Using Patent Drawings to Differentiate Stock Return Rate of China Listed Companies. A Study on China Patent Species of Utility Model Grant

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Abstract

Patent is an important outcome of technological innovation. Though patent claim always caught attention when considering patent quality, it had to be supported by the drawings according to the patent examination criteria. However, patent drawing was seldom discussed. Based on the company integrated database, more than 50% of China listed companies of RMB common stocks (A-shares) from 2017Q1 to 2021Q4 were selected as effective samples. The effect of China utility model grant patent's drawing count for differentiating A-share's stock return rate was thoroughly discussed via analysis of variation (ANOVA). The average drawing count and the total drawing count of utility model grants significantly increased over previous five years. The total drawing count of utility model grants was found to be an appropriate patent indicator for differentiating A-share's stock return rate whereas the average drawing count was not. The A-shares in the highest total drawing count groups of utility model grants showed significantly higher stock return rate means while the A-shares in the lower total drawing count groups showed significantly lower stock return rate means mostly from 2017Q1 to 2021Q4. The finding also proved that the utility model grant's patent quantity still mattered in China stock market.

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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. The stock market usually reflects the economic conditions of an economy.

Patent is the most important outcome of technological innovation. China has been the largest domestic patent application country in the world for many years. China Intellectual Property Administration (CNIPA) is now the world's largest patent office. In 2021, there are more than six million of patents published and/or issued by CNIPA, including 1,720 thousand invention publications, 696 thousand invention grants, 3,120 thousand utility model grants and 785 thousand design grants. Meanwhile, China is now the world No.2 economy to have a stock market with the world No.2 transaction volume. China listed companies lead the development of China patents, which the unlisted companies and individuals follow. 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). Based on patent information, Motohashi (2008) examined China's development of innovation capabilities from 1985 to 2005 by using more than 679 thousands China invention patent. Motohashi (2009) proposed to see a substantial trend of Chinese firms catching up with Western counterparts via patent statistics in two high-tech sectors: the pharmaceutical industry and mobile communications technology. He found that these two fields show contrasting trends, the rapid catching up can be found in mobile communications technology, while Chinese companies are still lagging behind Western counterparts in the pharmaceutical industry. Hu and Jefferson (2009) used a firm-level data set that spans the population of China's large and medium-size industrial enterprises to explore the factors that account for China's rising patent activity. They found that China's patent surge is seemingly paradoxical given the country's weak record of protecting intellectual property rights.

Lei, et al. (2011) found that the inventive activities of China have experienced three developmental phases and have been promoted quickly in recent years. The innovation strengths of the three development phases have shifted from government to university and research institute and then industry. Li (2012) found that China patent subsidy programs induced an increase in patent propensity and the patent grant ratio increased after the implementation of subsidy programs.

Liu and Qiu (2016) used Chinese firm-level patent data from 1998 to 2007 which featuring a drastic input tariff cut in 2002 because of China's WTO accession. They found that input tariff cut results in less innovation undertaken by Chinese firms. Boeing and Mueller (2019) proposed a patent quality index based on internationally comparable citation data from international search reports (ISR) to consider foreign, domestic, and self citations. They found that all three citation types may be used as economic indicators if policy distortion is not a concern. They also suggested that the domestic and self citations suffer from an upward bias in China and should be

employed with caution if they are to be interpreted as a measure of patent quality. Dang and Motohashi (2015) proposed that China patent statistics are meaningful indicators because China valid patent count is correlated with R&D input and financial output. Chen and Zhang (2019) studied 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 have different effects on different types of patents. They found that R&D investment has a positive and significant impact on patenting activities for all types of patents; the stimulating effect of foreign direct investment on patent applications is only robust for utility model patents and design patents; the patent subsidy only has a positive impact on design patents.

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) used the patent data and stock price data of China listed companies of RMB common stocks, so called China A-shares, in Shanghai main board from 2011 to 2017 and found the patent indicators have leading effect on A-share's stock price. Chiu, et al. (2020a, 2020b) focused on the whole China A-shares without distinguishing the stock boards from 2016Q4 to 2018Q3. They found that the patent indicators also have leading effect on the financial indicators including the stock price, return-on-asset (ROA), return-on-equity (ROE), book-value-per-share (BPS), earnings-per-share (EPS), price-to-book (PB) and price-to-earnings (PE). The patent prediction equations for quantitatively giving the predictive values of the aforementioned financial indicators are proposed.

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 majority of A-shares in SH main board, SZ main board are state-owned companies and big companies; most A-shares in GE board and SME 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 on each stock board, proposed each stock board's patent prediction equations on the stock return rate, ROA, ROE, BPS, EPS, PB and PE, finally proposed patent based stock selection criteria to have stock the performance surpassing the market trend.

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

Tsai, at al. (2021a, 2021b, 2021c, 2021d, 2021e, 2022a, 2022b, 2022c) discussed the relationship between various China patent indicators and the performance of China A-shares in China stock market. The A-shares with the higher innovation continuity are found to show higher stock return rate mean with regard to any China

patent species (Tsai, et al. 2021a). The A-shares having patents of higher patent count are found to show higher stock price means and higher stock return rate means with regard to any China patent species (Tsai, et al. 2021b). The A-shares having patents of higher patent count are found to show higher stock price means with regard to any of four stock boards in China stock market (Tsai, et al. 2021c). The A-shares having patents of the higher technology variety, i.e. higher International Patent Classification count, are found to show higher stock return rate mean (Tsai, et al. 2021d). The A-shares having patent grants of the longer examination duration are found to show higher stock return rate mean (Tsai, et al. 2021e). The A-shares having higher backward citation counts are found to show higher stock price means than the A-shares of lower backward citation counts (Tsai, et al. 2021f). The A-shares of higher forward citation counts are found to show lower stock price means than the A-shares free of forward citation counts (Tsai, et al. 2022a). The A-shares of higher price-citation, which incorporating the stock price and the patent forward citation, are found to show significantly higher stock return rate means (Tsai, et al. 2022b)

The A-shares having invention grant's patent lives above the general level usually showed higher market capitalization means than the A-shares having invention grant's patent lives below the general level whereas the A-shares having longer utility model grant's patent lives and longer design grant's patent lives did not show higher market capitalization means (Tsai, et al. 2022c).

The patent drawing is seldom discussed previously and usually regarded as less important when comparing with the patent claim. In fact, according the patent examination criteria, the claim has to be definitely 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 applied the drawing count as an indicator for quantitatively modeling US patent values. Though the drawing count of China patents has been applied for quantitatively giving the predictive values of A-share's financial indicators previously, however, the relationship between the drawing count and A-share's stock price is not yet discussed.

It is therefore the objective of this research to explore the following:

1. The varying trends of China A-share's average drawing count and total drawing count of utility model grants.
2. The relationship between China A-share's average drawing count of utility model grant patents and the stock return rate.
3. The relationship between China A-share's total drawing count of utility model grant patents and the stock return rate.

The managerial implication of this research comprises:
1. Enriching the understanding of China patent drawing count, especially the patent drawing count of the utility model grant.
2. Extending the application of China utility model grant's drawing count to the China stock market.
3. Helping the investment organizations to improve their stock selection strategy on China A-shares.

