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USING PATENT DRAWINGS OF INVENTION PUBLICATIONS TO DIFFERENTIATE STOCK RETURN RATE - AN EMPIRICAL STUDY ON CHINA STOCK MARKET

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Abstract

Patent is an important outcome of technological innovation, which drove economic growth. Though patent claim always caught attention when considering patentability, it had to be supported by the drawings according to the patent examination criteria. However, patent drawing was seldom discussed. More than 60% of China listed companies of RMB common stocks (A-shares) from 2017Q1 to 2021Q4 were selected as effective samples based on the company integrated database. The effect of China invention publication's patent drawing count for differentiating China A-share's stock return rate was thoroughly discussed via analysis of variation (ANOVA). The average drawing count and the total drawing count of invention publications significantly increased over previous five years even under the impact of COVID-19 pandemic. Moreover, the total drawing count was found to be an appropriate patent indicator for differentiating A-share's stock return rate whereas the average drawing count was not because the average drawing count did not show significant connection with the stock return rate. The A-shares in the group of the highest total drawing counts showed significantly higher stock return rate mean while the A-shares in the groups of lower total drawing counts showed significantly lower stock return rate means in most quarters from 2017Q1 to 2021Q4. The finding also proved that the patent quantity still mattered in China stock market.

Keywords: Patent, Analysis of Variation, ANOVA, Stock Return Rate, Drawing Count, Invention Publication

1. Introduction

Innovation is an essential driver of economic progress that benefits consumers, businesses and the economy as a whole. The technological innovation is a key driver of economic growth. Patent is the most important outcome of technological innovation. Crespi *et al.* (2014) used a wide range of innovation indicators to describe the innovation behavior of manufacturing firms in Latin America and the Caribbean. Burr *et al.* (2015) found that family management affected R&D output negatively in Germany. Malva and Santarelli (2016), using firm-level data for 28 transition countries in Eastern Europe and Central Asia, found that firms closer to the technological frontier were more likely to engage in formal R&D activities and stronger IPR systems were more effective in promoting investment in R&D.

China, the largest PCT patent application country, is also the largest domestic patent application country in the world. China Intellectual Property Administration (CNIPA), the patent office provided with the largest number of examiners in the world, published and/or granted more than six million of China patents in a single year of 2021, including 1,720 thousand of invention publications, 696 thousand of invention grants, 3,120 thousand of utility model grants and 785 thousand of design grants. With so huge amount of China patents, CNIPA made some achievements in trying to process more patent applications in a shorter period of time (Liegsalz and Wagner, 2013).

The development of China innovation capabilities from 1985 to 2005 was examined by using China invention patents (Motohashi, 2008). A substantial trend of Chinese companies catching up with Western counterparts via patent statistics was found in two high-tech sectors including the pharmaceutical industry and mobile communications technology (Motohashi, 2009). These two high-tech sectors showed contrasting trends, Chinese company's rapid catching up was found in the mobile communications technology, while Chinese companies were lagging behind in the pharmaceutical industry. Hu and Jefferson (2009) used a company-level data set to explore the factors that account for the rising patent activity in China, and found that the patent surge in China was seemingly paradoxical given China's weak record of protecting intellectual property rights.

Lei *et al.* (2011) found that China inventive activities had experienced three developmental phases and had been promoted quickly while the innovation strengths of the three development phases had shifted from government to university and research institute and then industry. China patent statistics was found to be meaningful because China valid patent count was correlated with R&D input and financial output (Dang and Motohashi, 2015). Hanley *et al.* (2015) found that regional credit depth had a significantly positive effect on China innovation performance. Credit depth had more marked impacts on China invention patents than on utility model patents and design patents. Liu and Qiu (2016) used Chinese firm-level patent data from 1998 to 2007 and found that the input tariff cut in 2002, resulting from China's WTO accession, resulted in less innovation undertaken by Chinese firms.

A patent quality index based on internationally comparable citation data from international search reports (ISR) of PCT patent applications was proposed to consider foreign, domestic, and self-citations as economic indicators (Boeing and Mueller, 2019). However, the domestic and self-citations suffered from an upward bias in China and were suggested to be employed with caution as a measure of patent quality. China's patent surge and its driving forces on patent applications filed by Chinese firms and found that R&D investment, foreign direct investment, and patent subsidy were found to have different effects on different types of patents (Chen and Zhang, 2019). R&D investment was found to have a positive and significant impact on patenting activities for all types of patents; the stimulating effect of foreign direct investment on patent applications was only robust for utility model patents and design patents; the patent subsidy only had a positive impact on design patents.

China is the world's second biggest economy to have a stock market with the world's second biggest transaction volume. China listed companies lead the development of China patents, which the unlisted companies and individuals follow. The stock market usually reflects the economic conditions of an economy. Regarding China stock market and the patent issues involved, He *et al.* (2016) found that it was difficult in integrating Chinese patent data with

company data, so they constructed a China patent database of all China listed companies and their subsidiaries from 1990 to 2010. Chen *et al.* (2018, 2020) started a trial on Shanghai main board, in which the number of listed companies is the most, and found the leading/lagging relationship between the patent indicators and the listed company's stock price. Chiu *et al.* (2020a, 2020b) extended the scope to the whole China stock market and provided quantitative discussions on the leading/lagging relationship between patent indicators and listed company's other well-known financial indicators including return-on-asset, return-on-equity, book-value-per-share, earnings-per-share, price-to-book and price-to-earnings. They further proposed patent-based stock selection criteria for building investment portfolios which showing preferable performance.

The China A-shares are listed on four stock boards including Shanghai main board, Shenzhen main board, Growing-Enterprises board, and Small-and-Medium-Enterprises board. The A-share sizes are quite different in these four stock boards.

The majority of A-shares in Shanghai main board, Shenzhen main board are state-owned companies and big companies; most A-shares in Growing-Enterprises board and Small-and-Medium-Enterprises board are small and medium companies. Chiu *et al.* (2020c, 2020d, 2020e, 2020f, 2021), Li *et al.* (2020a, 2020b, 2021) further studied the patent leading effect in each of the four stock boards, proposed each stock board's patent prediction equations on the stock price, return-on-asset, return-on-equity, book-value-per-share, earnings-per-share, price-to-book and price-to-earnings, finally proposed patent based stock selection criteria to build stock portfolios having preferable performance.

COVID-19 has been impacting everything in the world. The World Health Organization (WHO) on March 11, 2020, declared COVID-19 outbreak a global pandemic. The stock markets all over the world fluctuated dramatically in 2020 and 2021. However, the time-series fluctuation trend would not happen to patent. Is it possible to correlate China stock market with patent during such fluctuation situation?

Tsai *et al.* (2021a, 2021b, 2021c, 2021d, 2021e, 2021f, 2022a, 2022b) proposed to apply various China patent indicators for differentiating A-share's financial performance. Tsai *et al.* (2021a) focused on different patent species including the invention publication, the invention grant, the utility model grant, the design grant, and found that the China A-shares having higher patent application continuity of any patent species showed higher stock return rate mean than the A-shares having lower patent application continuity. Tsai *et al.* (2021b) found that the A-shares having higher patent counts showed higher stock price mean and higher stock return rate mean than the A-shares having lower patent counts with regard to any patent species of the invention publication, the invention grant, the utility model grant, and the design grant. Tsai *et al.* (2021c) found that the A-shares having patents of higher technology variety, i.e. international patent classification count, showed higher stock return rate mean than the A-shares having patents of lower technology variety. Tsai *et al.* (2021d) found that the A-shares having the invention grants of longer examination duration showed higher stock return rate mean than the A-shares having the invention grants of shorter examination duration. Tsai *et al.* (2021e) found that the A-shares having patents which receiving higher backward citation counts showed higher stock price means than the A-shares having patents which receiving lower backward citation counts. Tsai *et al.* (2021f) focused on specific stock boards including Shanghai main board, Shenzhen main board, Growing-Enterprises board, Small-and-Medium-Enterprises board, and found that the A-shares having higher patent counts showed higher stock price mean than the A-shares having lower patent counts. Tsai *et al.* (2022a) found that the A-shares having patents but free of forward citation counts showed higher stock price mean than the A-shares receiving higher forward citation counts. Tsai *et al.* (2022b) focused on different patent species including the invention grant, the utility model grant, the design grant, and found that the A-shares having invention grants with longer patent lives usually showed higher market capitalization mean than the A-shares having invention grant patents with shorter patent lives, whereas the A-shares having utility model grants or design grants with longer patent lives did not show higher market capitalization means than the A-shares having utility model grants or design grants with shorter patent lives.

