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Size Effect and Firm Size
– new relationship with the value effect –

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Abstract

This article analyses the size effect in the Japanese equity market using a similar approach to Berk (1997). The major outcome of this analysis is as follows: (1) a size effect similar to Berk (1997) is also demonstrated in the recent Japanese equity market; and (2) taking the value effect into consideration, unlike Berk (1997), the existence of a small size effect based on either book value or amount of sales is suggested.

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1. Introduction

It is a well-known fact that the size effect exists in a stock market as an anomaly, as well as the value effect. Generally, this is defined as a phenomenon where the performance of a relatively small company (based on market value) exceeds that of a large company.

Starting with Banz (1981), the existence of the size effect has been indicated in a number of publications. In addition, Fama and French (1993) shows that this concept of the size effect is a risk premium for small stocks. On the basis of the ICAPM framework, Ferguson and Shockley (2003) attempted to show that the credit risk premium, which might be included in the size effect, appears as an anomaly. The size effect can be confirmed as a phenomenon, and it is easily and intuitively accepted that it reflects a credit risk premium. As a consequence, the mentioned concepts can be considered as common today.

On the other hand, there is a study that is skeptical about the concept based on market capitalization, and which admits to the fact that a small company (by market value) can achieve good performance. Focusing on this point as to whether market capitalization is an appropriate indicator to measure firm size, Berk (1997) studied whether such a size effect can exist where book value or sales are used as a size measurement indicator of a firm. This study, using US data, where book value or sales are used as an indicator, showed that the size effect significantly weakens when compared to market capitalization as a standard. Additionally, in view of the difference in market capitalization, when the size effect based on book value or sales was examined, the study showed that results which should be expressed conversely as the large-sized stock effect were obtained.

Gómez, Hodoshima, and Kunimura (1998) applied this analysis to Japan. Using data between 1957 and 1993, this study confirmed that Berk (1997) can also be applied to stock markets in Japan.

Additionally, Arnott, Hsu, and Moore (2005) showed that firm size should not be identified with market capitalization by presenting an advantage of the index based on fundamental size indicators such as book value or sales instead of market capitalization.

Based on the analysis conducted by Berk (1997), this article used recent 19-year data to examine the relationship between size effect and size indicator in Japan. The next section considers the survey conducted in Berk's study (1997), and then section three applies its analysis to stock markets in Japan. Sections 3.1 and 3.2 consider the analyses in accordance with Berk (1997), and examine whether a similar relationship, regarding market capitalization and firm size, can be observed in recent stock markets in Japan. With the analytical results obtained up to section 3.2, section 3.3 examines the relationship between the size effect and value effect. As a result, the large-sized stock effect, based on market capitalization-adjusted

book value and sales, has also been confirmed in Japan. It has been found that this result was almost an aspect of the value effect. Furthermore, where the relationship with the value effect is taken into consideration, it has been indicated that the size effect exists in market capitalization, book value, and sales. As a result of examining the relationship with the value effect through data from Japan, which had not been referred to in previous research, the results derived differed, not only from Berk (1997), but also from that of Gomez, Hodoshima, and Kunimura (1998). This point can be considered as a very interesting discovery. Finally, section four gives conclusions and discusses future issues.

2. Survey

The basis of Berk's claim (1997) lies in the point that the difference between market capitalization and firm size and the relationship are based on financial theory. The outline of this claim is as follows.

According to traditional financial theory, market capitalization is defined as the present value of future cash flows. Although no clear definition for firm size can be found, it can be measured by the size of corporate book value or the amount of sales. In addition, it is believed that there is a high correlation between firm size and cash flow which is the foundation for calculating market capitalization. For example, it is easy to understand intuitively that the larger the sales of a company become, the more future cash flow can be obtained. When assuming that sales and cash flow have a definite positive correlation, and there exists a difference in the market capitalization of two companies having the same level of sales, the cause can be attributed to the discount rate. In other words, it is thought that the higher the discount rate becomes, the smaller market capitalization becomes. A discount rate means the expected return which the market requires in order to accept risk. Therefore, a company having a high discount rate becomes synonymous with a company having a high expected return. Hence, even if no anomaly effect is observed in firm size itself, a small company (by market value) outperforms a large company (by market value) in an ex-post way, which is known as the size effect. Berk indicated that the size effect is a natural consequence of financial theory. Berk actually confirmed this assumption, which can be viewed as a very interesting result, by using US data for 20 years from 1967 through 1987.[1]