In the following paragraphs, section 2 presents the data and methodology including the delimitation and limitation, population and sample, and the instrumentation which showing the company integrated patent database used, the calculation of China utility model grant's patent drawing count, the stock return rate processing and the stock price selected, and the principal of analysis of variance (ANOVA) for hypothesis testing; section 3 presents the result and finding; section 4 presents the conclusion.

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.

There are two stock exchanges in mainland China, one is Shanghai stock exchange, the other is Shenzhen stock exchange. In this research, China companies with RMB stocks listed in Shanghai stock exchange or Shenzhen stock exchange, so called China A-shares, are discussed. Though Chinese companies are listed all over the world, however, Chinese companies listed in Hong Kong Special Administrative Region or any overseas regions are all excluded.

Regarding the patent, China is now the world largest patent application country whereas China patents are less analyzed previously when comparing with US patents, therefore only China patents are discussed in this research. Foreign patents other than China 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 which issued 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 which issued by overcoming the preliminary examination. The invention publication is an invention application of a product or a process which published by overcoming the preliminary examination. The invention grant is an issued invention application which 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. Though

the invention grant in China is always regarded as the most valuable patent species while the utility model grant is usually regarded as lower level innovation with fewer technical features. However, the utility model grants occupy the majority of all China patents and more particularly, the utility model grant has been rarely discussed. It is therefore only the utility model grant 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 patent drawings, 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 as a whole.

It is also common that a patent is co-owned by plural companies. For avoiding duplicated 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 Counts 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 utility model grants which issued over previous one year of an A-share while the average drawing count is defined as the average number of drawings per utility model grant of an A-share. All the utility model grants over previous one year are retrieved based on the issue date. For 2017Q1, the utility model grants are retrieved by the issue date from 2016/04/01 to 2017/03/31; for 2018Q2, the utility model grants are retrieved by the issue date from 2017/07/01 to 2018/06/30; for 2019Q3, the utility model grants are retrieved by the issue date from 2018/10/01 to 2019/09/30; and so forth the other quarters.

When utility model grants are retrieved, the drawing count of each A-share is calculated. The average drawing counts and the total drawing counts of A-shares in each quarter from 2017Q1 to 2021Q4 are further ranked by percentile rank (PR).

The A-shares in each quarter are then divided into four average drawing groups (hereinafter, A-groups) and four total drawing groups (hereinafter, T-groups) by percentile rank of the average drawing count and the total drawing count respectively as below:

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 straight-forward indicator for beneficial investment. The time period for calculating the stock return rate is another issue. Considering the reasonable investment behaviour 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 while calculating is based on 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 price of every China A-share in the last trading day of each quarter from 2016Q1 to 2021Q4 is applied as the stock price to calculate the stock return rate in this research.

2.2.4 Analysis of Variance

Analysis of Variance (ANOVA) is applied in this research for discovering:

1. Whether the average drawing count and the total drawing count of utility model grants significantly different between different years?
2. Whether the stock return rate between different A-groups significantly different?
3. Whether the stock return rate between different T-groups significantly different?
4. Whether the average drawing count and/or the total drawing count of utility model grants significantly differentiating the stock return rate of A-share?
5. Which drawing group of utility model grants having significantly higher stock return rate mean and which drawing group of utility model grants having 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 ultimately produces a result which allowing a conclusion 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, and 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 either Shanghai stock exchange or 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:

1. The A-share was listed to have definite stock closing prices in the last trading days of the current quarter and the corresponding quarter of last year so as to derive an annual stock return rate over previous one year; and
2. The A-share had at least one new utility model grant by the end of the quarter over previous one year for calculating the drawing count.

The A-shares listed in the aforementioned quarters but having no definite stock closing prices, having no annual stock return rates or having no patents 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 all A-shares is 3,172 while the number of effective samples is 1,613. By the end of 2021Q4, the number of all A-shares is 4,686 while the number of effective samples is 2,825. The sampling rate of the effective samples to all A-shares is more than 50%, the analysis in this research should be free of survivorship bias.

Table 1: Amount of effective samples in each quarter from 2017Q1 to 2021Q4

	Effective sample A-shares			
Year	Q1	Q2	Q3	Q4
2017	1,658	1,679	1,711	1,793
2018	1,920	2,022	2,132	2,211
2019	2,213	2,222	2,245	2,264
2020	2,350	2,431	2,474	2,494
2021	2,843	2,886	3,028	3,163

Data Source: This Research

3. Result and Finding

3.1   Variance of Utility Model Grant's Drawing Count

3.1.1   Average Drawing Count

Table 2 and Figure 1 show the utility model grant's average drawing count mean statistics for A-groups in every quarter from 2017Q1 to 2021Q4. The increasing trends of average drawing count mean are shown in Figure 1 for all A-groups.

Table 2: A-group's average drawing count mean from 2017Q1 to 2021Q4

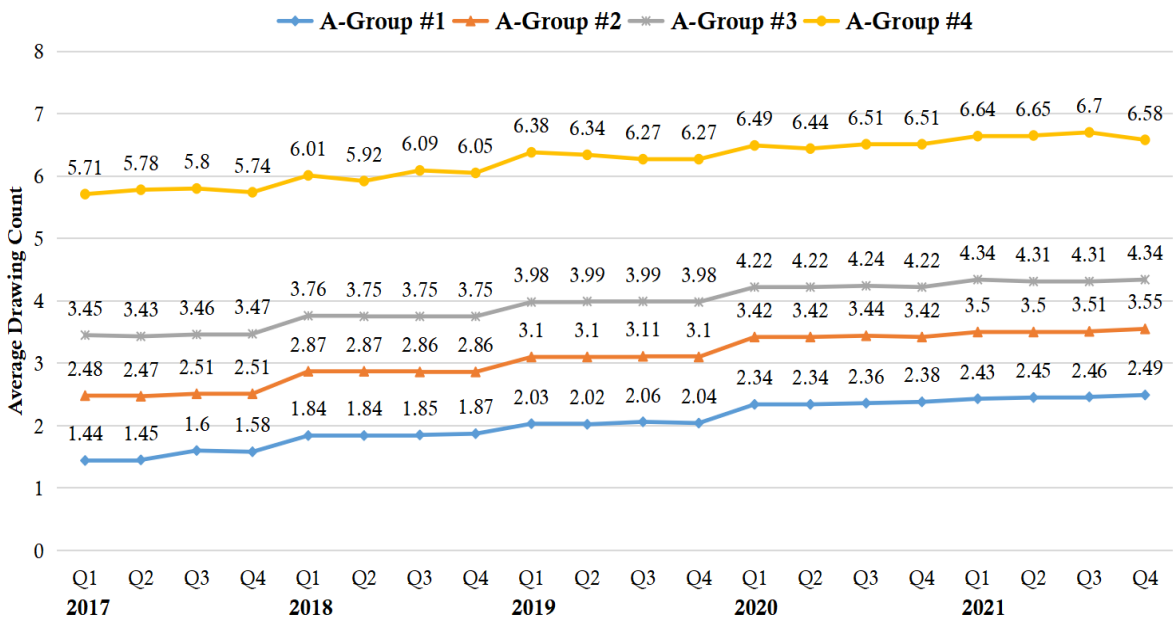| Year	Quarter	Average drawing count mean				
		A-group #1	A-group #2	A-group #3	A-group #4	All groups
2017	1	1.44	2.48	3.45	5.71	2.97
	2	1.45	2.47	3.43	5.78	3.07
	3	1.60	2.51	3.46	5.80	3.43
	4	1.58	2.51	3.47	5.74	3.49
2018	1	1.84	2.87	3.76	6.01	3.53
	2	1.84	2.87	3.75	5.92	3.59
	3	1.85	2.86	3.75	6.09	3.65
	4	1.87	2.86	3.75	6.05	3.68
2019	1	2.03	3.10	3.98	6.38	3.73
	2	2.02	3.10	3.99	6.34	3.81
	3	2.06	3.11	3.99	6.27	3.87
	4	2.04	3.10	3.98	6.27	3.92
2020	1	2.34	3.42	4.22	6.49	3.98
	2	2.34	3.42	4.22	6.44	4.07
	3	2.36	3.44	4.24	6.51	4.13
	4	2.38	3.42	4.22	6.51	4.17
2021	1	2.43	3.50	4.34	6.64	4.22
	2	2.45	3.50	4.31	6.65	4.22
	3	2.46	3.51	4.31	6.70	4.24
	4	2.49	3.55	4.34	6.58	4.23