The patent drawing is seldom discussed previously and usually regarded as less important when comparing with the patent claim. In fact, according to the patent examination criteria, the claim has to be supported by the drawings and/or the specification. It means that the drawings must clearly and fully reveal the claimed embodiments, and possibly show all alternatives of the claimed embodiments. A patent with more embodiments would result in more drawings while a patent with few embodiments and would result in few drawings.

With regard to the drawing count of patents, Lai and Che (2009a, 2009b, 2009c) focused on US patents and damage awards of infringement lawsuits, applied the drawing count as an indicator for quantitatively modeling US patent legal values. Though the drawing count of China patents has been applied for quantitatively giving the predictive values of A-share's financial indicators (Chiu *et al.* 2020a, 2020b, 2020c, 2020d, 2020e, 2020f, 2021; Li *et al.* 2020a, 2020b, 2021), however, the relationship between the drawing count and A-share's financial performance has not been discussed yet. It is therefore the objective of this research to clearly explore the aforementioned relationship, especially, the relationship between China patent drawing count and China A-share's stock return rate.

The managerial implication of this research would enrich the understanding of China patent drawing count, extend the application of China patent drawing count to the China stock market, and further help the investment organizations to improve their the investment performance on the China A-shares.

In the following paragraphs, Section 2 presents the data and methodology, which includes the delimitation and limitation, population and sample, and the instrumentation, which show the company integrated patent database used, the calculation of patent drawing count, the stock price selected, and the principal of analysis of variance (ANOVA). Section 3 presents the result and finding. Finally, Section 4 presents the conclusion and recommendation.

2. Data and methodology

2.1. Delimitation and limitation

The objective of this research is to explore the relationship between China patent drawing count and China A-share's stock return rate. It is therefore only the patents filed by companies are discussed, while the patents filed by the government, the R&D institutes, the academic organizations, or the individuals, are all excluded.

Chinese companies are listed all over the world. In this research, China companies listed with RMB common stocks in Shanghai stock exchange or Shenzhen stock exchange, so called China A-shares, are discussed whereas Chinese companies listed in Hong Kong or overseas are excluded.

Regarding the patent, since China is now the world's largest patent application country and China patents are less analyzed previously when comparing with US patents, therefore only China patents are discussed in this research. Foreign patents are excluded even though these foreign patents are filed by China A-shares.

Regarding the patent species, there are four major patent species in China patent system including the invention publication, the invention grant, the utility model grant and the design grant. The design grant is a design application of a product granted by overcoming the preliminary examination by having a distinct configuration, distinct surface ornamentation or both. The utility model grant is a utility model application of a product granted by overcoming the preliminary examination. The invention publication is an invention application of a product or a process published by overcoming the preliminary examination. The invention grant is an invention application granted by overcoming not only the preliminary examination but also the substantial examination by having novel and distinct technical features over the prior arts, especially the prior patents. The species of the invention publication and the invention grant in China are usually regarded more valuable than the species of the utility model grant and the design grant because the invention publication and the invention grant catch more government's attention. Though the patentability of the invention grant is higher than the invention publication, the time lag of the invention grant resulted from the substantial examination is too long. The invention publication is more appropriate to show patent

applicant's real and important innovation behavior in time. It is therefore only the invention publication is discussed in this research.

2.2. Instrumentation

2.2.1. Company integrated patent database

It is a common phenomenon that a listed company has a lot of subsidiaries. When a subsidiary's revenue is merged to its parent listed company in the formal financial reports, the subsidiary's patents are therefore inferred to contribute to its parent company's financial performance in this research. In order to collect the correct patents and count the correct forward citations, a company integrated patent database is built in this research by carefully reviewing all China A-share's formal financial reports and integrating all subsidiaries' patents together with their parent A-share's patents. The patent drawing count of each parent A-share is then calculated.

It is also common that a patent is co-owned by plural companies. For avoiding duplicating calculation, if a patent is co-owned by the parent A-share and its subsidiaries, it is regarded as a single one patent of the parent A-share; if a patent is co-owned by several subsidiaries, it is also regarded as a single one patent of the parent A-share. However, if a patent is co-owned by two or more A-shares, it is assumed to contribute equivalently to each parent A-share, so the patent is duplicated and distributed to each of the co-owning A-shares.

2.2.2. Patent drawing count and drawing groups

There are two kinds of drawing counts discussed in this research, i.e. the average drawing count and the total drawing count. The total drawing count is defined as the number of all drawings of all invention publications over previous one year of an A-share while the average drawing count is defined as the average number of drawings per invention publication of an A-share. The time interval of one year is applied for retrieving each A-share's invention publications. For 2017Q1, invention publications are retrieved by the publication date from 2016/04/01 to 2017/03/31; for 2018Q2, invention publications are retrieved by the publication date from 2017/07/01 to 2018/06/30; for 2019Q3, invention publications are retrieved by the publication date from 2018/10/01 to 2019/09/30; and so forth the other quarters.

When invention publications are retrieved, the drawing count of each A-share is then calculated. The average drawing counts and the total drawing counts of A-shares in each quarter from 2017Q1 to 2021Q4 are ranked by percentile rank (PR). The A-shares in each quarter are then divided into four average drawing groups (hereinafter, A-group) and four total drawing groups (hereinafter, T-group) by percentile rank of the average drawing count and the total drawing count respectively as follows: Group #1: PR 0~25, the group of the lowest drawing counts; Group #2: PR 25~50; Group #3: PR 50~75; Group #4: PR 75~100, the group of the highest drawing counts.

2.2.3 Stock return rate

The stock return rate is a simple but straightforward indicator for beneficial investment. The time period for calculating the stock return rate is another issue. Considering the reasonable investment behavior and the earlier patent's effect on later market success, the annual stock return rate is applied for observing A-share's performance in this research.

The stock return rate is calculated by the stock price. The stock price in every trading day is always varying. The opening price, the closing price, the highest price, the lowest price, and the mean price, are extensively used in various analyses according to different purposes. However, it does not matter to use any of the aforementioned stock prices in this research. For simplification and consistency, the closing prices of every China A-share in the last trading day of each quarter from 2016Q1 to 2021Q4 are applied as the stock prices to calculate the annual stock return rates from 2017Q1 to 2021Q4 in this research.

2.2.4. Analysis of variance

Analysis of Variance (ANOVA) is applied in this research for discovering whether the average drawing count and the total drawing count of invention publications are significantly different between different years, whether the average drawing count and/or the total drawing count of invention publications are significantly differentiating the stock return rate of A-share, and which drawing group has significantly higher stock return rate mean and which drawing group has significantly lower stock return rate mean.

ANOVA is a statistical approach used to compare variances across the means of different data groups. The outcome of ANOVA is the "F-Ratio".

$$F = \frac{MST}{MSE} = \frac{\sum n_j (\overline{x_j} - \overline{x})^2 /(k-1)}{\sum\sum (x - \overline{x_j})^2 /(N-k)} \tag{1}$$

This ratio shows the difference between the within group variance and the between group variance, which produces a result that the null hypothesis H_0: $\mu_1 = \mu_2 = ... = \mu_k$ is supported or rejected. If there is a significant difference between the groups, the null hypothesis is not supported, the F-ratio will be larger and the corresponding p value should be smaller than 0.05.

2.3. Population and sample

The population comprises all China A-shares listed in Shanghai stock exchange and Shenzhen stock exchange. There are twenty-four quarters from 2016Q1 to 2021Q4 for collecting effective samples to calculate the annual stock return rates from 2017Q1 to 2021Q4. For each of the quarters from 2017Q1 to 2021Q4, an effective sample must meet the following conditions:

i. The A-share was listed to have definite stock closing prices in the last trading days of the quarters of current year and last year so as to have a definitely annual stock return rate over previous one year; and
ii. The A-share had at least one new invention publication by the end of the quarter over previous one year for calculating the average drawing count and the total drawing count.

