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Industrial Development and Technology Accumulation: Similar and Differentiated Technologies in China’s Robot Cleaner Industry

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Abstract: This study examines the characteristics of similar and differentiated technologies in an industry to investigate firms’ technology accumulation patterns. Cosine similarity compares technology positions generated by the patent applications of two major Chinese firms in the robot cleaner industry. The analysis shows that as the number of patent applications increases, firms tend to accumulate standard technologies for the basic performance of products while accumulating differentiated technologies for specific products and functions. The combination of standard and specific technologies has the advantage of creating barriers to entry, but the disadvantage of being slower to adapt to changes in the business environment.

JEL classification: O3, L1, L2

Keywords: differentiation, patent application, similarity, standard

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Industrial Development and Technology Accumulation:

Similar and Differentiated Technologies in China's Robot Cleaner Industry*

Koichiro Kimura†

1. Introduction

Technology accumulation is a long-term activity of firms. A firm's product or business usually does not utilize a single technology but rather combine various technologies. In addition, because competitors in the same industry also accumulate technologies, competition significantly impacts each firm's technology accumulation process and strategy. Moreover, existing markets and demand can be drastically reduced by changes in consumer behavior or completely taken over by new entrants from outside the industry due to technological changes. Therefore, firms must accumulate various technologies while adapting to industrial development.

Much research has been conducted on technological accumulation in industrial development. [1] First, the focus of innovation is initially on the product but shifts to the

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[1] Although not directly indicative of technology accumulation, research on the relationship between market structure and research and development incentives also indicates the impact of

process after the dominant design of the product has been established (Abernathy and Utterback, 1978). The shift from product to process innovation represents a stage in industrial development from the perspective of technological development. Next, the patent system can influence other technology developments that are close to a technological development (Scotchmer, 1991). Technology developments are never independent of other technologies but rather occurs within the context of a technological process of cumulative innovation. Furthermore, a product combines its core and peripheral technologies (Kimura, 2022; Kimura et al., 2022). The pattern of a firm's technological composition indicates its technological development and maturity level. As a result, it has become clear how technological accumulation progresses and changes the process of industrial development.

However, the combination of technological similarities and differences has not been explicit in accumulating diverse technologies. For novelty and differentiation purposes, firms undertake technology development; however, as firms imitate each other in the competitive process, some technologies become similar across firms in a particular industry. What characteristics do similar and differentiated technologies develop in the process of industrial development?

This study examines the similarities and differences between technologies and their relationships. To do this, I compare patent documents filed by firms and identify the characteristics of patent applications that are relatively similar and different between firms. Specifically, I focus on China's robot cleaner industry, where the number of patent applications has increased over the past decade and where major Chinese firms have accumulated technologies. Through this analysis, this study generalizes the characteristics of similar and differentiated technologies in a new industry and its implications for an industry and market.

The structure of this article is as follows: First, Section 2 introduces the method and industry. Next, Section 3 presents the results of the analysis. Finally, Section 4 summarizes and concludes the analysis.

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the stage of industrial development on firms' technology development behavior (Aghion et al., 2005).

2. Method and Industry

2.1. Method

This study compares the patent applications of two firms based on natural language processing (NLP) and determines the characteristics of their similar and differentiated technologies. To this end, this study is conducted following three steps.

The first step vectorizes each patent application to compare each Chinese patent application. The vector here is simply the bag of words in the title and abstract of each patent application, excluding symbols, numbers, and stop words. [2]

The second step uses cosine similarity to measure the technological similarity or distance between patent applications. Cosine similarity has been widely used to measure similarity (Jaffe, 1988). [3] Let $\mathbf{F}_i$ and $\mathbf{F}_j$ be the technological positions of patent applications with elements F_{ik} and F_{jk} as the fractions of each word k filed in patent applications i and j, respectively. In other words, the technological position is a vector whose elements are words in a patent application, indicating the technological characteristics of the patent application. The cosign similarity s_{ij} between patent applications i and j is given by

$$s_{ij} = similarity(\mathbf{F}_i, \mathbf{F}_j) = \frac{\sum_{k=1}^{m} F_{ik} F_{jk}}{\sqrt{\sum_{k=1}^{m} F_{ik}^2}\sqrt{\sum_{k=1}^{m} F_{jk}^2}}.$$

