of HHI larger than 1800 with relatively high CR3 (from 56 to 94 %): the KSIC code (1) 24132 (Manufacture of pipes and tubes of non-cast iron or steel), (2) 24191 (Manufacture of guilt, coloration, surface processing steel materials), (3) 24221 (Manufacture of rolled, drawn, and folded products of copper), and (4) 26511 (Manufacture of television). These four subclasses were removed from the list of industrial areas appropriate to the SMEs because the values of CR3 and HHI should be low for the initial market penetration of SMEs. Also, it is expected that the market competition of the SME with other SMEs is much easier than that with major corporates having relatively high values of annual sales and market share. Therefore,

Table 5 Values of CR3 and HHI for the selected subclasses (2010 ~ 2012)

KSIC code	Subclass in the manufacturing sector of KSIC	CR3 (%)			HHI		
		2010	2011	2012	2010	2011	2012
24121	Manufacture of hot rolled, drawn, and extruded iron or steel products	35	35	37	770	786	836
24132	Manufacture of pipes and tubes of non-cast iron or steel	59	57	57	2326	2210	2148
24191	Manufacture of guilt, coloration, surface processing steel materials	75	72	72	2833	2587	2467
24221	Manufacture of rolled, drawn, and folded products of copper	58	56	57	1809	1686	1785
24222	Manufacture of rolled, drawn, and folded products of aluminum	47	48	47	1254	1309	1214
26110	Manufacture of electronic integrated circuits	39	39	40	1020	1069	1056
26221	Manufacture of printed circuit boards	22	22	24	944	936	925
26511	Manufacture of television	89	78	94	5909	3866	7459
30310	Manufacture of parts and accessories for motor engines	29	30	31	820	797	784
30320	Manufacture of parts and accessories for motor vehicle body	19	19	20	677	643	644
30391	Manufacture of power transmission for motor vehicles	44	46	48	1253	1455	1621
30392	Manufacture of electrical equipment for motor vehicles	51	53	50	1163	1239	1226

As presented in Table 4, the chosen subclasses had 20 % or more proportion of SMEs in the annual sales
Data source: Analysis of market concentration, KISTI Market Analysis and Prediction System
(K-MAPS) (http://kmaps.kisti.re.kr)

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it is important to analyze the statistical data relevant to the market environment including annual sales, CR3, and HHI synthetically in the level of KSIC subclass in order to discover the promising industry fields for the SMEs.

Study for tendency and CAGR of the annual sales from 2010 to 2012

In order to perform the analysis for growth potential of the selected subclasses from Table 5, the tendency and the CAGR of annual sales from 2010 to 2012 were computed as listed in Table 6. For the discovery of SMEs-recommendable industry fields, the value of CAGR should be relatively high and the sales from 2010 to 2012 should be increased continuously. Among total 8 subclasses remaining in the previous step, very low values of CAGR were observed in three subclasses: the KSIC code (1) 24121 (Manufacture of hot rolled, drawn, and extruded iron or steel products, 1.01 %), (2) 24222 (Manufacture of rolled, drawn, and folded products of aluminum, -0.06 %), and (3) 26110 (Manufacture of electronic integrated circuits, 0.61 %). In addition, the high value of CAGR was found in the KSIC code 30391 (Manufacture of power transmission for motor vehicles, 10.92 %) but its annual sales from 2010 to 2012 did not show the continuous increment. From these results, total 4 subclasses with the high value of CAGR and the continuous increase in the annual sales were selected as the candidates of suitable areas to the SMEs: the KSIC code (1) 26221 (Manufacture of printed circuit boards, 14.89 %), (2) 30310 (Manufacture of parts and accessories for motor engines, 9.16 %), (3) 30320 (Manufacture of parts and accessories for motor vehicle body, 9.17 %), and (4) 30392 (Manufacture of electrical equipment for motor vehicles, 16.18 %).

Selection of SMEs-recommendable industrial areas

For the discovery of industrial fields appropriate to the SMEs, the values of annual sales, CR3, HHI, and CAGR should be taken into account synthetically. From this perspective, the subclass with the KSIC code 30392 (Manufacture of electrical

Table 6 Annual sales and their values of CAGR for the chosen subclasses (2010 ~ 2012)

KSIC code	Subclass in the manufacturing sector of KSIC	Annual sales (Million won)			CAGR (%)
		2010	2011	2012	
24121	Manufacture of hot rolled, drawn, and extruded iron or steel products	6,425,208	6,988,439	6,555,231	1.01
24222	Manufacture of rolled, drawn, and folded products of aluminum	7,151,018	7,554,277	7,142,339	-0.06
26110	Manufacture of electronic integrated circuits	6,346,772	6,587,213	6,424,311	0.61
26221	Manufacture of printed circuit boards	6,579,265	7,480,920	8,684,789	14.89
30310	Manufacture of parts and accessories for motor engines	9,379,206	11,077,627	11,175,734	9.16
30320	Manufacture of parts and accessories for motor vehicle body	9,071,525	10,709,960	10,811,588	9.17
30391	Manufacture of power transmission for motor vehicles	6,849,358	8,516,331	8,426,627	10.92
30392	Manufacture of electrical equipment for motor vehicles	1,446,523	1,805,942	1,952,468	16.18

As listed in Table 5, the selected subclasses showed the HHI values lower than 1800

Data source: Analysis of market concentration, KISTI Market Analysis and Prediction System (K-MAPS) (http://kmaps.kisti.re.kr)

equipment for motor vehicles) could not be listed in the industrial fields suitable to the SMEs because of its relatively high values of CR3 (51, 53 and 50 %) and HHI (1163, 1239 and 1226) from 2010 to 2012 compared to those of other three subclasses (The KSIC code 26221, 30310, and 30320). According to the position of SMEs, it is possible for them to choose the appropriate fields through the following two ways. The first one is that the SMEs can select the industrial area with higher CAGR when their first consideration is in its growth potential. In this case, the subclass of the KSIC code 26221 (Manufacture of printed circuit boards) is able to become the best field by following the basic methodology of this study. On the other hand, the second one is that the SMEs preferentially consider the stable entrance to the initial market having lower value of HHI. For this objective, the SMEs can choose the subclasses of the KSIC code 30310 (Manufacture of parts and accessories for motor engines) and 30320 (Manufacture of parts and accessories for motor vehicle body) as their prospective areas through the selection procedure of SMEs-recommendable industry area from this research. Thus, the SMEs can discover the suitable fields by applying their realistic position and purpose to the basic methodology of this study.

Conclusions and future work

This research was performed for the establishment of the basic methodology utilizing the statistical data as quantitative evidences. Through the overall procedure of this study, it was possible to select the SMEs-recommendable industry fields by considering their annual sales, market consideration (CR3 and HHI), and growth potential (CAGR). From the results of this study, it was found that those factors can be used as indicators to find the industrial areas suitable to the SMEs in Korea. However, the methodology of this study has the potential limits because it is difficult to reflect the market situation which can be changed suddenly in the near future. In order to overcome this defect, it is necessary to develop the methodology of this study as a further work under the consideration of more factors such as the business profits, the information about the number of enterprises founded or closed, the analysis of emerging industry/technology, and so on. Through the continuous development of the basic methodology studied in this study for the discovery of industrial areas appropriate to the SMEs, it will be very helpful for them to select the specific industry field with the value of investment having high annual sales or business profits, low market concentration, great potential of growth, and so on. Furthermore, from this research, the following influences on the SMEs can be accomplished: (1) improvement in their capabilities of business planning, (2) progress of their innovation, and (3) enhancement of investment efficiency in the national R&D for them.

Authors' contributions
All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

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