Data Source: This Research

Figure 1: Average drawing count means of A-groups from 2017Q1 to 2021Q4

Table 3 shows the results of ANOVA on utility model grant's average drawing count between five years from 2017 to 2021. For each A-group, the average drawing count variances between five years are of significance. A-shares in different years have significantly different utility model grant's average drawing count means.

Table 3: ANOVA on A-group's average drawing count between five years

A-group	Year	Average drawing count			
		Sum square	Mean square	F	p
#1	between years	1,318.7	329.7	1,212.699	0.001***
	within years	3,197.1	0.3		
#2	between years	1,462.5	365.6	7,050.105	0.001***
	within years	587.5	0.1		
#3	between years	1,116.7	279.2	3,202.928	0.001***
	within years	997.6	0.1		
#4	between years	1,049.4	262.4	48.730	0.001***
	within years	60,225.3	5.4		

Data Source: This Research. $p^*<0.05$, $p^{**}\leq0.01$, $p^{***}\leq0.001$

Table 4 further shows the multiple comparisons of ANOVA on utility model grant's average drawing count between any two years with regard to each A-group.
It is clear that for any A-group #1, #2, #3 or #4, the average drawing count variances between any two years are of significance. According to the significant mean differences, A-shares in 2017 show the lowest average drawing count mean while A-shares in 2021 show the highest average drawing count mean. The average drawing count shows a significantly increasing trend from 2017 to 2021. When taking the patent drawing count as one of indicators of patent quality, the utility model grant's patent quality of China A-shares has gradually increased significantly over previous five years because the average drawing count increased.

Table 4: Multiple comparisons of ANOVA on A-group's average drawing count between two years

A-group	Year(I)	Year(J)	Average drawing count		
			Mean Diff. (I-J)	Std. Error	p
#1	2018	2017	0.348	0.017	0.001***
	2019	2017	0.536	0.017	0.001***
	2019	2018	0.188	0.016	0.001***
	2020	2017	0.851	0.016	0.001***
	2020	2018	0.502	0.015	0.001***
	2020	2019	0.315	0.015	0.001***
	2021	2017	0.956	0.016	0.001***
	2021	2018	0.608	0.015	0.001***
	2021	2019	0.420	0.015	0.001***
	2021	2020	0.105	0.014	0.001***
#2	2018	2017	0.372	0.007	0.001***
	2019	2017	0.608	0.007	0.001***
	2019	2018	0.236	0.007	0.001***
	2020	2017	0.929	0.007	0.001***
	2020	2018	0.557	0.007	0.001***
	2020	2019	0.321	0.007	0.001***
	2021	2017	1.021	0.007	0.001***
	2021	2018	0.649	0.007	0.001***
	2021	2019	0.413	0.006	0.001***
	2021	2020	0.091	0.006	0.001***
#3	2018	2017	0.297	0.009	0.001***
	2019	2017	0.531	0.009	0.001***
	2019	2018	0.234	0.009	0.001***
	2020	2017	0.772	0.009	0.001***
	2020	2018	0.475	0.009	0.001***
	2020	2019	0.241	0.009	0.001***
	2021	2017	0.871	0.009	0.001***
	2021	2018	0.574	0.008	0.001***
	2021	2019	0.340	0.008	0.001***
	2021	2020	0.099	0.008	0.001***
#4	2018	2017	0.260	0.078	0.001***
	2019	2017	0.553	0.077	0.001***
	2019	2018	0.293	0.071	0.001***
	2020	2017	0.727	0.075	0.001***
	2020	2018	0.467	0.070	0.001***
	2020	2019	0.174	0.068	0.011*
	2021	2017	0.883	0.073	0.001***
	2021	2018	0.623	0.067	0.001***
	2021	2019	0.330	0.065	0.001***
	2021	2020	0.156	0.064	0.014*

p*<0.05, p**≤0.01, p***≤0.001; Data Source: This Research

3.1.2   Total Drawing Count

Table 5, Figures 2 and 3 show the utility model grant's total drawing count mean statistics and trends of four T-groups in every quarter from 2017Q1 to 2021Q4. In Figure 2, the fluctuation of total drawing count mean of T-group #3 is higher than those of T-groups #1 and #2. In Figure 3, the total drawing count mean of T-group #4 is also fluctuating. However, all T-groups seem to show increasing trends.

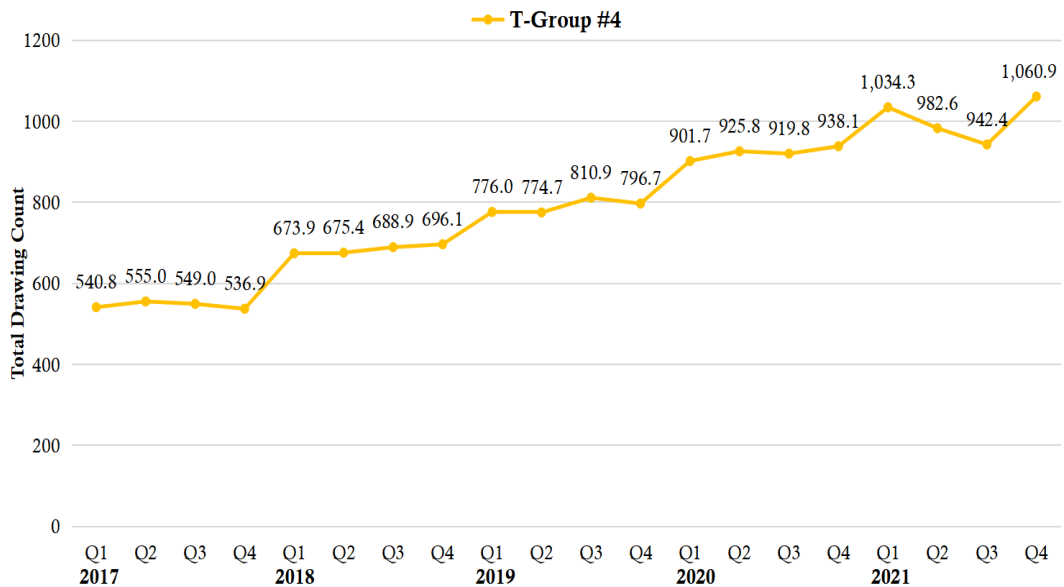**Table 5: T-group's total drawing count mean from 2017Q1 to 2021Q4**