Because the vector elements in this study are 0 or positive, the similarity is 1 if the angle between the two technology positions is equal and 0 if it is orthogonal. [4]

Finally, the third step arranges the two vector pairs in descending order of similarity to examine the characteristics of similar and differentiated technologies. The classification and evaluation of similar and different technologies is discussed in detail

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[2] I use the R package quanteda for NLP, such as patent application vectorization and similarity calculations.

[3] Cosine similarity is a traditional method that has been used for many purposes to measure similarity (Bloom et al., 2013; Forman and van Zeebroeck, 2019; Kimura, 2022; Kimura et al., 2022).

[4] However, if the elements of the vectors are negative, the similarity can also be negative.

in Section 3.[5]

2.2. Industry

This study analyzes China's robot cleaner industry. A robot or robotic cleaner is an automatic floor or window cleaner for home or commercial use. This study focuses on home floor or window cleaners as products, although the firms may produce products for both home and commercial use.[6] Floor cleaners include those with a vacuum function, a water wipe function, or both. The robot cleaner market started with vacuum cleaners, but the number of cleaners with a wipe function and both functions has increased.

Robot cleaners became popular globally in the 2000s. The robot cleaner market was created and expanded with introducing Trilobite from Electrolux of Sweden and Roomba from iRobot of the United States. The navigation system of the early types of robot cleaners was random, changing direction randomly when robot cleaners hit a wall or something. However, in 2009, Neato Robotics of the United States launched a robot cleaner based on Simultaneous Localization and Mapping (SLAM) technology to recognize space, avoid obstacles, and clean more efficiently. This represented an evolution of the dominant product characteristics of cleaning robots.

According to the Qianzhan Industrial Research Institute in China, the Chinese market expanded rapidly in the 2010s, with 6.54 million units sold in 2020. The Chinese market is dominated by Chinese firms, such as Suzhou Ecovacs Commercial Robotics Co., Ltd. (hereinafter, Ecovacs [科沃斯]) and Beijing Roborock Technology Co., Ltd.

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[5] When technologies are compared between firms in the same industry or between an industry and other industries, they can be classified into three categories: commonality within the same industry, differentiation between firms in the same industry, and technological change in the same industry or commonality with other industries (Kimura et al., 2022; Kimura, 2023). However, this study does not consider whether technologies in an industry are similar to those in other industries, which is related to the third classification; I only consider the first two classifications within an industry: similar or different technologies between firms in the same industry.

[6] Therefore, firms that manufacture both types of products should be aware that technological developments for commercial use may affect their products for home use.

(hereinafter, Roborock [石头]). Furthermore, Chinese firms are gradually increasing their share of the global market because of the balance of price, high quality, and multifunctionality of their products.