This analysis broadly consists of two viewpoints. The first uses three firm size indicators, namely market capitalization, book value, and sales, to examine each size effect. Building the decile portfolios that are rebalanced annually based on the size of each indicator at end-June, the performance of each portfolio was compared under the condition where the strategy of what was

[1] *For listed stocks on the New York Stock Exchange, the CRSP database is used for returns and market capitalization, and Compustat data for book value and sales.*

bought and held for one year would be continued for 20 years. The comparison showed that the size effect based on market capitalization rather than book value and sales resulted in an outstanding performance. Furthermore, to distinguish market capitalization effect from book value and sales effects, the second analysis builds quintile portfolios. Afterwards, the double sorting method is used to divide respective quantile portfolios into five more quantiles with another indicator. Upon measuring the market capitalization-adjusted book value effect, for example, quintile portfolios are built first with market capitalization. Next, a total of 25 quantile portfolios are built by dividing each into five more quantiles with a book value. With this analysis, although the size effect has been observed among the book value-adjusted or sales-adjusted market capitalization quantile portfolios, an unexpected result was obtained that the larger stocks become, the better the performance achieved among the market capitalization-adjusted book value or sales quantile portfolios. On the assumption that the correlations between cash flows and book value or cash flows and sales are sufficiently high, small companies (by market value) exhibited a good performance despite having the same level of book value and sales. Also, large companies by book value and sales posted a good performance despite having the same level of market capitalization. Such companies had large discount rates as indicated in Berk. These results confirmed the discussion.

3. Data and Empirical Analysis

3.1 Effects of market capitalization and firm size in the Japanese market

For this article, data regarding domestically-listed stocks (including JASDAQ) covering 1986 to 2005 was examined.[2] Based on the fact that most companies' accounting periods were concentrated on the month of March, book value and sales were extracted from the latest accounting data in the end of each September as the mid-point.[3] The market capitalization at the end of each September was used. Performance was measured for one year from the end of September to the end of the following September, and those companies that continued to exist during the relevant year were the targets of this measurement. The number of target companies was from 1,500 to 3,500 every year. In view of the number of listed companies that went bankrupt in the course of the year, survivorship bias was considered to have had only a limited effect.

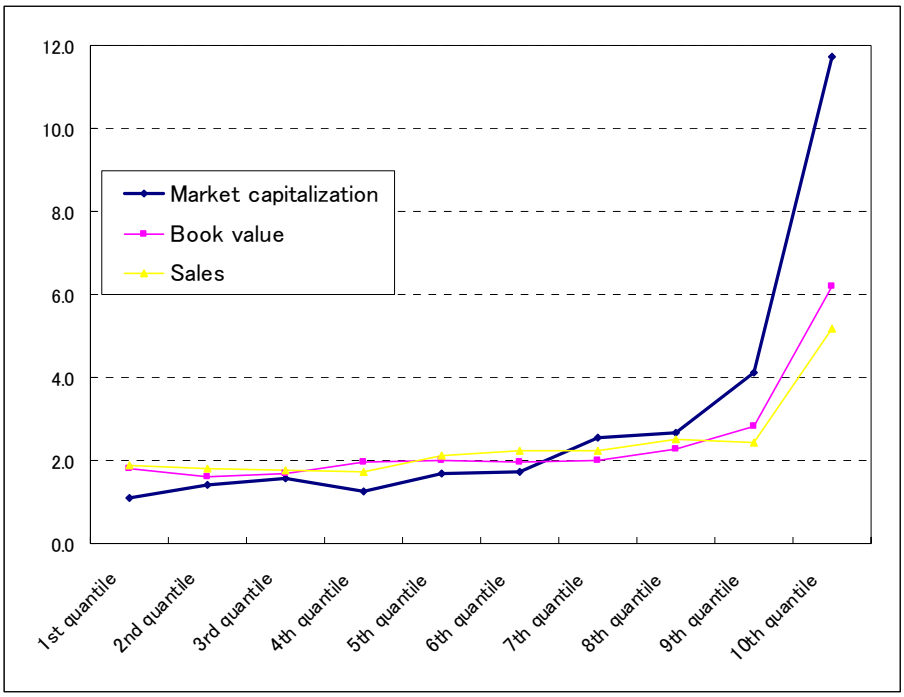
At first, the decile portfolios including the same number of listed stocks were built in descending order by three indicators, market capitalization, book value, and sales. In order to manage one yen for 19 years rebalancing annually at end-September, one yen was invested in