The A-shares listed in the aforementioned quarters but having no definite stock closing price, having no annual stock return rates or having no invention publications over previous one year are all excluded.

Table 1 shows the effective samples statistics by quarter from 2017Q1 to 2021Q4. The numbers of effective samples gradually increase by quarter. By the end of 2017Q1, the number of effective samples is 2,020 while the number of all A-shares is 3,172. By the end of 2021Q4, the number of effective samples is 3,247 while the number of all A-shares is 4,686. The sampling rate of the effective samples to all A-shares is more than 60%, the analysis in this research should be free of survivorship bias.

Table 1. Effective samples statistics in every quarter from 2017 to 2021

	Effective Sample A-shares			
Year	**Q1**	**Q2**	**Q3**	**Q4**
2017	2,020	2,029	2,092	2,173
2018	2,268	2,312	2,378	2,488
2019	2,543	2,558	2,570	2,562
2020	2,609	2,657	2,658	2,656
2021	2,942	3,004	3,182	3,247

Source: Author's own preparation

3. Results and finding
3.1. Variance of invention publication's drawing count
3.1.1. Average drawing count

Table 2 and Figure 1 show the average drawing count mean statistics and trends for four A-groups in every quarter from 2017Q1 to 2021Q4. An increasing tendency of average drawing count mean is shown in Figure 1 for all A-groups. It is interesting to note that the average drawing count means of A-group #1 from 2017Q1 to 2018Q4 are less than 1.0, it is because there are many A-shares of which the invention publications have no drawings. Such invention publications are mostly related to chemical compounds.

Table 2. Average drawing count mean statistics of A-groups

		Average Drawing Count Mean				
Year	**Quarter**	**A-Group #1**	**A-Group #2**	**A-Group #3**	**A-Group #4**	**All**
2017	1	0.66	2.30	3.79	6.87	3.11
	2	0.65	2.33	3.83	7.02	3.19
	3	0.68	2.37	3.81	6.97	3.61
	4	0.66	2.36	3.81	6.93	3.62
2018	1	0.78	2.63	4.17	7.30	3.64
	2	0.81	2.64	4.18	7.41	3.74
	3	0.85	2.64	4.19	7.44	3.79
	4	0.84	2.67	4.17	7.39	3.80
2019	1	1.00	2.86	4.35	7.56	3.84
	2	1.02	2.85	4.38	7.46	3.87
	3	1.02	2.88	4.38	7.42	3.91
	4	1.05	2.89	4.39	7.56	4.05
2020	1	1.17	3.24	4.80	7.83	4.14
	2	1.14	3.26	4.79	7.97	4.22
	3	1.15	3.24	4.79	8.10	4.32
	4	1.18	3.29	4.81	7.79	4.30
2021	1	1.32	3.42	4.92	7.99	4.40
	2	1.41	3.50	5.03	8.13	4.50
	3	1.41	3.55	5.13	8.52	4.61
	4	1.45	3.60	5.16	8.44	4.65

Source: Author's own preparation

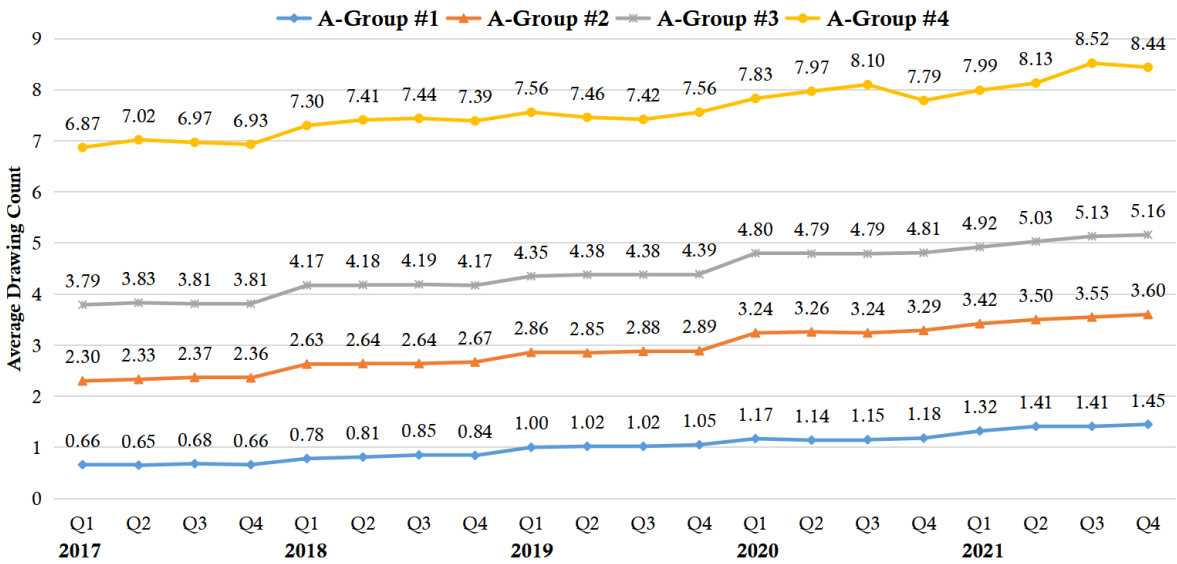

Figure 1. Average Drawing Count Means of A-Groups from 2017Q1 to 2021Q4
Source: Author's own preparation

Table 3 shows the results of ANOVA on average drawing count between five years from 2017 to 2021. For any of A-groups #1, #2, #3 and #4, the average drawing count variances between five years are of significance. A-shares in different years have significantly different average drawing count means.

Table 3. Result of ANOVA on average drawing count between years

		Average Drawing Count			
A-Group	**Year**	**Sum Square**	**Mean Square**	**F**	**p**
#1	Between Years	823.5	205.9	424.0	0.001*
	Within Years	5,972.2	0.5		
#2	Between Years	2,200.9	550.2	2,656.0	0.001*
	Within Years	2,582.5	0.2		
#3	Between Years	2,290.2	572.5	2,593.9	0.001*
	Within Years	2,617.6	0.2		
#4	Between Years	2,487.3	621.8	72.7	0.001*
	Within Years	102,834.0	8.6		

Note: p*<0.05, p**≤0.01, p***≤0.001.
Source: Author's own preparation

Table 4 shows the multiple comparisons of ANOVA on average drawing count between every two years with regard to every A-group. With regard to A-groups #1, #2 and #3, the average drawing count variances between every two years are all of significance. With regard to A-group #4, the average drawing count variance between 2019 and 2018 is free of significance while the average drawing count variances between any other two years are of significance. According to the significant and positive mean differences, the average drawing count mean of any of A-groups #1, #2, #3 and #4 gradually and significantly increases from 2017 to 2021. It is noted that the increasing trend of any A-group still goes on in 2020 and 2021. The COVID-19 pandemic did not change the innovation momentum in China. When taking the patent drawing count of invention grants as one of indicators of patent quality, the invention publication's patent quality of China A-shares is supposed to have gradually and significantly increased over previous five years.

Table 4. Multiple comparisons of ANOVA on average drawing count between years

			Average Drawing Count		
A-Group	**Year (I)**	**Year (J)**	**Mean Difference (I-J)**	**Std. Error**	**p**
#1	2018	2017	0.162	0.022	0.001*
	2019	2017	0.364	0.021	0.001*
	2019	2018	0.202	0.020	0.001*
	2020	2017	0.501	0.021	0.001*
	2020	2018	0.340	0.020	0.001*
	2020	2019	0.138	0.020	0.001*
	2021	2017	0.741	0.020	0.001*
	2021	2018	0.579	0.019	0.001*
	2021	2019	0.378	0.019	0.001*
	2021	2020	0.240	0.019	0.001*
#2	2018	2017	0.305	0.014	0.001*
	2019	2017	0.529	0.014	0.001*
	2019	2018	0.223	0.013	0.001*
	2020	2017	0.913	0.013	0.001*
	2020	2018	0.608	0.013	0.001*
	2020	2019	0.384	0.013	0.001*
	2021	2017	1.176	0.013	0.001*
	2021	2018	0.871	0.013	0.001*
	2021	2019	0.648	0.012	0.001*
	2021	2020	0.264	0.012	0.001*
#3	2018	2017	0.364	0.015	0.001*
	2019	2017	0.567	0.015	0.001*
	2019	2018	0.203	0.014	0.001*
	2020	2017	0.988	0.015	0.001*
	2020	2018	0.623	0.014	0.001*
	2020	2019	0.421	0.014	0.001*
	2021	2017	1.254	0.014	0.001*
	2021	2018	0.890	0.013	0.001*
	2021	2019	0.687	0.013	0.001*
	2021	2020	0.266	0.013	0.001*
#4	2018	2017	0.436	0.092	0.001*
	2019	2017	0.549	0.090	0.001*
	2019	2018	0.113	0.086	0.192
	2020	2017	0.974	0.089	0.001*
	2020	2018	0.538	0.085	0.001*
	2020	2019	0.425	0.083	0.001*
	2021	2017	1.326	0.086	0.001*
	2021	2018	0.889	0.082	0.001*
	2021	2019	0.777	0.080	0.001*
	2021	2020	0.351	0.079	0.001*

Note: p*<0.05, p**≤0.01, p***≤0.001.