Year	Quarter	Total drawing count mean				
		T-group #1	T-group #2	T-group #3	T-group #4	All groups
2017	1	5.75	22.45	59.97	540.78	142.35
	2	5.61	22.61	59.75	554.97	149.58
	3	5.82	22.48	60.38	549.04	164.63
	4	5.57	22.37	59.40	536.89	166.18
2018	1	7.57	29.37	77.10	673.92	178.48
	2	7.70	29.50	77.39	675.42	193.33
	3	7.65	29.70	78.15	688.91	203.03
	4	7.58	29.93	77.14	696.08	213.58
2019	1	8.55	35.23	89.77	776.03	220.82
	2	8.61	34.26	90.07	774.66	218.06
	3	8.65	33.62	90.31	810.93	231.45
	4	8.77	33.80	90.33	796.72	241.80
2020	1	10.80	43.39	112.16	901.65	235.78
	2	10.79	42.48	115.36	925.80	261.18
	3	11.53	43.87	115.66	919.79	282.76
	4	10.78	43.63	116.46	938.11	300.95
2021	1	12.01	49.49	130.95	1034.28	304.24
	2	11.95	47.86	125.92	982.63	290.18
	3	12.01	47.03	120.27	942.36	278.41
	4	13.28	51.37	128.93	1060.88	311.33

Data Source: This Research
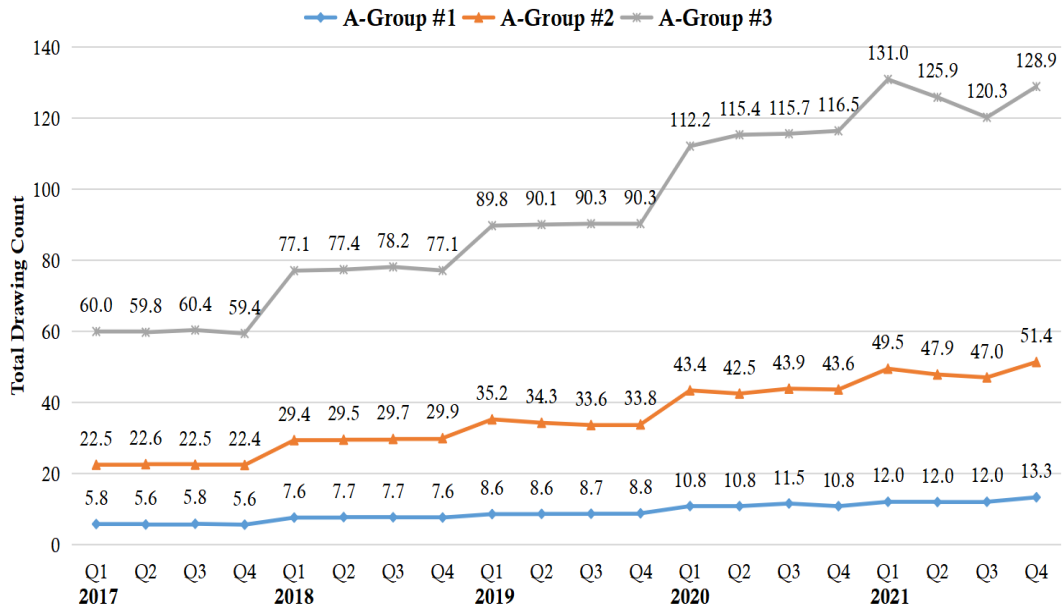
Data Source: This Research

Figure 2: Utility model grant's total drawing count means of T-groups #1, #2 and #3 from 2017Q1 to 2021Q4

Data Source: This Research

Figure 3: Utility model grant's total drawing count means of T-group #4 from 2017Q1 to 2021Q4

Table 6 shows the results of ANOVA on utility model grant's total drawing count between five years from 2017 to 2021. For all T-groups #1, #2, #3 and #4, the total drawing count variances between five years are of significance, A-shares in different years have significantly different utility model grant's total drawing count means.

Table 6: ANOVA on T-group's total drawing count between five years

T-group	Year	Total drawing count			
		Sum square	Mean square	F	p
#1	between years	64,660.3	16,165.1	467.776	0.001***
	within years	403,249.7	34.6		
#2	between years	1,003,072.5	250,768.1	1,926.000	0.001***
	within years	1,485,859.9	130.2		
#3	between years	6,581,256.9	1,645,314.2	2,136.344	0.001***
	within years	8,727,388.8	770.2		
#4	between years	293,815,883.8	73,453,970.9	12.821	0.001***
	within years	64,772,140,111.7	5,729,005.8		

Data Source: This Research. p*<0.05, p**≤0.01, p***≤0.001.

Table 7 further shows the multiple comparisons of ANOVA on utility model grant's total drawing count between any two years with regard to four T-groups.
Regarding T-groups #1, #2 and #3, the total drawing count variances between any two years are of significance. According to the significant mean differences, A-shares in 2021 have the highest total drawing count means while A-shares in 2017 have the lowest total drawing count means. The total drawing count means of T-groups #1, #2 and #3 show increasing trends.
Regarding T-group #4, the total drawing count variances between 2019 and 2017, between 2020 and 2017, between 2020 and 2018, between 2021 and 2017, between 2021 and 2018, between 2021 and 2019, 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 #4, A-shares in 2021 have the highest total drawing count mean while A-shares in 2017 have the lowest total drawing count mean. The total drawing count mean of T-group #4 also shows an increasing trend.
According to Table 7, the utility model grant's total drawing count of any T-group shows a significantly increasing trend from 2017 to 2021, China A-shares have significantly more and more total patent drawings of utility model grants over previous five years.

Table 7: Multiple comparisons of ANOVA on T-group's total drawing count between two years

T-group	Year(I)	Year(J)	Total drawing count		
			Mean Diff. (I-J)	Std. Error	p
#1	2018	2017	1.934	0.189	0.001***
	2019	2017	2.952	0.186	0.001***
	2019	2018	1.018	0.177	0.001***
	2020	2017	5.285	0.183	0.001***
	2020	2018	3.351	0.174	0.001***
	2020	2019	2.333	0.171	0.001***
	2021	2017	6.643	0.176	0.001***
	2021	2018	4.709	0.166	0.001***
	2021	2019	3.691	0.163	0.001***
	2021	2020	1.359	0.160	0.001***
#2	2018	2017	7.158	0.375	0.001***
	2019	2017	11.763	0.368	0.001***
	2019	2018	4.605	0.347	0.001***
	2020	2017	20.864	0.362	0.001***
	2020	2018	13.706	0.341	0.001***
	2020	2019	9.100	0.333	0.001***
	2021	2017	26.487	0.349	0.001***
	2021	2018	19.329	0.326	0.001***
	2021	2019	14.724	0.319	0.001***
	2021	2020	5.624	0.312	0.001***
#3	2018	2017	17.591	0.912	0.001***
	2019	2017	30.259	0.894	0.001***
	2019	2018	12.668	0.854	0.001***
	2020	2017	55.120	0.876	0.001***
	2020	2018	37.529	0.835	0.001***
	2020	2019	24.861	0.816	0.001***
	2021	2017	66.610	0.843	0.001***
	2021	2018	49.019	0.800	0.001***
	2021	2019	36.351	0.780	0.001***
	2021	2020	11.490	0.760	0.001***
#4	2018	2017	139.480	78.736	0.077
	2019	2017	244.800	77.464	0.002**
	2019	2018	105.320	73.403	0.151
	2020	2017	377.509	76.022	0.001***
	2020	2018	238.029	71.878	0.001***
	2020	2019	132.709	70.483	0.060
	2021	2017	460.374	73.104	0.001***
	2021	2018	320.894	68.785	0.001***
	2021	2019	215.574	67.326	0.001***
	2021	2020	82.865	65.661	0.207