[2] *Book value and sales were created by the author based on NIKKEI NEEDS and AMSUS data.*
[3] *Consolidated data was used where consolidated accounting was available, if not, non-consolidated accounting data was used. This examination is pursuant to Berk (1997), which conducted analysis based on end-June US data where accounting is settled in the business year ending 31 December.*

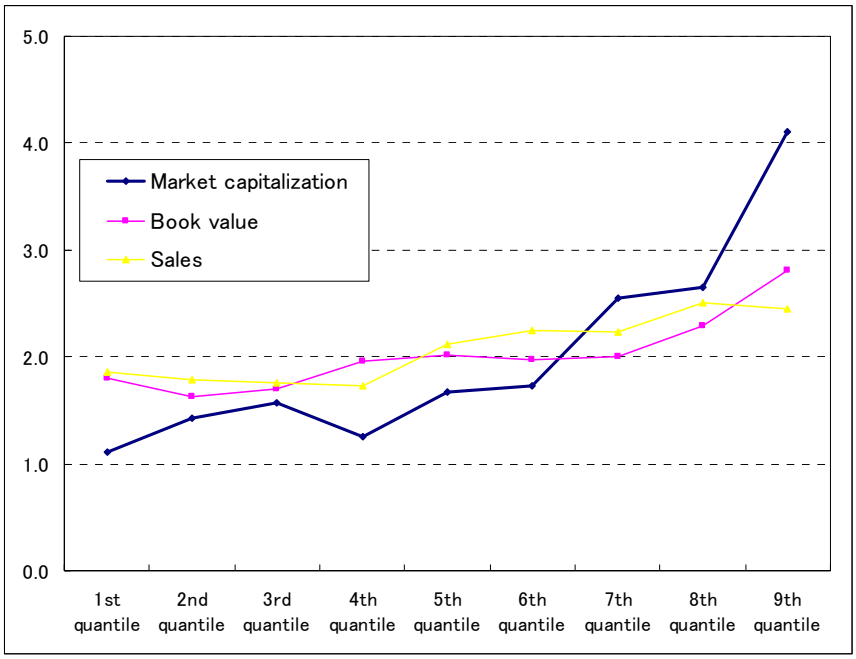
each quantile at end-September 1986; **Figure 1** shows what the value of that one yen would have been at end-September 2005. **Figure 1 (a)** graphically shows respective management results between the first quantile and tenth quantile of each indicator. According to this figure, compared to book value and sales, a significant size effect was obtained in the quantile portfolio based on market capitalization. In this regard, however, each indicator achieved good performance in the tenth quantile, which is the minimum portfolio. Given that, **Figure 1 (b)** that removes the result of the tenth quantile portfolio, is also cited here. As shown in this figure, it is clear that the size effect using market capitalization as a size indicator was observed to be significant compared to the case of using book value and sales. In other words, in stock markets in Japan, a strong position can be realized which shows that the size effect is the market capitalization effect. Then, is it impossible to confirm the size effect with a firm size indicator such as book value or sales? As far as observing graph or return rates is concerned, although the level of effect shows a small value, it is thought that a constant size effect can be confirmed in Japan even with these firm size indicators.