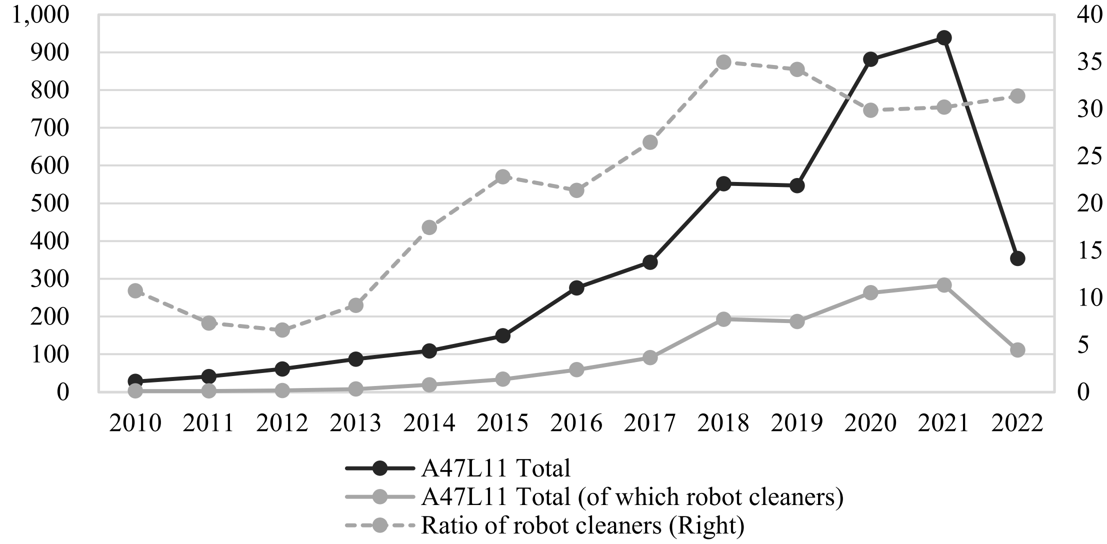
Robot cleaners comprise various technological areas, including cleaning, mobility, sensors, control, and power supply functions. Thus, robot cleaner firms must accumulate and organize these related technologies. Service robots, including robot cleaners, generally do not have a long history of commercialization, although the history of their development is not short, so there is much room for product sophistication by firms in this industry.

Much of the technology associated with robot cleaners is included under A47L11 (Machines for cleaning floors, carpets, furniture, walls, or wall coverings) in the International Patent Classification of the technological patent fields. Figure 1 shows the number of patent applications for A47L11 from 2010 to 2022 in China. The patent application data in Figure 1 were downloaded from CNIPR, the intellectual property database published by the Intellectual Property Publishing House in China, on October 3, 2023.[7] The dark solid line in the figure shows the number of patent applications for A47L11 from 2010 to 2022, indicating that the number increased sharply in the late 2010s. The light solid and dashed lines indicate the number of patent applications containing the term "robot cleaners" out of the number indicated by the dark solid line, and the ratio of the number of patent applications containing the term to the total number of patent applications, respectively.[8] The ratio is approximately 30%, but even patent applications without the term also include related technologies for any specific functions of robot cleaners. Therefore, the number of A47L11 patent applications has increased with the growth in robot cleaner-related technologies.

[7] In addition, patent applications are valid at the time of downloading.

[8] The following Chinese terms are used to describe robot cleaners: 扫地机器人, 打扫机器人, and 清洁机器人. In these terms, 扫地, 打扫, and 清洁 mean cleaning and 机器人 means a robot(s).

Figure 1: Number of Patent Applications for A47L11, 2010–2022
(Unit: Applications on the left, % on the right)



Source: Author’s creation based on the CNIPR.

This case study focuses on the major firms in China’s robot cleaner market, Ecovacs and Roborock. Ecovacs, founded in 1998, has accumulated robotic technologies and developed their first robot cleaners in the 2000s. Roborock, founded in 2014 and backed by the Xiaomi Group, has developed robot cleaners and stick-type cleaners. Xiaomi Group is a major Chinese manufacturer of smartphones and an extensive line of consumer electronics products. Because Roborock has a strong relationship with Xiaomi Group, they have filed many patent applications jointly. Table 1 shows the number of patent applications annually for both firms as of December 15, 2023.[9] The next section analyzes the similarities and differences between the pairs of each of the 420 patent applications of the two firms.

[9] More than 20 years have passed since Ecovacs was founded in 1998; thus, it is possible that some of their patent applications have become invalid.

Table 1: Number of Patent Applications by Firm, 2011–2022 (Unit: Applications)

Firm \ Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
Ecovacs	1	39	37	33	19	15	6	35	27	35	18	4	269
Roborock	-	-	-	-	19	27	8	10	11	19	41	16	151

Source: Same as Figure 1.