Data Source: This Research. $p^* < 0.05$, $p^{**} \leq 0.01$, $p^{***} \leq 0.001$.
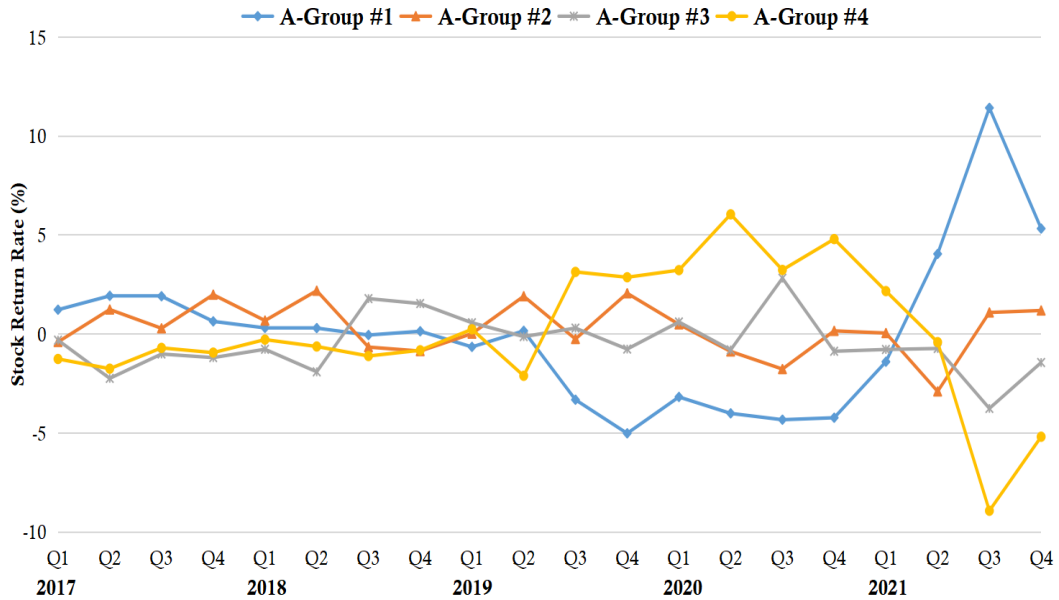
3.2   Variance of Stock Return Rate
3.2.1   Variance of Stock Return Rate between A-Groups

Table 8 shows the stock return rate means of A-groups in every quarter from 2017Q1 to 2021Q4. For clearly illustration, Figure 4 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 4 denote the stock return rates thereof higher than the market trend, while the negative values denote the stock return rates thereof lower than the market trend. It seems that different A-groups have different stock return rate means. However, there is no any A-groups mostly showing higher or lower stock return rate than the market trend.

Table 8: A-group's stock return rate mean in each quarter from 2017Q1 to 2021Q4

Year	Quarter	Stock return rate mean (%)				
		A-group #1	A-group #2	A-group #3	A-group #4	All groups
2017	1	-0.70	-2.33	-2.24	-3.19	-1.93
	2	-9.28	-9.97	-13.45	-12.96	-11.21
	3	-6.28	-7.90	-9.20	-8.89	-8.19
	4	-16.64	-15.29	-18.47	-18.22	-17.28
2018	1	-21.73	-21.36	-22.81	-22.32	-22.04
	2	-27.62	-25.73	-29.83	-28.55	-27.92
	3	-37.03	-37.64	-35.19	-38.09	-36.98
	4	-36.89	-37.89	-35.49	-37.85	-37.03
2019	1	-17.19	-16.52	-15.97	-16.30	-16.54
	2	-2.38	-0.63	-2.67	-4.65	-2.54
	3	1.47	4.54	5.09	7.93	4.79
	4	16.90	23.98	21.16	24.79	21.92
2020	1	-9.42	-5.75	-5.63	-3.01	-6.24
	2	5.99	9.12	9.20	16.05	10.00
	3	16.70	19.26	23.85	24.27	21.03
	4	12.73	17.12	16.09	21.76	16.96
2021	1	16.71	18.16	17.33	20.28	18.11
	2	22.92	15.97	18.14	18.46	18.87
	3	26.59	16.25	11.40	6.23	15.16
	4	27.44	23.30	20.67	16.92	22.11

Data Source: This Research

Data Source: This Research

Figure 4: Relative stock return rate means of A-groups in each quarter from 2017Q1 to 2021Q4

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 A-groups in 2019Q4, 2020Q2 to 2020Q4, 2021Q3 and 2020Q4 are of significance whereas the stock return rate variances between four A-groups in the other fourteen quarters are free of significance. In all twenty quarters, there are only six quarters in which the stock return rate variances between different A-groups are of significance, the rate of significance is only 30%.

Table 9: ANOVA on stock return rate between four A-groups

Year	Quarter	A-group	Stock return rate (%)			
			Sum square	Mean square	F	p
2017	1	between groups	1,404.9	468.3	0.357	0.784
		within groups	2,170,067.6	1,312.0		
	2	between groups	5,595.2	1,865.1	1.477	0.219
		within groups	2,115,531.0	1,263.0		
	3	between groups	2,051.6	683.9	0.570	0.635
		within groups	2,048,979.6	1,200.3		
	4	between groups	3,028.8	1,009.6	0.797	0.495
		within groups	2,266,253.4	1,266.8		
2018	1	between groups	575.2	191.7	0.196	0.899
		within groups	1,872,139.1	977.1		
	2	between groups	4,442.7	1,480.9	1.961	0.118
		within groups	1,523,798.6	755.1		
	3	between groups	2,636.8	878.9	1.642	0.178
		within groups	1,138,906.3	535.2		
	4	between groups	2,173.6	724.5	1.812	0.143
		within groups	882,398.1	399.8		
2019	1	between groups	452.6	150.9	0.171	0.916
		within groups	1,944,314.6	880.2		
	2	between groups	4,576.6	1,525.5	1.301	0.273
		within groups	2,601,289.9	1,172.8		
	3	between groups	11,678.0	3,892.7	2.577	0.052
		within groups	3,384,962.6	1,510.5		
	4	between groups	20,167.8	6,722.6	3.091	0.026*
		within groups	4,915,656.6	2,175.1		
2020	1	between groups	13,579.0	4,526.3	2.417	0.065
		within groups	4,393,336.0	1,872.7		
	2	between groups	34,328.1	11,442.7	3.809	0.010**
		within groups	7,291,495.7	3,004.3		
	3	between groups	25,268.3	8,422.8	2.969	0.031*
		within groups	7,006,989.2	2,836.8		
	4	between groups	26,066.3	8,688.8	2.696	0.044*
		within groups	8,024,404.4	3,222.7		
2021	1	between groups	5,160.8	1,720.3	0.557	0.643
		within groups	8,764,102.6	3,087.0		
	2	between groups	18,513.0	6,171.0	1.446	0.228
		within groups	12,302,021.4	4,268.6		
	3	between groups	170,732.5	56,910.8	11.345	0.001***
		within groups	15,169,481.8	5,016.4		
	4	between groups	46,708.3	15,569.4	4.841	0.002**
		within groups	10,159,276.6	3,216.0		

Data Source: This Research. p*<0.05, p**≤0.01, p***≤0.001.