Source: Author's own preparation

3.1.2. Total drawing count

Figure 2 and Table 5 show the total drawing count mean statistics and trends for four T-groups in every quarter from 2017Q1 to 2021Q4. The fluctuation of total drawing count mean of T-group #4 is higher than those of the other T-groups.

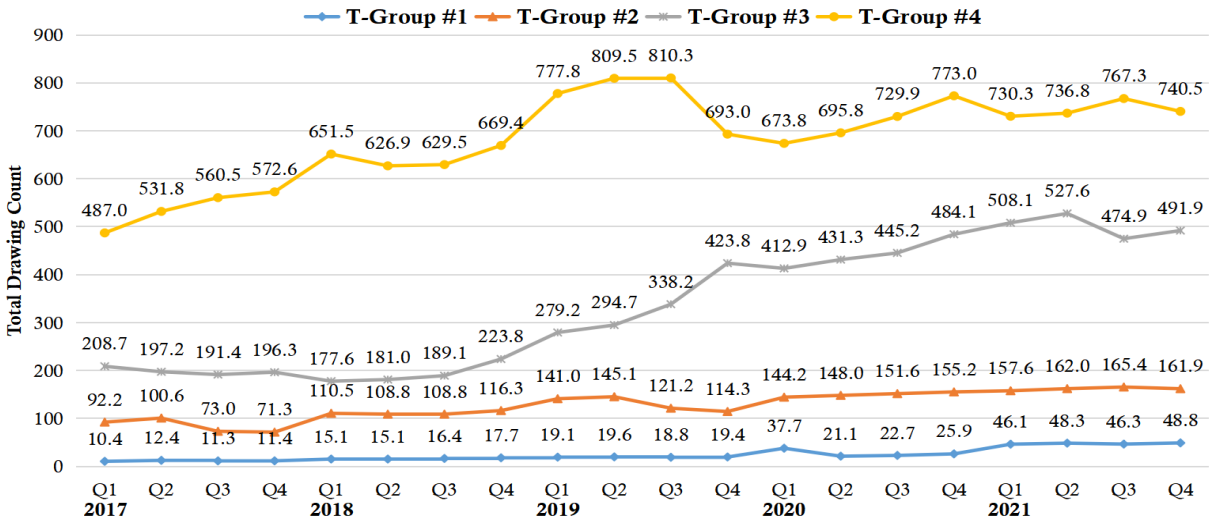

Figure 2. Total drawing count means of T-Groups from 2017Q1 to 2021Q4
Source: Author's own preparation

Table 5. Total drawing count mean statistics of T-Groups

Year	Quarter	Total Drawing Count Mean				
		T-Group #1	T-Group #2	T-Group #3	T-Group #4	All
2017	1	10.4	92.2	208.7	487.0	176.5
	2	12.4	100.6	197.2	531.8	189.2
	3	11.3	73.0	191.4	560.5	222.9
	4	11.4	71.3	196.3	572.6	229.3
2018	1	15.1	110.5	177.6	651.5	229.8
	2	15.1	108.8	181.0	626.9	231.5
	3	16.4	108.8	189.1	629.5	237.4
	4	17.7	116.3	223.8	669.4	260.2
2019	1	19.1	141.0	279.2	777.8	293.2
	2	19.6	145.1	294.7	809.5	310.2
	3	18.8	121.2	338.2	810.3	320.7
	4	19.4	114.3	423.8	693.0	321.7
2020	1	37.7	144.2	412.9	673.8	303.1
	2	21.1	148.0	431.3	695.8	314.4
	3	22.7	151.6	445.2	729.9	335.9
	4	25.9	155.2	484.1	773.0	361.0
2021	1	46.1	157.6	508.1	730.3	358.9
	2	48.3	162.0	527.6	736.8	366.7
	3	46.3	165.4	474.9	767.3	359.1
	4	48.8	161.9	491.9	740.5	359.5

Source: Author's own preparation

With regard to the total drawing count, Table 6 shows the results of ANOVA on total drawing count between five years from 2017 to 2021. For T-groups #1, #2 and #3, the total drawing count variances between five years are of significance, whereas for T-group #4, the total drawing count variance between five years is free of significance.

A-shares of any of T-groups #1, #2, #3 in different years have significantly different total drawing count means; however, A-shares of T-group #4 in different years do not have significantly different total drawing count means though it seems to be different as shown in Figure 2.

Table 6. Result of ANOVA on total drawing count between years

		Total Drawing Count			
T-Group	**Year**	**Sum Square**	**Mean Square**	**F**	**p**
#1	Between Years	2,165,403.7	541,350.9	9.039	0.001***
	Within Years	736,676,071.3	59,887.5		
#2	Between Years	9,162,864.2	2,290,716.1	4.628	0.001***
	Within Years	6,170,826,388.7	495,012.5		
#3	Between Years	184,968,439.3	46,242,109.8	15.303	0.001***
	Within Years	35,834,548,678.7	3,021,717.6		
#4	Between Years	70,886,531.3	17,721,632.8	1.784	0.129
	Within Years	119,439,720,836.9	9,935,922.2		

Note: p*<0.05, p**≤0.01, p***≤0.001.

Source: Author's own preparation

Table 7 shows the multiple comparisons of ANOVA on total drawing count between every two years with regard to three T-groups of which the total drawing count variances between years are of significance. Regarding T-group #1, the total drawing count variances between 2020 and 2017, between 2021 and 2017, between 2021 and 2018, between 2021 and 2019, between 2021 and 2020, are of significance; whereas the total drawing count variances between any other two years are free of significance. According to the significant mean differences in T-group #1, A-shares in 2021 have the highest total drawing count mean while A-shares in 2017 have the lowest total drawing count mean.

Regarding T-group #2, the total drawing count variances between 2019 and 2017, between 2020 and 2017, between 2021 and 2017, between 2021 and 2018, are of significance; whereas the total drawing count variances between any other two years are free of significance. According to the significant mean differences in T-group #2, A-shares in 2021 have the highest total drawing count mean while A-shares in 2017 have the lowest total drawing count mean.

Regarding T-group #3, the total drawing count variances between 2018 and 2017, between 2021 and 2020, are free of significance; whereas the total drawing count variances between any other two years are of significance. According to the significant mean differences in T-group #3, A-shares in 2021 have the highest total drawing count mean while A-shares in 2017 have the lowest total drawing count mean. According to the significant and positive mean differences, the total drawing count mean of each of T-groups #1, #2 and #3 has significantly increased from 2017 to 2021. China A-shares have more and more drawings in patents. It is also noted that the increasing trend of any T-group still goes on in 2020 and 2021. The COVID-19 pandemic did not change the innovation momentum in China.