3. Analysis

This section examines the characteristics of the two firms' similar and differentiated technologies. The technologies are extracted from approximately 88,000 pairs formed by 420 patent applications. However, because these technologies are in the patent application stage, they may not be granted or commercialized, or, if commercialized, not well received by consumers. Therefore, this study shows the technologies that the firms focus on to ensure their future competitive performance.

First, similar technologies are defined as the top 200 pairs in terms of similarity, excluding those from only the firm's own patent applications. Table 2 shows the Ecovacs and Roborock patent applications in the top 200 pairs. These technologies are considered standard or basic for conducting business in this industry. However, which aspects are specifically standard is determined by the commonalities between each pair. Each pair is listed in Table 1A in the Appendix.

Table 2: Similar Patent Applications between Ecovacs and Roborock

(a) Ecovacs

No.	Year	IPC	Title	Application No.
1	2013	A47L11	Cleaning apparatus, roller brush cleaning chamber, and cleaning system	CN201310269581.4
2	2017	A47L1	A control method of multimedia intelligent robot cleaner	CN201711437819.4
3	2017	A47L1	A robot control method, a storage medium, and a robot	CN202111022534.0
4	2018	G05D1	Avoidance method, device, and storage medium	CN201811261238.4
5	2018	A47L11	Robotic cleaning method and robot	CN201811188720.X
6	2019	G05D1	Robot localization method, device, intelligent robot, and storage medium	CN201911017826.8
7	2020	A47L11	A robot control method, a robot, and a storage medium	CN202010418839.2
8	2020	A47L1	Cleaning device and robotic cleaning system	CN202010845601.8
9	2020	A47L11	A method and a device for controlling a robot, and a robot	CN202010202733.9
10	2022	A47L11	Cleaning system and its cleaning module removal assembly	CN202210043276.2
11	2022	A47L11	Cleaning base station, cleaning device, and cleaning system	CN202210044716.6
12	2022	A47L11	Cleaning system, self-moving cleaning device, and control method for cleaning system	CN202210043279.6

Source: Same as Figure 1.

(b) Roborock

No.	Year	IPC	Title	Application No.
13	2015	A47L11	Robot cleaner and robot collision avoidance method	CN201510178819.1
14	2016	A47L11	Obstacle crossing method and apparatus	CN202011273298.5
15	2016	A47L11	Obstacle crossing method and apparatus	CN201610394236.7
16	2016	A47L11	Robot cleaner and obstacle crossing method	CN201610394228.2
17	2018	G05D1	Intelligent mobile device and its movement path planning method, device, program, and medium	CN201810141097.6
18	2018	A47L11	Robot positioning method, device, electronic device, storage medium	CN201811268293.6
19	2019	G10L15	Robot voice control method, device, robot, and medium	CN201910265960.3
20	2019	A47L11	Robot voice control method, device, robot, and medium	CN202210225162.X
21	2020	H02J7	Charge control method and device, storage medium, and robot cleaner	CN202010266733.5
22	2021	A47L11	An automatic cleaning device	CN202110138563.7
23	2021	A47L11	An automatic cleaning device	CN202110186817.2
24	2021	A47L11	Robot cleaner and its control method, electronic device, and storage medium	CN202110280971.6
25	2021	A47L11	Method and apparatus for detraining a robot cleaner, media, and electronic device	CN202110184806.0
26	2021	A47L11	Cleaning equipment base and cleaning system	CN202111075121.9
27	2021	A47L11	Method and apparatus for controlling an automatic cleaning device, media and electronic device	CN202110184703.4
28	2021	A47L11	Method and apparatus for detraining a robot cleaner, media, and electronic device	CN202110184802.2
29	2021	A47L11	An automatic cleaning device	CN202110186818.7
30	2021	A47L11	An automatic cleaning device	CN202110188181.5
31	2021	A47L11	Method of controlling a robot cleaner, device, robot cleaner, and storage medium	CN202111208641.2
32	2021	A47L11	A method of controlling a robot cleaner	CN202110846591.4
33	2021	A47L11	Cleaning system control method, apparatus, device, and storage medium.	CN202110948745.0
34	2022	A47L11	Cleaning device and its control method	CN202210273048.4
35	2022	A47L11	Method, equipment, device, and media for configuring cleaning parameters of an automatic cleaning device	CN202210265114.3

Source: Same as Figure 1.