In order to identify which A-group having higher or lower stock return rate, the multiple comparisons of ANOVA on the stock return rate between any two A-groups in the six quarters of which the stock return rate variances between A-groups are of significance as shown in Table 10.

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

Year	Quarter	A-group (I)	A-group (J)	Stock Return Rate (%)		
				Mean Diff. (I-J)	Std. Error	p
2019	4	#2	#1	7.079	2.838	0.013*
		#3	#1	4.261	2.852	0.135
		#3	#2	-2.818	2.717	0.300
		#4	#1	7.886	2.843	0.006**
		#4	#2	0.807	2.707	0.766
		#4	#3	3.625	2.722	0.183
2020	2	#2	#1	3.130	3.162	0.322
		#3	#1	3.209	3.064	0.295
		#3	#2	0.079	3.268	0.981
		#4	#1	10.065	3.044	0.001***
		#4	#2	6.935	3.249	0.033*
		#4	#3	6.856	3.153	0.030*
	3	#2	#1	2.561	3.047	0.401
		#3	#1	7.151	2.993	0.017*
		#3	#2	4.590	3.048	0.132
		#4	#1	7.575	3.012	0.012*
		#4	#2	5.014	3.067	0.102
		#4	#3	0.424	3.013	0.888
	4	#2	#1	4.392	3.298	0.183
		#3	#1	3.356	3.180	0.291
		#3	#2	-1.036	3.220	0.748
		#4	#1	9.030	3.220	0.005**
		#4	#2	4.639	3.260	0.155
		#4	#3	5.674	3.140	0.071
2021	3	#2	#1	-10.335	3.626	0.004**
		#3	#1	-15.193	3.644	0.001***
		#3	#2	-4.857	3.637	0.182
		#4	#1	-20.360	3.644	0.001***
		#4	#2	-10.024	3.637	0.006**
		#4	#3	-5.167	3.655	0.158
	4	#2	#1	-4.142	2.846	0.146
		#3	#1	-6.770	2.844	0.017*
		#3	#2	-2.628	2.856	0.358
		#4	#1	-10.527	2.848	0.001***
		#4	#2	-6.385	2.861	0.026*
		#4	#3	-3.757	2.858	0.189

Data Source: This Research. $p^* < 0.05$, $p^{**} \leq 0.01$, $p^{***} \leq 0.001$.

In 2019Q4, the stock return rate variances between A-groups #2 and #1, between A-groups #4 and #1, 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 #1 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 #1 has the lowest stock return rate mean.

In 2020Q3, the stock return rate variances between A-groups #3 and #1, between A-groups #4 and #1, 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 higher stock return rate mean while A-group #1 has lower stock return rate mean.

In 2020Q4, the stock return rate variance between between A-groups #4 and #1 is 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 higher stock return rate mean while A-group #1 has lower stock return rate mean.

In 2021Q3, the stock return rate variances between A-groups #2 and #1, between A-groups #3 and #1, 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 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 2021Q4, the stock return rate variances between A-groups #3 and #1, 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 #1 has the highest stock return rate mean while A-group #4 has the lowest stock return rate mean.

In the six quarters of which the stock return rate variances between A-groups are of significance, A-group #4 shows the highest and higher stock return rate means in four quarters whereas A-group #4 also shows the lowest or lower stock return rate means in two quarters; A-group #1 shows the highest or higher stock return rate means in two quarters whereas A-group #1 also shows the lowest or lower stock return rates in four quarters. In general, the average drawing count of utility model grants is not an appropriate patent indicator for differentiating A-share's stock return rate. The A-shares having higher average drawing counts of utility model grants do not mostly show either higher or lower stock return rate means while the A-shares having lower average drawing counts of utility model grants do not show either lower or higher stock return rate means.

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 5 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 5 denote the stock return rates thereof higher than the market trend, while the negative values denote the stock return rates thereof lower than the market trend. It seems that different T-groups have different stock return rates. T-group #4 shows the highest stock return rate means in most quarters, however, it is not easy to identify the T-group which usually showing 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: T-group's stock return rate means in every quarter from 2017Q1 to 2021Q4

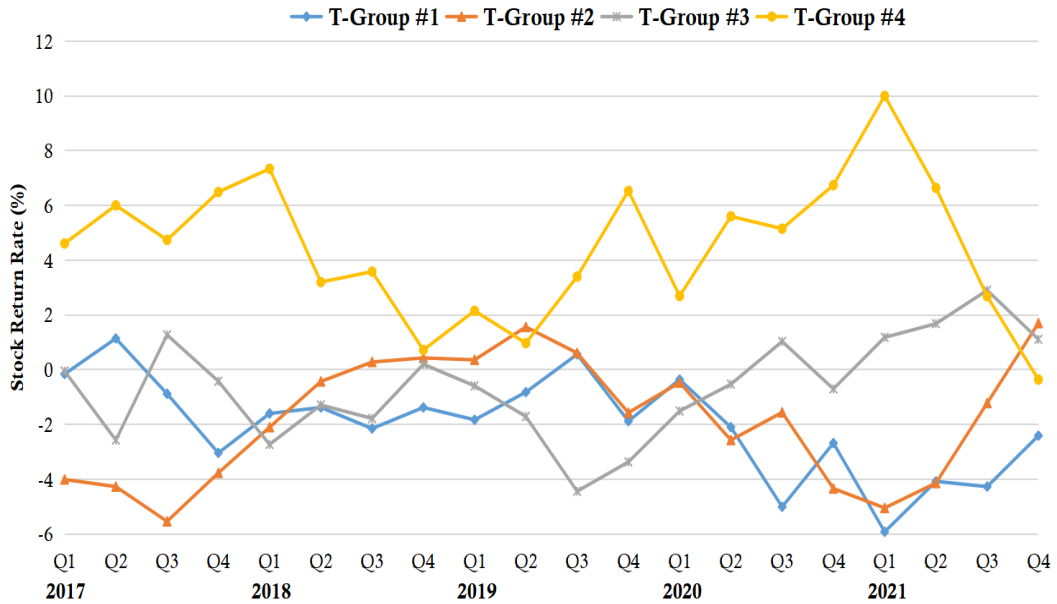| Year	Quarter	Stock return rate mean (%)				
		T-group #1	T-group #2	T-group #3	T-group #4	All groups
2017	1	-2.09	-5.94	-1.98	2.68	-1.93
	2	-10.07	-15.48	-13.78	-5.21	-11.21
	3	-9.07	-13.73	-6.92	-3.45	-8.19
	4	-20.32	-21.05	-17.70	-10.79	-17.28
2018	1	-23.64	-24.14	-24.77	-14.70	-22.04
	2	-29.30	-28.35	-29.21	-24.72	-27.92
	3	-39.13	-36.70	-38.76	-33.40	-36.98
	4	-38.41	-36.60	-36.83	-36.31	-37.03
2019	1	-18.37	-16.18	-17.13	-14.39	-16.54
	2	-3.36	-0.98	-4.25	-1.57	-2.54
	3	5.35	5.40	0.35	8.19	4.79
	4	20.04	20.35	18.55	28.45	21.92
2020	1	-6.60	-6.71	-7.75	-3.55	-6.24
	2	7.90	7.43	9.47	15.60	10.00
	3	16.02	19.47	22.06	26.18	21.03
	4	14.28	12.62	16.26	23.70	16.96
2021	1	12.19	13.06	19.29	28.11	18.11
	2	14.79	14.73	20.55	25.51	18.87
	3	10.89	13.94	18.06	17.84	15.16
	4	19.70	23.81	23.22	21.75	22.11