Figure 1: Size effect according to size indicators

(a) Performance comparison according to size



(b) Performance comparison according to size (except bottom quantile)



(c) Performance table according to size

	Max	2	3	4	5	6	7	8	9	Min	Average return
Market capitalization	1.11	1.42	1.57	1.25	1.67	1.74	2.55	2.65	4.10	11.73	2.979
Book value	1.80	1.63	1.70	1.96	2.01	1.97	2.00	2.29	2.81	6.18	2.437
Sales	1.86	1.78	1.76	1.73	2.12	2.24	2.23	2.51	2.45	5.20	2.388

3.2 Market capitalization-adjusted firm size effect

Each effect of the three indicators is confirmed as in the previous section, considering that any of them is a proxy variable for firm size, and each effect can be viewed as overlapping. Therefore, the effect after overlapping is removed has to be measured.

In this regard, based on Berk (1997), quintile portfolios were first built and then double sorting utilized to build 25 quantile portfolios by dividing each respective quantile portfolio into five by another indicator. Through this process we can confirm whether there is an effect in the indicator in the second stage, after removing the effect in the first stage indicator. It is believed that the relationship between firm size and market capitalization can be clarified by confirming whether the size effect based on book value and sales exists after removing the influence of market capitalization, or the contrary, by confirming whether the size effect based on market capitalization exists after removing the influences of book value and sales.

In **tables 1** and **2**, the quintile portfolios are built based on book value and sales, after building the quintile portfolios with market capitalization. Then, under the condition of rebalancing annually in September, these tables summarize performance derived as a result of managing all the portfolios from 1986 to 2005. In both **tables 1** and **2**, (a) shows average return, (b) the standard deviation of return,[4] and (c) risk-adjusted returns calculated by (a) / (b), respectively. The following point is observed as common to both tables: in most cases, a large stock exceeds the performance of a small stock in terms of book value and sales effect in each quantile having the same level of market capitalization. In other words, as indicated in Berk (1997), the size effect disappears when removing the market capitalization effect; instead, the large-sized stock effect appears. Only the portfolios of the fifth quantile by market capitalization and the fifth quantile by firm size resulted in exceptionally high performance. However, this quantile is quite unique when compared to other portfolios because, for example, a relatively great number of capital deficit stocks are included. Hence, it can be viewed that this result itself does not have a decisive influence on the examination result of the entire large-sized stock effect observed.

Table 1: Book value size effect according to market capitalization quantile

(a)

Average return		Book value Max	2	3	4	Min	Average
Market capitalization	Max	0.051	0.059	0.057	0.027	0.009	0.040
	2	0.097	0.074	0.052	0.031	0.029	0.057
	3	0.112	0.104	0.067	0.057	0.037	0.076
	4	0.144	0.092	0.090	0.076	0.097	0.100
	Min	0.170	0.136	0.154	0.149	0.245	0.171
	Average	0.115	0.093	0.084	0.068	0.084	0.089
	1-4	0.101	0.082	0.066	0.048	0.043	0.068

(b)

Standard deviation		Book value Max	2	3	4	Min	Average
Market capitalization	Max	0.241	0.230	0.233	0.237	0.309	0.250
	2	0.294	0.278	0.275	0.280	0.365	0.298
	3	0.324	0.320	0.300	0.321	0.375	0.328
	4	0.329	0.296	0.316	0.340	0.396	0.335
	Min	0.352	0.347	0.381	0.384	0.500	0.393
	Average	0.308	0.294	0.301	0.312	0.389	0.321
	1-4	0.297	0.281	0.281	0.294	0.361	0.303

[4] *The standard deviation of annual return rate in each quantile was obtained.*

(c)

Risk-adjusted return		Book value Max	2	3	4	Min	Average
Market capitalization	Max	0.209	0.256	0.243	0.115	0.029	0.170
	2	0.331	0.268	0.188	0.110	0.080	0.195
	3	0.348	0.324	0.224	0.177	0.100	0.234
	4	0.437	0.310	0.286	0.223	0.246	0.300
	Min	0.484	0.392	0.404	0.388	0.490	0.432
	Average	0.362	0.310	0.269	0.203	0.189	0.266
	1-4	0.331	0.289	0.235	0.156	0.113	0.225