Table 7. Multiple comparisons of ANOVA on total drawing count between years

			Total Drawing Count		
T-Group	**Year (I)**	**Year (J)**	**Mean Difference (I-J)**	**Std. Error**	**p**
#1	2018	2017	4.723	7.639	0.536
	2019	2017	7.869	7.426	0.289
	2019	2018	3.146	7.145	0.660
	2020	2017	15.542	7.387	0.035*
	2020	2018	10.819	7.105	0.128
	2020	2019	7.673	6.874	0.264
	2021	2017	36.010	7.105	0.001***
	2021	2018	31.287	6.811	0.001***
	2021	2019	28.140	6.570	0.001***
	2021	2020	20.468	6.526	0.002**
#2	2018	2017	26.771	21.666	0.217
	2019	2017	46.156	21.261	0.030*
	2019	2018	19.385	20.751	0.350
	2020	2017	65.408	20.642	0.002**
	2020	2018	38.637	20.116	0.055
	2020	2019	19.252	19.679	0.328
	2021	2017	77.408	20.117	0.001***
	2021	2018	50.637	19.577	0.010**
	2021	2019	31.252	19.128	0.102
	2021	2020	12.000	18.437	0.515
#3	2018	2017	-4.200	55.910	0.940
	2019	2017	136.586	54.654	0.012*
	2019	2018	140.786	51.144	0.006**
	2020	2017	246.316	54.929	0.001***
	2020	2018	250.516	51.438	0.001***
	2020	2019	109.730	50.070	0.028*
	2021	2017	301.729	52.127	0.001***
	2021	2018	305.929	48.433	0.001***
	2021	2019	165.143	46.978	0.001***
	2021	2020	55.413	47.298	0.241

Note: p*<0.05, p**≤0.01, p***≤0.001.

Source: Author's own preparation

3.2. Variance of stock return rate

3.2.1. Variance of stock return rate between A-groups

Table 8 shows the stock return rate means of each A-group in every quarter from 2017Q1 to 2021Q4. For clearly illustration, Figure 3 shows the relative stock return rate means by comparing to the stock return means of all A-shares, which might be regarded as the market trend. The positive values in Figure 3 signify that the corresponding stock return rates are higher than the market trend, while the negative values in Figure 3 signify that the corresponding stock return rates are lower than the market trend. It seems that different A-groups have different stock return rates. However, it is not easy to identify the A-groups which usually show higher stock return rate means or lower stock return rate means.

Table 8. Stock return rate means of A-groups

Year	Quarter	Stock Return Rate Mean (%)				
		A-Group #1	A-Group #2	A-Group #3	A-Group #4	All
2017	1	-2.71	-3.38	-4.33	-4.27	-3.58
	2	-10.47	-10.20	-12.91	-15.27	-11.97
	3	-9.72	-4.81	-9.92	-10.56	-8.75
	4	-19.22	-14.98	-19.33	-16.13	-17.29
2018	1	-22.86	-20.81	-25.04	-17.08	-21.51
	2	-26.18	-27.67	-28.12	-24.52	-26.62
	3	-35.03	-37.17	-36.36	-35.14	-35.92
	4	-35.71	-37.98	-35.29	-36.92	-36.47
2019	1	-14.69	-17.75	-15.68	-17.05	-16.27
	2	-1.12	-1.69	-1.24	-3.18	-1.79
	3	4.47	2.77	7.21	10.43	6.22
	4	20.92	20.68	24.49	29.02	23.90
2020	1	-6.60	-7.40	-6.25	0.09	-5.13
	2	9.73	8.45	9.06	19.83	11.72
	3	21.86	19.50	19.79	24.81	21.48
	4	18.44	16.51	12.68	19.35	16.76
2021	1	21.10	16.17	14.23	16.56	17.02
	2	21.75	17.41	11.53	18.52	17.31
	3	19.56	16.79	11.44	3.89	13.03
	4	22.35	20.56	21.55	18.32	20.70

Source: Author's own preparation

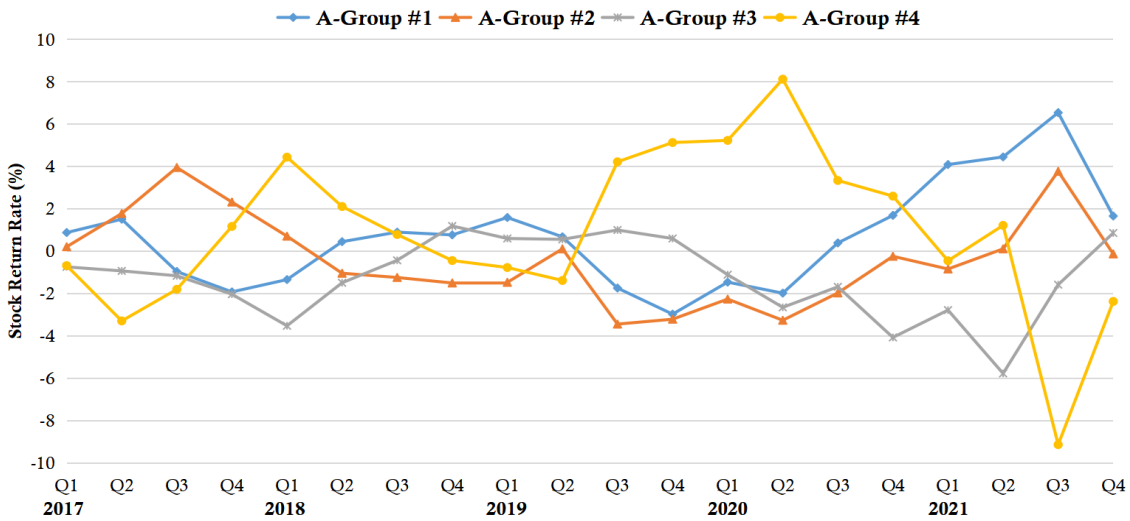

Figure 3. Relative stock return rate means of A-groups from 2017Q1 to 2021Q4
Source: Author's own preparation

Table 9 shows the results of ANOVA on the stock return rate between four A-groups in every quarter from 2017Q1 to 2021Q4. The stock return rate variances between four different A-groups in 2017Q3, 2018Q1, 2019Q3, 2019Q4, 2020Q1, 2020Q2, 2021Q2 and 2021Q3 are of significance whereas the stock return rate variances in the other quarters are free of significance. In all twenty quarters, there are only eight quarters in which the stock return rate

variances between different A-groups are of significance, the rate of significance is 40%. The average drawing count of invention publications might not be an appropriate patent indicator for differentiating China A-share's stock return rate.

Table 9. ANOVA on stock return rate between A-groups

			Stock Return Rate (%)			
Year	**Quarter**	**A-Group**	**Sum Square**	**Mean Square**	**F**	**p**
2017	1	Between Groups	800.6	266.9	0.210	0.889
		Within Groups	2,252,868.5	1,269.9		
	2	Between Groups	7,460.6	2,486.9	2.089	0.100
		Within Groups	2,194,817.8	1,190.2		
	3	Between Groups	10,318.2	3,439.4	2.886	0.034*
		Within Groups	2,263,139.3	1,191.8		
	4	Between Groups	7,124.5	2,374.8	1.831	0.139
		Within Groups	2,581,440.9	1,297.2		
2018	1	Between Groups	17,280.5	5,760.2	5.668	0.001***
		Within Groups	2,116,754.6	1,016.2		
	2	Between Groups	4,207.7	1,402.6	1.675	0.170
		Within Groups	1,785,334.0	837.4		
	3	Between Groups	1,737.6	579.2	1.010	0.387
		Within Groups	1,273,169.3	573.5		
	4	Between Groups	2,599.4	866.5	1.986	0.114
		Within Groups	1,021,147.3	436.4		
2019	1	Between Groups	3,486.2	1,162.1	1.263	0.285
		Within Groups	2,211,673.8	920.0		
	2	Between Groups	1,602.9	534.3	0.428	0.733
		Within Groups	3,031,695.6	1,248.1		
	3	Between Groups	20,528.4	6,842.8	4.282	0.005**
		Within Groups	3,923,549.7	1,598.2		
	4	Between Groups	28,687.3	9,562.4	4.053	0.007**
		Within Groups	5,783,053.1	2,359.5		
2020	1	Between Groups	22,040.0	7,346.7	4.663	0.003**
		Within Groups	3,948,606.9	1,575.7		
	2	Between Groups	55,472.7	18,490.9	6.386	0.001***
		Within Groups	7,403,730.8	2,895.5		
	3	Between Groups	11,678.2	3,892.7	1.509	0.210
		Within Groups	6,627,889.5	2,578.9		
	4	Between Groups	16,428.0	5,476.0	1.757	0.153
		Within Groups	8,023,785.3	3,117.2		
2021	1	Between Groups	18,660.4	6,220.1	2.037	0.107
		Within Groups	8,973,430.0	3,054.3		
	2	Between Groups	41,061.8	13,687.3	3.255	0.021*
		Within Groups	12,616,871.9	4,205.6		
	3	Between Groups	110,627.4	36,875.8	7.702	0.001***
		Within Groups	15,215,772.0	4,787.8		
	4	Between Groups	7,382.8	2,460.9	0.789	0.500
		Within Groups	10,111,402.0	3,117.9		

Note: p*<0.05, p**≤0.01, p***≤0.001.