Data Source: This Research

Figure 5: 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 variance between four different T-groups from 2017Q1 to 2018Q3, in 2019Q3 and 2019Q4, and from 2020Q2 to 2021Q2 are of significance whereas the stock return rate variances between four different T-groups in the other six quarters are free of significance. In all twenty quarters, there are fourteen quarters in which the stock return rate variances between different T-groups are of significance, the rate of significance is 70%. The total drawing count of utility model grants might be applied as an indicator for differentiating China A-share's stock return rate.

Table 12: ANOVA on stock return rate between four T-groups in each quarter from 2017Q1 to 2021Q4

Year	Quarter	T-group	Stock return rate (%)			
			Sum square	Mean square	F	p
2017	1	between groups	14,295.8	4,765.3	3.654	0.012*
		within groups	2,157,176.7	1,304.2		
	2	between groups	24,759.9	8,253.3	6.594	0.001***
		within groups	2,096,366.3	1,251.6		
	3	between groups	23,659.8	7,886.6	6.640	0.001***
		within groups	2,027,371.4	1,187.7		
	4	between groups	30,639.4	10,213.1	8.162	0.001***
		within groups	2,238,642.8	1,251.3		
2018	1	between groups	30,095.4	10,031.8	10.431	0.001***
		within groups	1,842,618.9	961.7		
	2	between groups	6,979.9	2,326.6	3.086	0.026*
		within groups	1,521,261.4	753.8		
	3	between groups	11,068.9	3,689.6	6.945	0.001***
		within groups	1,130,474.1	531.2		
	4	between groups	1,466.0	488.7	1.221	0.300
		within groups	883,105.8	400.1		
2019	1	between groups	4,657.8	1,552.6	1.768	0.151
		within groups	1,940,109.4	878.3		
	2	between groups	3,834.9	1,278.3	1.090	0.352
		within groups	2,602,031.6	1,173.1		
	3	between groups	17,932.4	5,977.5	3.965	0.008**
		within groups	3,378,708.2	1,507.7		
	4	between groups	35,181.1	11,727.0	5.408	0.001**
		within groups	4,900,643.3	2,168.4		
2020	1	between groups	5,151.7	1,717.2	0.915	0.433
		within groups	4,401,763.3	1,876.3		
	2	between groups	24,990.2	8,330.1	2.769	0.040*
		within groups	7,300,833.6	3,008.2		
	3	between groups	34,543.5	11,514.5	4.064	0.007**
		within groups	6,997,714.0	2,833.1		
	4	between groups	47,119.2	15,706.4	4.887	0.002**
		within groups	8,003,351.6	3,214.2		
2021	1	between groups	115,002.3	38,334.1	12.575	0.001***
		within groups	8,654,261.1	3,048.3		
	2	between groups	58,083.3	19,361.1	4.550	0.003**
		within groups	12,262,451.2	4,254.8		
	3	between groups	26,787.0	8,929.0	1.763	0.152
		within groups	15,313,427.3	5,064.0		
	4	between groups	7,999.3	2,666.4	0.826	0.479
		within groups	10,197,985.6	3,228.2		

Data Source: This Research. p*<0.05, p**≤0.01, p***≤0.001.

In order to identify which T-group having higher or lower stock return rate, the multiple comparisons of ANOVA on the stock return rate between any two T-groups in the fourteen quarters of which the stock return rate variance between T-groups are of significance as shown in Table 13.

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

Year	Quarter	T-group (I)	T-group (J)	Stock return rate (%)		
				Mean Diff. (I-J)	Std. Error	p
2017	1	#2	#1	-3.847	2.447	0.116
		#3	#1	0.106	2.431	0.965
		#3	#2	3.953	2.532	0.119
		#4	#1	4.765	2.506	0.057
		#4	#2	8.613	2.604	0.001**
		#4	#3	4.659	2.588	0.072
	2	#2	#1	-5.408	2.398	0.024*
		#3	#1	-3.711	2.385	0.120
		#3	#2	1.697	2.456	0.490
		#4	#1	4.861	2.438	0.046*
		#4	#2	10.269	2.507	0.001***
		#4	#3	8.572	2.496	0.001***
	3	#2	#1	-4.665	2.388	0.051
		#3	#1	2.146	2.357	0.363
		#3	#2	6.811	2.371	0.004**
		#4	#1	5.619	2.344	0.017*
		#4	#2	10.284	2.357	0.001***
		#4	#3	3.472	2.326	0.136
	4	#2	#1	-0.726	2.405	0.763
		#3	#1	2.625	2.403	0.275
		#3	#2	3.351	2.376	0.159
		#4	#1	9.534	2.356	0.001***
		#4	#2	10.260	2.327	0.001***
		#4	#3	6.909	2.326	0.003**
2018	1	#2	#1	-0.504	1.922	0.793
		#3	#1	-1.132	1.985	0.568
		#3	#2	-0.628	2.010	0.755
		#4	#1	8.943	2.010	0.001***
		#4	#2	9.447	2.034	0.001***
		#4	#3	10.075	2.094	0.001***