Next, differentiated technologies are defined as the bottom 100 pairs in terms of similarity; again, those from only the firm's own patent applications are excluded. Table 3 shows the Ecovacs and Roborock patent applications in the bottom 100 pairs. These technologies can be viewed as technologically differentiated. However, which aspects are specifically different is determined by the differentiation between each pair. Each pair is listed in Table 2A in the Appendix.

Table 3: Differentiated Patent Applications between Ecovacs and Roborock

(a) Ecovacs

No.	Year	IPC	Title	Application No.
35	2012	A47L1	Adsorption device and glass wiping device using the adsorption device	CN201210097472.4
36	2012	A47L1	A glass cleaning robot power failure emergency treatment method	CN201210387009.3
37	2012	C08L23	A glass fiber-reinforced polypropylene composite material and process for producing the same	CN201210290291.3
38	2013	B25J13	Laser-guided walking operation system for self-moving robot and control method thereof	CN201310074720.8
39	2013	A47L11	Pressure detecting and venting device and adsorption robot using the same	CN201310590021.9
40	2014	B25J9	Obstacle avoidance walking method for self-moving robots	CN201410148490.X
41	2014	F24F1	A method for multi-point cleaning by a cleaning robot	CN201410522044.0
42	2018	A47L11	Spot sweeping method, sweeping robot and storage medium	CN201810582948.0
43	2018	G05D1	Raster map construction method, obstacle avoidance method, device, and medium	CN201811158962.4
44	2018	H03K17	An activation circuit and vacuum cleaner	CN201810731058.1
45	2018	A47L11	Floor material detecting method, device, sweeping robot, and storage medium	CN201810645504.7
46	2018	G05D1	Robotic cleaning method, device, robot, and storage medium	CN201810260944.0
47	2018	B25J9	Robot positioning method, robot, and storage medium	CN201810624053.9
48	2018	H04L29	Service provisioning method, device, robot, and storage medium	CN201810933438.3
49	2018	G01C21	Robot relocalization and environment map construction method, robot, and storage medium	CN201810582949.5
50	2018	B25J9	Service robot and safe interaction device	CN202110558264.9
51	2019	G05D1	Self-moving robot control method, apparatus, self-moving robot, and storage medium	CN201911398752.7
52	2019	G06T17	3D map interaction method, device, robot, and storage medium	CN201911167481.4
53	2019	H04W4	Positioning verification method, device, robot, external device, and storage medium	CN201910678678.8
54	2019	G01C21	A raster semantic map generation method, apparatus, and storage device	CN201910739998.X
55	2020	A47L1	Window cleaning method and robot	CN202010269798.5

Source: Same as Figure 1.

(b) Roborock

No.	Year	IPC	Title	Application No.
56	2015	G01S17	Laser distance measuring device and automatic cleaning device	CN201511021200.6
57	2015	H02J7	Charging stack and its identification method, device, and automatic cleaning device	CN201510965386.4
58	2015	A47L11	Sweeping components for intelligent cleaning device and intelligent cleaning device	CN201510179602.2
59	2015	A47L11	Intelligent cleaning device and their sweeping components	CN201510178820.4
60	2016	A47L11	Autonomous cleaning device	CN202010899245.8
61	2016	A47L9	Active noise reduction device for automatic cleaning device and automatic cleaning device	CN201610394851.8
62	2016	A47L11	Roller brush assemblies, air circuit structure, and automatic cleaning device	CN201610232742.6
63	2018	A47L11	Water tank and automatic cleaning device	CN201811075287.9
64	2021	A47L11	Push-button structure, fluid reservoir, and automatic cleaning device	CN202111021326.9
65	2021	A47L11	Self-cleaning dust collector and dust removal system	CN202111676014.1
66	2021	H04N5	Line laser module and self-moving device	CN202110615607.0
67	2022	B08B1	Cleaning brush and intelligent cleaning device	CN202210022939.2
68	2022	A47L11	Automatic cleaning device	CN202210809352.6
69	2022	A47L11	Stack and cleaning system	CN202211041336.3
70	2022	A47L11	Tank for cleaning device and cleaning device	CN202210016427.5

Source: Same as Figure 1.