Source: Author's own preparation

Table 10 shows the multiple comparisons of ANOVA on the stock return rate between every two A-groups in eight quarters of which the stock return rate variances between A-groups are of significance.

Table 10. Multiple comparisons of ANOVA on stock return rate between A-groups

		A-Group		Stock Return Rate (%)		
Year	**Quarter**	**Group (I)**	**Group (J)**	**Mean Difference (I-J)**	**Std. Error**	**p**
2017	3	#2	#1	4.910	2.277	0.031*
		#3	#1	-0.198	2.321	0.932
		#3	#2	-5.107	2.257	0.024*
		#4	#1	-0.838	2.232	0.707
		#4	#2	-5.748	2.166	0.008**
		#4	#3	-0.641	2.212	0.772
2018	1	#2	#1	2.051	1.940	0.291
		#3	#1	-2.176	1.969	0.269
		#3	#2	-4.226	1.954	0.031*
		#4	#1	5.780	1.996	0.004**
		#4	#2	3.729	1.982	0.060
		#4	#3	7.956	2.010	0.001***
2019	3	#2	#1	-1.705	2.280	0.455
		#3	#1	2.737	2.265	0.227
		#3	#2	4.442	2.287	0.052
		#4	#1	5.959	2.274	0.009**
		#4	#2	7.664	2.296	0.001***
		#4	#3	3.222	2.281	0.158
	4	#2	#1	-0.237	2.818	0.933
		#3	#1	3.572	2.778	0.199
		#3	#2	3.809	2.808	0.175
		#4	#1	8.103	2.742	0.003**
		#4	#2	8.340	2.772	0.003**
		#4	#3	4.531	2.731	0.097
2020	1	#2	#1	-0.794	2.164	0.714
		#3	#1	0.357	2.272	0.875
		#3	#2	1.151	2.266	0.612
		#4	#1	6.690	2.229	0.003**
		#4	#2	7.484	2.223	0.001***
		#4	#3	6.333	2.328	0.007
	2	#2	#1	-1.279	2.932	0.663
		#3	#1	-0.672	3.054	0.826
		#3	#2	0.607	3.033	0.842
		#4	#1	10.097	2.993	0.001***
		#4	#2	11.375	2.971	0.001***
		#4	#3	10.769	3.092	0.001***

Table 10. Continued

Year	Quarter	A-Group		Stock Return Rate (%)		
		Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	p
2021	2	#2	#1	-4.339	3.336	0.193
		#3	#1	-10.225	3.343	0.002*
		#3	#2	-5.886	3.346	0.079
		#4	#1	-3.227	3.348	0.335
		#4	#2	1.113	3.350	0.740
		#4	#3	6.999	3.358	0.037*
	3	#2	#1	-2.769	3.463	0.424
		#3	#1	-8.127	3.430	0.018*
		#3	#2	-5.357	3.432	0.119
		#4	#1	-15.670	3.511	0.001***
		#4	#2	-12.901	3.512	0.001***
		#4	#3	-7.544	3.480	0.030*

Note: p*<0.05, p**≤0.01, p***≤0.001.

Source: Author's own preparation

In 2017Q3, the stock return rate variances between A-groups #2 and #1, between A-groups #3 and #2, between A-groups #4 and #2, are of significance; whereas the stock return rate variances between any other two A-groups are free of significance. According to the significant mean differences, A-group #2 has the highest stock return rate mean, while A-group #4 has the lowest stock return rate mean.

In 2018Q1, the stock return rate variances between A-groups #3 and #2, between A-groups #4 and #1, between A-groups #4 and #3, are of significance; whereas the stock return rate variances between any other two A-groups are free of significance. According to the significant mean differences, A-group #4 has the highest stock return rate mean, while A-group #3 has the lowest stock return rate mean.

In 2019Q3, 2019Q4 and 2020Q1, the stock return rate variances between A-groups #4 and #1, between A-groups #4 and #2, are of significance; whereas the stock return rate variances between any other two A-groups are free of significance. According to the significant mean differences, A-group #4 has higher stock return rate mean, while A-group #2 has lower stock return rate mean.

In 2020Q2, the stock return rate variances between A-groups #4 and #1, between A-groups #4 and #2, between A-groups #4 and #3, are of significance; whereas the stock return rate variances between any other two groups are free of significance. According to the significant mean differences, A-group #4 has the highest stock return rate mean, while A-group #2 has lowest stock return rate mean.

In 2021Q2, the stock return rate variances between A-groups #3 and #1, between A-groups #4 and #3, are of significance; whereas the stock return rate variances between any other two groups are free of significance. According to the significant mean differences, A-group #1 has higher stock return rate mean, while A-group #3 has lower stock return rate mean.

In 2021Q3, the stock return rate variances between A-groups #3 and #1, between A-groups #4 and #1, between A-groups #4 and #2, between A-groups #4 and #3, are of significance; whereas the stock return rate variances between any other two A-groups are free of significance. According to the significant mean differences, A-group #1 has the highest stock return rate mean, while A-group #4 has the lowest stock return rate mean.

In eight quarters of which the stock return rate variances between A-groups are of significance, A-group #4 shows the highest or higher stock return rate means in six quarters while A-group #2 shows the lowest or higher stock return rate means in five quarters. However, for twenty quarters from 2017Q1 to 2021Q4, the aforementioned significantly quarters of higher or lower stock return rate mean still play a small part. In general, the average drawing count is

not an appropriate patent indicator for differentiating A-share's stock return rate. The A-shares having higher average drawing counts do not show higher stock return rate mean, while the A-shares having lower average drawing counts do not show lower stock return rate mean.

3.2.2. Variance of stock return rate between T-groups

Table 11 shows the stock return rate means of each T-group in every quarter from 2017Q1 to 2021Q4. For clearly illustration, Figure 4 shows the relative stock return rate means of T-groups by comparing to the stock return means of all A-shares, which might be regarded as the market trend. The positive values in Figure 4 signify that the corresponding stock return rates are higher than the market trend, while the negative values in Figure 4 signify that the corresponding stock return rates are lower than the market trend. It seems that different T-groups have different stock return rates. T-group #4 usually shows the highest stock return rate means while T-groups #1 and #2 usually show lower stock return rate means. Meanwhile, there are nineteen quarters in which T-group #4 shows higher stock return rate means than the market trend; while T-groups #1, #2 and #3 show lower stock return rate means than the market trend in most quarters.