	2	#2	#1	0.951	1.701	0.576
		#3	#1	0.089	1.723	0.959
		#3	#2	-0.862	1.743	0.621
		#4	#1	4.578	1.713	0.008**
		#4	#2	3.627	1.733	0.037*
		#4	#3	4.489	1.755	0.011*
	3	#2	#1	2.428	1.423	0.088
		#3	#1	0.370	1.414	0.794
		#3	#2	-2.058	1.407	0.144
		#4	#1	5.731	1.417	0.001***
		#4	#2	3.303	1.411	0.019*
		#4	#3	5.361	1.401	0.001***
2019	3	#2	#1	0.048	2.312	0.984
		#3	#1	-4.998	2.307	0.030*
		#3	#2	-5.046	2.307	0.029*
		#4	#1	2.841	2.329	0.223
		#4	#2	2.794	2.329	0.230
		#4	#3	7.839	2.324	0.001***
	4	#2	#1	0.308	2.833	0.913
		#3	#1	-1.490	2.775	0.591
		#3	#2	-1.798	2.766	0.516
		#4	#1	8.412	2.776	0.002**
		#4	#2	8.104	2.767	0.003**
		#4	#3	9.902	2.708	0.001***
2020	2	#2	#1	-0.474	3.110	0.879
		#3	#1	1.565	3.109	0.615
		#3	#2	2.038	3.134	0.515
		#4	#1	7.696	3.162	0.015*
		#4	#2	8.170	3.187	0.010**
		#4	#3	6.131	3.186	0.054
	3	#2	#1	3.451	3.069	0.261
		#3	#1	6.048	3.031	0.046*
		#3	#2	2.597	3.050	0.395
		#4	#1	10.161	3.006	0.001***
		#4	#2	6.710	3.026	0.027*
		#4	#3	4.113	2.986	0.169
	4	#2	#1	-1.655	3.317	0.618
		#3	#1	1.980	3.301	0.549
		#3	#2	3.634	3.198	0.256
		#4	#1	9.420	3.243	0.004**
		#4	#2	11.075	3.139	0.001***
		#4	#3	7.440	3.122	0.017*

2021	1	#2	#1	0.870	2.915	0.765
		#3	#1	7.097	2.920	0.015*
		#3	#2	6.227	2.941	0.034*
		#4	#1	15.919	2.917	0.001***
		#4	#2	15.049	2.939	0.001***
		#4	#3	8.822	2.943	0.003**
	2	#2	#1	-0.061	3.426	0.986
		#3	#1	5.758	3.427	0.093
		#3	#2	5.819	3.437	0.091
		#4	#1	10.719	3.432	0.002**
		#4	#2	10.780	3.441	0.002**
		#4	#3	4.961	3.443	0.150

Data Source: This Research. $p* < 0.05$, $p** \leq 0.01$, $p*** \leq 0.001$

In 2017Q1, the stock return rate variance between T-groups #4 and #2 is of significance; whereas the stock return rate variances between any other two T-groups are free of significance. According to the significant mean difference, T-group #4 has higher stock return rate mean while T-group #2 has lower stock return rate mean.

In 2017Q2, the stock return rate variances between T-groups #2 and #1, 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 mean while T-group #2 has the lowest stock return rate mean.

In 2017Q3, the stock return rate variances between T-groups #3 and #2, between T-groups #4 and #1, between T-groups #4 and #2, 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 mean while T-group #2 has the lowest stock return rate mean.

From 2017Q4 to 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; while 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 #2 has the lowest stock return rate mean in 2017Q4, T-group #3 has the lowest stock return rate mean in 2018Q1, T-group #1 has the lowest stock return rate means in 2018Q2 and 2018Q3.

In 2019Q3, the stock return rate variances between T-groups #3 and #1, between T-groups #3 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 mean while T-group #3 has the lowest stock return rate mean.

In 2019Q4, 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; while 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 mean while T-group #3 has the lowest stock return rate mean.

In 2020Q2, the stock return rate variances between T-groups #4 and #1, between T-groups #4 and #2, 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 #2 has lower stock return rate mean.

In 2020Q3, the stock return rate variances between T-groups #3 and #1, between T-groups #4 and #1, between T-groups #4 and #2, 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 mean while T-group #1 has the lowest stock return rate mean.

In 2020Q4, 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 mean while T-group #2 has the lowest stock return rate mean.

In 2021Q1, the stock return rate variance between T-groups #4 and #1 is free of significance; whereas 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 2021Q2, the stock return rate variances between T-groups #4 and #1, between T-groups #4 and #2, are free 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 #2 has lower stock return rate mean.

In fourteen 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 quarters, T-group #2 shows the lowest or lower stock return rate means in seven quarters, T-group #1 shows the lowest or lower stock return rate means in four quarters, T-group #3 shows the lowest or lower stock return rate means in three quarters.

In general, the total drawing count of utility model grants is an appropriate patent indicator for differentiating A-share's stock return rate. The A-shares in the utility model grant's T-group of the highest total drawing counts, i.e. T-group #4, mostly show the highest or higher stock return rate mean while the A-shares in the utility model grant's T-groups of lower total drawing counts, i.e. T-groups #1 and #2, usually show lower stock return rate mean.

4. Conclusion

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 utility model grant patent's drawing count 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 sample 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 patent were excluded. Two kinds of patent drawing counts of utility model grants were discussed, wherein, the average drawing count was defined as the average number of drawings per utility model grant of an A-share and the total drawing count was defined as the total number of all utility model grant'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 (average drawing groups) and four T-groups (total drawing groups), wherein, group #1 was the group of the lowest drawing counts while group #4 was the group of the highest drawing counts. The following conclusions were arrived:

1. With regard to any of A-groups, A-shares in different years from 2017 to 2021 showed significantly different average drawing count means. The average drawing count mean of any of A-groups #1, #2, #3 and #4 gradually increased significantly from 2017 to 2021. When taking the patent drawing count as an indicator of patent quality, the utility model grant's patent quality of China A-shares gradually increased significantly over previous five years.

2. With regard to any of T-groups, A-shares in different years from 2017 to 2021 showed significantly different total drawing count means. The total drawing count mean of any of T-groups #1, #2, #3 and #4 also gradually increased significantly from 2017 to 2021.

3. Though COVID-19 pandemic impacted the world since the beginning of 2020, the significantly increasing trend of the average drawing count and the total drawing count of China A-share's utility model grants had not been affected.

4. In all twenty quarters from 2017Q1 to 2021Q4, there were only six quarters in which the stock return rate variances between different A-groups were of significance, the rate of significance was 30%. In addition, it was not able to identify which A-group usually showing higher or lower stock return rate mean. The average drawing count of utility model grants was not an appropriate indicator for differentiating China A-share's stock return rate.

5. In all twenty quarters from 2017Q1 to 2021Q4, there were fourteen quarters in which the stock return rate variances between different T-groups were of significance, the rate of significance was 70%. In these fourteen quarters of significance, T-group #4 showed the highest or higher stock return rate means in all quarters, while T-groups #1 and #2 showed the lowest or lower stock

return rate means in eleven quarters.

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

In practice, the number of patent 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 of utility model grants usually resulted from few utility model grants with more drawings in them. More drawings in an utility model grant were usually accompanied with more claims. Such utility model grants 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 attorneys and the patent applicants, especially the listed company applicants. The patent attorney could suggest clients to file more but small utility model applications rather than to file few but complicated utility model applications with lots of drawings therein. The listed companies would not struggle anymore in deciding to file few but complicated utility model applications or to file many and simple utility model applications, because higher average drawing count of utility model grants did not significantly connected with higher stock return rate whereas higher total drawing count of utility model grants did.

Since higher total drawing count of an A-share usually resulted from more patents, it meant that patent quantity, especially the utility model grants, still mattered for China A-shares. The finding of this research would enrich the understanding of China utility model grant patents and the innovation behaviour of China A-shares in the recent years. It would also contribute the state of art in evaluating listed companies and help financial organizations improve their investment strategy.

ACKNOWLEDGEMENTS

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