Table 2: Sales size effect according to market capitalization quantile

(a)

Average return		Sales Max	2	3	4	Min	Average
Market capitalization	Max	0.057	0.061	0.047	0.026	0.011	0.040
	2	0.099	0.071	0.044	0.046	0.023	0.057
	3	0.103	0.107	0.075	0.054	0.038	0.075
	4	0.127	0.109	0.101	0.094	0.067	0.100
	Min	0.179	0.162	0.128	0.158	0.227	0.171
	Average	0.113	0.102	0.079	0.076	0.073	0.089
	1-4	0.097	0.087	0.067	0.055	0.035	0.068

(b)

Standard deviation		Sales Max	2	3	4	Min	Average
Market capitalization	Max	0.260	0.229	0.227	0.238	0.288	0.248
	2	0.329	0.283	0.263	0.283	0.349	0.301
	3	0.338	0.340	0.302	0.315	0.349	0.329
	4	0.348	0.335	0.321	0.361	0.344	0.342
	Min	0.401	0.366	0.339	0.388	0.483	0.396
	Average	0.335	0.311	0.290	0.317	0.363	0.323
	1-4	0.319	0.297	0.278	0.299	0.333	0.305

(c)

Risk-adjusted return		Sales Max	2	3	4	Min	Average
Market capitalization	Max	0.219	0.268	0.206	0.110	0.038	0.168
	2	0.303	0.252	0.167	0.162	0.065	0.190
	3	0.305	0.316	0.248	0.171	0.110	0.230
	4	0.366	0.326	0.314	0.262	0.195	0.292
	Min	0.448	0.442	0.378	0.407	0.470	0.429
	Average	0.328	0.321	0.263	0.222	0.176	0.262
	1-4	0.298	0.290	0.234	0.176	0.102	0.220

Now, upon analyzing stock return, is there no information in firm size indicators associated with book value and sales? What should be noticed is the standard deviation of each quantile shown in **Table 1 (b)** and **Table 2 (b)**. Looking at **Table 1 (b)** which uses book value, despite

the large-sized stock effect being observed, almost no difference in risk was observed between the first and fourth quantiles. In the minimum quantile portion, conversely, an increased tendency for risk can be confirmed. On the other hand, in **Table 2 (b)** which uses sales, although it seems that risk increases slightly in the quantile having large sales, the minimum quantile shows the greatest risk. This means, by firm size indicators, that a company with extremely small firm size is seemingly not rewarded in spite of high risks. Hence, the large-sized stock effect clearly appears in comparisons (**Table 1 (c)** and **Table 2 (c)**) using the risk-adjusted return indicator which divided average return by standard deviation. This also allows us to interpret the result as showing that risk premium does not exist in small stocks based on book value and sales.

Tables 3 and **4** are contrary to **tables 1** and **2**, in that they show the results of the quintile portfolios based on market capitalization which were built from quintile portfolios based on book value and sales built first. The size effect based on market capitalization independent of relationships with book value and sales prominently appeared in both tables. For a different viewpoint of book value or sales, these results show the existence of size effect by market capitalization.

Table 3: Market capitalization effect according to book value quantile

(a)

Average return		Market capitalization: Max	2	3	4	Min	Average
Book value	Max	0.031	0.041	0.047	0.065	0.099	0.057
	2	0.032	0.056	0.055	0.082	0.131	0.071
	3	0.017	0.059	0.081	0.105	0.131	0.078
	4	0.016	0.059	0.104	0.097	0.176	0.090
	Min	0.070	0.090	0.134	0.161	0.275	0.146
	Average	0.033	0.061	0.084	0.102	0.162	0.089
	1-4	0.024	0.054	0.071	0.087	0.134	0.074

(b)