The reason why there are 200 similar technologies yet only 100 differentiated technologies is as follows. Pairs of similar technologies are particularly common among patent applications from identical firms; therefore, this study focuses on a relatively larger number of them. In contrast, the pairs of differentiated technologies are particularly common among patent applications from different firms; therefore, this study focuses on fewer of them.

Many similar technologies in Table 2 involve controlling the movement of robot cleaners, although the tables show only the titles of the patent applications. Robot cleaners must sense the entire space, including multiple rooms, navigate more efficiently, and avoid obstacles, pets, and so on; therefore, motion control is one of this industry's most important core technologies. The perfection of a service robot depends not only on the design of the product as hardware, but also on whether it is sufficiently adapted to the environment in which it is to work. While the introduction of SLAM technology and the formation of markets based on this technology have been led by the foreign firm, Chinese firms have also adapted to this change and developed many related technologies. Many similar technologies were filed especially in the late 2010s, which were considered standard at that time.

However, many technologies in Table 3 relate to specific products or features. In terms of particular products, the Ecovacs product line includes robot window cleaners; thus, the firm has prioritized developing technologies that adhere to windows. In terms of specific features, the two firms each focus on improving the mapping and location of spaces, the efficiency of cleaning paths, detecting floor materials, and reducing noise. While each feature is important to both firms' businesses and similar to the areas of the standard technologies, the content of the patent applications differs significantly depending on whether a firm is focused on developing technologies with a particular keyword. Consequently, it is possible that a specific technology will become a future standard technology that is essential for the entire industry if a feature based on the technology is well received by consumers.

4. Conclusion

This study examined the characteristics of similar and differentiated technologies in the robot cleaner industry to analyze firms' technology accumulation patterns. Cosine similarity compared the technology positions generated by the patent applications of the two major Chinese firms in this industry. I found that as the number of patent applications increased, firms tended to accumulate standard technologies for the basic performance of products while accumulating differentiated technologies for specific products and functions. In other words, to understand the industrial development process, it is necessary to examine not only the quality and quantity of technology, but also the combination patterns of various technologies. Therefore, developing combinations of standard and specific technologies can have a significant impact on a firm's competitiveness.

The first is an advantage. It is complicated for new entrants to build such a combination quickly. However, without standard technologies, it is difficult for them to achieve the minimum level of functionality that satisfies consumers in the market, without which it is difficult to appeal to consumers based on differentiation. As a result, incumbents can create barriers to entry for new entrants due to the sunk costs that incumbents invested when they entered the market and competed.

The second is a disadvantage. Building combinations of technologies may make it difficult for firms to promptly adapt to market and technology changes. Such inertia can delay recognizing significant changes in the business environment that could be disastrous if not adapted to. Consequently, combining standard and specific technologies has advantages and disadvantages for firms.

Many challenges were also revealed. First, to examine the characteristics of the technologies in more detail, it is necessary to vary the vectorization method and divide the similarity pairs by year or aggregate them by firm. Second, to examine the impact of technological characteristics, it is necessary to estimate the relationship between technology accumulation patterns and firm performance. Since firms accumulate not just a single technology but a variety of technologies over time, as mentioned at the beginning of this article, understanding the process of technology accumulation from different angles is critical.