Table 11. Stock return rate means of T-groups

		Stock Return Rate Mean (%)				
Year	**Quarter**	**T-Group #1**	**T-Group #2**	**T-Group #3**	**T-Group #4**	**All**
2017	1	-4.9	-5.0	-3.7	-0.2	-3.6
	2	-12.9	-12.2	-15.7	-6.9	-12.0
	3	-12.2	-10.4	-9.7	-3.3	-8.7
	4	-23.5	-20.2	-18.0	-8.0	-17.3
2018	1	-26.2	-25.7	-20.6	-12.7	-21.5
	2	-29.1	-28.6	-26.8	-21.6	-26.6
	3	-38.0	-37.8	-36.3	-31.5	-35.9
	4	-37.1	-36.9	-36.4	-35.6	-36.5
2019	1	-15.8	-18.0	-16.9	-14.3	-16.3
	2	0.0	-3.9	-3.3	0.1	-1.8
	3	6.7	4.7	3.6	9.9	6.2
	4	20.5	20.5	22.3	32.2	23.9
2020	1	-6.6	-6.3	-6.6	-0.4	-5.1
	2	7.5	7.4	10.4	22.3	11.7
	3	18.6	19.3	20.6	27.1	21.5
	4	15.8	11.6	14.1	24.9	16.8
2021	1	15.4	13.0	17.0	22.8	17.0
	2	17.2	14.4	16.7	21.0	17.3
	3	13.3	9.1	14.1	15.7	13.0
	4	19.6	21.9	21.5	19.8	20.7

Source: Author's own preparation

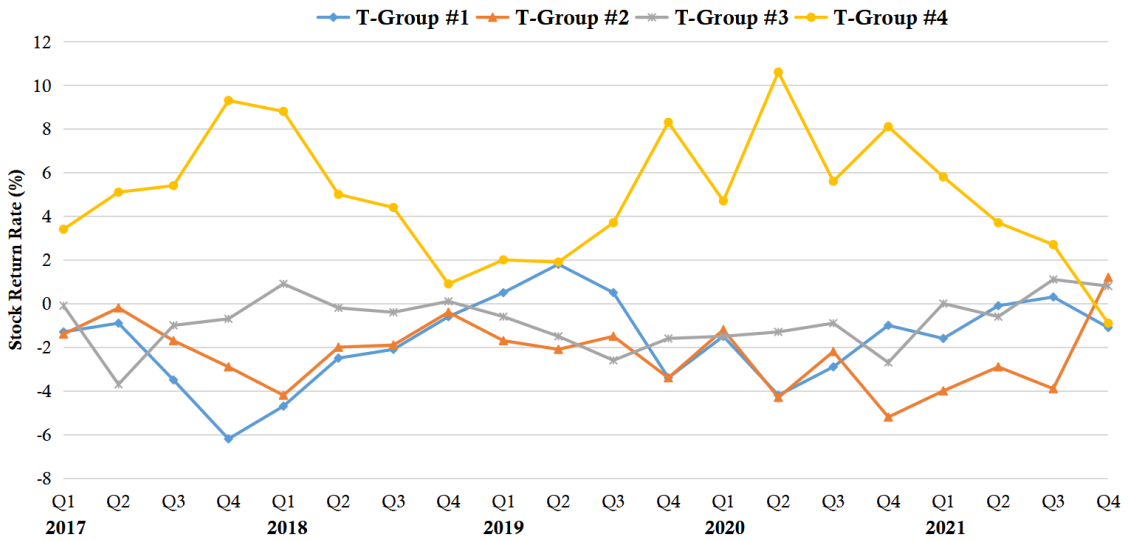

Figure 4. Relative stock return rate means of T-groups from 2017Q1 to 2021Q4

Table 12 shows the results of ANOVA on the stock return rate between four T-groups in every quarter from 2017Q1 to 2021Q4. The stock return rate variances between four different T-groups in 2017Q2 to 2018Q3, and 2019Q3 to 2021Q1 are of significance whereas the stock return rate variances between four T-groups in the other quarters are free of significance. In all twenty quarters, there are thirteen quarters in which the stock return rate variances between different T-groups are of significance, the rate of significance is 65%. The total drawing count might be applied as a patent indicator for differentiating China A-share's stock return rate.

Table 12. ANOVA on stock return rate between T-groups

			Stock Return Rate			
Year	**Quarter**	**T-Group**	**Sum Square**	**Mean Square**	**F**	**p**
2017	1	Between Groups	6,240.5	2,080.2	1.642	0.178
		Within Groups	2,247,428.6	1,266.9		
	2	Between Groups	17,999.5	5,999.8	5.065	0.002**
		Within Groups	2,184,278.9	1,184.5		
	3	Between Groups	22,288.5	7,429.5	6.267	0.001***
		Within Groups	2,251,169.0	1,185.5		
	4	Between Groups	67,261.5	22,420.5	17.696	0.001***
		Within Groups	2,521,303.9	1,267.0		
2018	1	Between Groups	60,326.4	20,108.8	20.199	0.001***
		Within Groups	2,073,708.6	995.5		
	2	Between Groups	18,560.8	6,186.9	7.448	0.001***
		Within Groups	1,770,981.0	830.7		
	3	Between Groups	15,361.0	5,120.3	9.025	0.001***
		Within Groups	1,259,545.9	567.4		
	4	Between Groups	826.1	275.4	0.630	0.596
		Within Groups	1,022,920.5	437.1		

Table 12. Continued

			Stock Return Rate			
Year	**Quarter**	**T-Group**	**Sum Square**	**Mean Square**	**F**	**p**
2019	1	Between Groups	4,501.8	1,500.6	1.632	0.180
		Within Groups	2,210,658.2	919.6		
	2	Between Groups	8,320.6	2,773.5	2.227	0.083
		Within Groups	3,024,977.8	1,245.4		
	3	Between Groups	14,061.4	4,687.1	2.928	0.033*
		Within Groups	3,930,016.7	1,600.8		
	4	Between Groups	58,316.2	19,438.8	8.281	0.001***
		Within Groups	5,753,424.2	2,347.4		
2020	1	Between Groups	16,103.0	5,367.7	3.401	0.017*
		Within Groups	3,954,543.9	1,578.0		
	2	Between Groups	94,327.7	31,442.6	10.917	0.001***
		Within Groups	7,364,875.8	2,880.3		
	3	Between Groups	30,045.6	10,015.2	3.894	0.009**
		Within Groups	6,609,522.0	2,571.8		
	4	Between Groups	67,505.4	22,501.8	7.265	0.001***
		Within Groups	7,972,707.8	3,097.4		
2021	1	Between Groups	37,607.3	12,535.8	4.113	0.006**
		Within Groups	8,954,483.1	3,047.8		
	2	Between Groups	16,518.2	5,506.1	1.307	0.270
		Within Groups	12,641,415.5	4,213.8		
	3	Between Groups	19,182.3	6,394.1	1.328	0.264
		Within Groups	15,307,217.2	4,816.6		
	4	Between Groups	3,414.4	1,138.1	0.365	0.778
		Within Groups	10,115,370.3	3,119.1		

Note: p*<0.05, p**≤0.01, p***≤0.001.

Source: Author's own preparation

Table 13 further shows the multiple comparisons of ANOVA on the stock return rate between every two T-groups in thirteen quarters of which the stock return rate variance between T-groups are of significance.

Table 13. Multiple comparisons of ANOVA on stock return rate between T-groups

				Stock Return Rate (%)		
Year	**Quarter**	**T-Group (I)**	**T-Group (J)**	**Mean Difference (I-J)**	**Std. Error**	**p**
2017	2	#2	#1	0.691	2.226	0.756
		#3	#1	-2.731	2.236	0.222
		#3	#2	-3.423	2.292	0.135
		#4	#1	6.041	2.243	0.007**
		#4	#2	5.349	2.299	0.020*
		#4	#3	8.772	2.309	0.001***
	3	#2	#1	1.775	2.264	0.433
		#3	#1	2.556	2.291	0.265
		#3	#2	0.781	2.238	0.727
		#4	#1	8.906	2.233	0.001***
		#4	#2	7.131	2.180	0.001***
		#4	#3	6.350	2.207	0.004**
	4	#2	#1	3.215	2.275	0.158
		#3	#1	5.446	2.279	0.017
		#3	#2	2.231	2.251	0.322
		#4	#1	15.448	2.260	0.001***
		#4	#2	12.233	2.231	0.001***
		#4	#3	10.002	2.236	0.001***
2018	1	#2	#1	0.519	1.934	0.789
		#3	#1	5.676	1.902	0.003**
		#3	#2	5.157	1.994	0.010**
		#4	#1	13.499	1.924	0.001***
		#4	#2	12.981	2.015	0.001***
		#4	#3	7.824	1.984	0.001***
	2	#2	#1	0.511	1.739	0.769
		#3	#1	2.288	1.752	0.192
		#3	#2	1.777	1.777	0.317
		#4	#1	7.489	1.753	0.001***
		#4	#2	6.978	1.777	0.001***
		#4	#3	5.201	1.790	0.004**
	3	#2	#1	0.157	1.422	0.912
		#3	#1	1.694	1.427	0.235
		#3	#2	1.537	1.424	0.281
		#4	#1	6.523	1.433	0.001***
		#4	#2	6.366	1.431	0.001***
		#4	#3	4.829	1.435	0.001***