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Appendices

Table A1: Similar Technologies from the Top 300 Pairs in Ascending Order of No. by Firm

(a) Ecovacs

Ecovacs	Roborock	Similarity
1	22	0.6212
1	26	0.6132
2	14	0.6320
2	15	0.6168
2	16	0.5977
2	25	0.7030
2	31	0.6287
3	14	0.6598
3	15	0.6428
3	16	0.6218
3	21	0.6176
3	25	0.7194
3	28	0.5964
3	31	0.6764
4	17	0.6324
5	14	0.6335
5	15	0.6345
5	16	0.6150
5	22	0.6382
5	23	0.5987
5	24	0.7608
5	25	0.6808
5	31	0.6598
6	18	0.6339
7	31	0.6294
8	26	0.6215
9	13	0.5970
9	19	0.6032
9	20	0.6118
9	21	0.6087
9	31	0.7047
9	32	0.6173
10	22	0.6722
10	23	0.6392
10	26	0.6454
10	30	0.6281
10	34	0.6271
11	21	0.6283
11	22	0.6613
11	23	0.6329
11	26	0.7153
11	27	0.5985
11	30	0.6236
11	33	0.6796
11	35	0.6052
12	21	0.6524
12	22	0.6888
12	23	0.6716
12	26	0.6381
12	29	0.6269
12	30	0.6814
12	34	0.6324

(b) Roborock

Ecovacs	Roborock	Similarity
9	13	0.5970
2	14	0.6320
3	14	0.6598
5	14	0.6335
2	15	0.6168
3	15	0.6428
5	15	0.6345
2	16	0.5977
3	16	0.6218
5	16	0.6150
4	17	0.6324
6	18	0.6339
9	19	0.6032
9	20	0.6118
3	21	0.6176
9	21	0.6087
11	21	0.6283
12	21	0.6524
1	22	0.6212
5	22	0.6382
10	22	0.6722
11	22	0.6613
12	22	0.6888
5	23	0.5987
10	23	0.6392
11	23	0.6329
12	23	0.6716
5	24	0.7608
2	25	0.7030
3	25	0.7194
5	25	0.6808
1	26	0.6132
8	26	0.6215
10	26	0.6454
11	26	0.7153
12	26	0.6381
11	27	0.5985
3	28	0.5964
12	29	0.6269
10	30	0.6281
11	30	0.6236
12	30	0.6814
2	31	0.6287
3	31	0.6764
5	31	0.6598
7	31	0.6294
9	31	0.7047
9	32	0.6173
11	33	0.6796
10	34	0.6271
12	34	0.6324
11	35	0.6052

Note: The numbers in the first and second columns refer to “No.” in Table 2.

Source: Author’s creation based on the results of calculations.

Table A2: Differentiated Technologies from the Bottom 100 Pairs in Ascending Order of No. by Firm

(a) Ecovacs

Ecovacs	Roborock	Similarity
35	64	0.0025
36	58	0.0018
37	65	0.0027
38	62	0.0026
39	58	0.0019
40	61	0.0026
40	69	0.0028
40	70	0.0023
41	58	0.0020
42	57	0.0028
42	60	0.0028
42	67	0.0025
43	63	0.0025
44	58	0.0016
45	58	0.0028
46	56	0.0024
46	66	0.0021
47	67	0.0027
48	58	0.0020
49	58	0.0027
49	67	0.0027
49	68	0.0024
50	68	0.0026
51	58	0.0023
52	56	0.0025
53	58	0.0017
54	58	0.0020
54	59	0.0027
55	66	0.0027
55	67	0.0026

(b) Roborock

Ecovacs	Roborock	Similarity
46	56	0.0024
52	56	0.0025
42	57	0.0028
36	58	0.0018
39	58	0.0019
41	58	0.0020
44	58	0.0016
45	58	0.0028
48	58	0.0020
49	58	0.0027
51	58	0.0023
53	58	0.0017
54	58	0.0020
54	59	0.0027
42	60	0.0028
40	61	0.0026
38	62	0.0026
43	63	0.0025
35	64	0.0025
37	65	0.0027
46	66	0.0021
55	66	0.0027
42	67	0.0025
47	67	0.0027
49	67	0.0027
55	67	0.002615
49	68	0.002354
50	68	0.002561
40	69	0.002756
40	70	0.002259

Note: The numbers in the first and second columns refer to “No.” in Table 3.

Source: Same as Table A1.