Table 13. Continued

Year	Quarter	T-Group (I)	T-Group (J)	Stock Return Rate (%)		
				Mean Difference (I-J)	Std. Error	p
2019	3	#2	#1	-2.018	2.283	0.377
		#3	#1	-3.073	2.262	0.174
		#3	#2	-1.056	2.291	0.645
		#4	#1	3.217	2.274	0.157
		#4	#2	5.235	2.302	0.023*
		#4	#3	6.290	2.282	0.006**
	4	#2	#1	-0.034	2.777	0.990
		#3	#1	1.758	2.740	0.521
		#3	#2	1.792	2.799	0.522
		#4	#1	11.672	2.734	0.001***
		#4	#2	11.706	2.794	0.001***
		#4	#3	9.913	2.757	0.001***
2020	1	#2	#1	0.268	2.194	0.903
		#3	#1	0.008	2.207	0.997
		#3	#2	-0.260	2.221	0.907
		#4	#1	6.147	2.273	0.007**
		#4	#2	5.879	2.286	0.010**
		#4	#3	6.139	2.298	0.008**
	2	#2	#1	-0.002	2.939	1.000
		#3	#1	2.923	2.994	0.329
		#3	#2	2.924	3.020	0.333
		#4	#1	14.836	2.985	0.001***
		#4	#2	14.838	3.011	0.001***
		#4	#3	11.914	3.064	0.001***
	3	#2	#1	0.634	2.834	0.823
		#3	#1	2.015	2.844	0.479
		#3	#2	1.381	2.859	0.629
		#4	#1	8.489	2.797	0.002**
		#4	#2	7.855	2.812	0.005**
		#4	#3	6.474	2.822	0.022*
	4	#2	#1	-4.244	3.146	0.177
		#3	#1	-1.759	3.134	0.575
		#3	#2	2.485	3.121	0.426
		#4	#1	9.075	3.084	0.003**
		#4	#2	13.319	3.071	0.001***
		#4	#3	10.834	3.058	0.001***
2021	1	#2	#1	-2.419	2.866	0.399
		#3	#1	1.534	2.861	0.592
		#3	#2	3.952	2.897	0.173
		#4	#1	7.337	2.862	0.010**
		#4	#2	9.756	2.898	0.001***
		#4	#3	5.803	2.893	0.045*

Note: p*<0.05, p**≤0.01, p***≤0.001.

Source: Author's own preparation

In 2017Q2, 2017Q3 and 2017Q4, the stock return rate variances between T-groups #4 and #1, between T-groups #4 and #2, between T-groups #4 and #3, are of significance; whereas the stock return rate variances between any other two T-groups are free of significance. According to the significant mean differences, T-group #4 has the highest stock return rate means in all quarters while T-group #3 has the lowest stock return rate mean in 2017Q2, T-group #1 has the lowest stock return rate means in 2017Q3 and 2017Q4.

In 2018Q1, the stock return rate variance between T-groups #2 and #1 is free of significance; while the stock return rate variances between any other two T-groups are of significance. According to the significant mean differences, T-group #4 has the highest stock return rate mean while T-group #1 has the lowest stock return rate mean.

In 2018Q2 and 2018Q3, the stock return rate variances between T-groups #4 and #1, between T-groups #4 and #2, between T-groups #4 and #3, are of significance; whereas the stock return rate variances between any other two T-groups are free of significance. According to the significant mean differences, T-group #4 has the highest stock return rate means while T-group #1 has the lowest stock return rate means in both quarters.

In 2019Q3, the stock return rate variances between T-groups #4 and #2, between T-groups #4 and #3, are of significance; whereas the stock return rate variances between any other two T-groups are free of significance. According to the significant mean differences, T-group #4 has higher stock return rate mean while T-group #3 has lower stock return rate mean.

From 2019Q4 to 2021Q1, the stock return rate variances between T-groups #4 and #1, between T-groups #4 and #2, between T-groups #4 and #3, are of significance; whereas the stock return rate variances between any other two T-groups are free of significance. According to the significant mean differences, T-group #4 has the highest stock return rate means in all quarters while T-group #2 has the lowest stock return rate means in 2019Q4, 2020Q2, 2020Q4 and 2021Q1, T-group #1 has the lowest stock return rate means in 2020Q1 and 2020Q3.

In thirteen quarters of which the stock return rate variances between T-groups are of significance, T-group #4 shows the highest or higher stock return rate means in all thirteen quarters, the T-groups #1 and #2 show the lowest or lower stock return rate means in eleven quarters. In general, the total drawing count is an appropriate patent indicator for differentiating A-share's stock return rate. The A-shares in the T-group of the highest total drawing counts of invention publications show the highest or higher stock return rate means while the A-shares in T-groups of lower total drawing counts of invention publications show lower stock return rate means.

4. Conclusion and recommendation

Based on the company integrated patent database of China A-shares and the stock return rate data in twenty quarters from 2017Q1 to 2021Q4, the effect of patent drawing count of China invention publications for differentiating China A-share's stock return rate was thoroughly analyzed via ANOVA.

The population for analysis was the China A-share listed in either Shanghai stock exchange or Shenzhen stock exchange whereas China companies listed overseas were excluded. The effective samples had an annual stock return rate and at least one new China invention publication patent published over previous one year by the end of any quarter from 2017Q1 to 2021Q4. The foreign patents other than China parent were excluded. Two kinds of patent drawing count of invention publications were discussed, wherein, the average drawing count was defined as the average number of drawings per invention publication of an A-share and the total drawing count was defined as the total number of all invention publication's drawings of an A-share. According to the percentile rank of average drawing counts and total drawing counts, all effective sample A-shares in each quarter were divided into four A-groups and four T-groups, wherein, group #1 was the group of the lowest drawing count while group #4 was the group of the highest drawing count . The following conclusions were arrived:

With regard to any of A-groups #1, #2, #3 and #4, A-shares in different years from 2017 to 2021 had significantly different average drawing count means. The average drawing count mean of any A-group gradually and significantly increased from 2017 to 2021. When taking the

patent drawing count as one of indicators of patent quality, the invention publication' patent quality of China A-shares gradually and significantly increased over previous five years.

With regard to T-group #4, A-shares in different years from 2017 to 2021 did not have significantly different total drawing count means. However, with regard to any of T-groups #1, #2 and #3, A-shares in different years from 2017 to 2021 had significantly different total drawing count means. Also, the total drawing counts means of T-groups #1, #2 and #3 showed an increasing tendency from 2017 to 2021.

In all twenty quarters from 2017Q1 to 2021Q4, there were only eight quarters in which the stock return rate variances between different A-groups were of significance, the rate of significance was 40%. The average drawing count of invention publications might not be an appropriate indicator for differentiating China A-share's stock return rate.

In all twenty quarters from 2017Q1 to 2021Q4, there were thirteen quarters in which the stock return rate variances between different T-groups were of significance, the rate of significance was 65%. T-group #4 showed the highest or higher stock return rate means in all these thirteen quarters, while T-groups #1 and #2 show the lowest or lower stock return rate means in eleven quarters.

In general, the total drawing count was an appropriate patent indicator for differentiating A-share's stock return rate. The A-shares in T-group of the highest total drawing counts showed the highest or higher stock return rate mean while the A-shares in T-groups of lower total drawing counts showed lower stock return rate mean.

In practice, the number of drawings depended on two points: one is the quality and richness of the innovation proposed by the patent applicant; the other is the ability of patent attorneys and/or patent engineers. Higher average drawing count usually resulted from few patents with many drawings in them. More drawings in a patent usually accompanied with more claims. Such patents of more drawings and claims always cost more effort in patent drafting and cost more money in attorney service charge and official fee. The finding of this research would light up the patent applicants; especially China listed company applicants, because it was found that higher average drawing count was not significantly connected with higher stock return rate whereas higher total drawing count was. It is not necessary to pay much for filing few patents with lots of drawings therein. Since higher total drawing count of an A-share usually resulted from more patents. It meant that patent quantity still mattered for China A-shares. The finding of this research would enrich the understanding of China invention publication patents and the innovation behavior of China A-shares in recent years. It would contribute the state of art in evaluating China listed companies and help financial organizations improve their investment strategy.

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