Standard deviation		Market capitalization: Max	2	3	4	Min	Average
Book value	Max	0.243	0.220	0.234	0.239	0.295	0.246
	2	0.295	0.284	0.273	0.301	0.343	0.299
	3	0.293	0.293	0.306	0.319	0.326	0.307
	4	0.362	0.310	0.336	0.323	0.369	0.340
	Min	0.430	0.374	0.384	0.395	0.482	0.413
	Average	0.324	0.296	0.307	0.315	0.363	0.321
	1-4	0.298	0.277	0.287	0.295	0.333	0.298

(c)

Risk-adjusted return		Market capitalization Max	2	3	4	Min	Average
Book value	Max	0.127	0.186	0.199	0.272	0.335	0.224
	2	0.110	0.197	0.201	0.273	0.383	0.233
	3	0.056	0.201	0.264	0.331	0.401	0.251
	4	0.045	0.189	0.309	0.300	0.476	0.264
	Min	0.163	0.241	0.347	0.408	0.571	0.346
	Average	0.100	0.203	0.264	0.317	0.433	0.263
	1-4	0.085	0.193	0.243	0.294	0.399	0.243

Table 4: Market capitalization effect according to sales quantile

(a)

Average return		Market capitalization Max	2	3	4	Min	Average
Sales	Max	0.030	0.045	0.059	0.080	0.104	0.064
	2	0.005	0.059	0.053	0.097	0.123	0.067
	3	0.026	0.075	0.074	0.106	0.155	0.087
	4	0.008	0.065	0.098	0.123	0.182	0.095
	Min	0.052	0.068	0.122	0.142	0.264	0.130
	Average	0.024	0.062	0.081	0.110	0.166	0.089
	1-4	0.017	0.061	0.071	0.101	0.141	0.078

(b)

Standard deviation		Market capitalization Max	2	3	4	Min	Average
Sales	Max	0.241	0.221	0.244	0.278	0.359	0.269
	2	0.239	0.261	0.286	0.312	0.365	0.293
	3	0.307	0.329	0.298	0.318	0.379	0.326
	4	0.298	0.311	0.334	0.358	0.394	0.339
	Min	0.399	0.343	0.356	0.366	0.490	0.391
	Average	0.297	0.293	0.304	0.326	0.397	0.323
	1-4	0.271	0.280	0.291	0.317	0.374	0.307

(c)

Risk-adjusted return		Market capitalization Max	2	3	4	Min	Average
Sales	Max	0.126	0.205	0.241	0.287	0.289	0.230
	2	0.020	0.226	0.184	0.311	0.338	0.216
	3	0.084	0.228	0.247	0.334	0.408	0.260
	4	0.026	0.209	0.293	0.343	0.461	0.267
	Min	0.130	0.197	0.342	0.388	0.540	0.319
	Average	0.077	0.213	0.261	0.333	0.407	0.258
	1-4	0.064	0.217	0.241	0.319	0.374	0.243

Additionally, an interesting result has been obtained comparing the standard deviations of **Table 3 (b)** and **Table 4 (b)**. In the market capitalization quantile, after removing the effects of

book value and sales, no significant difference was observed from the first to the fourth portfolios; only the minimum quantile portfolio showed a tendency of increased risk. This is the same phenomenon observed in the quantiles of book value and sales after the deduction of market capitalization; however, there is a significant difference between the two of them. In other words, the market capitalization quantile could gain a return through risk because of the size effect, whereas the large-sized stock effect is obtained in the quantile of book value and sales. A small-sized stock could not obtain a return for risk.

Such a result shows that the size effect does not affect firm size but is affected by market capitalization size, and this can be considered as evidence that the assumption of Berk (1997), which finds grounds for such results in the relationship between cash flows and expected returns, has been observed in the Japanese market. On the other hand, the increasing risk in the minimum quantile, that is thought to have a relationship with credit risk, was confirmed in both quantiles, the market capitalization quantile which was obtained by the size effect and the quantile of book value and sales which could not obtain that effect. For this reason, a more measured examination might be required to judge whether credit risk is the background for the effect of low market capitalization.[5]

3.3 Size effect and value effect

The method mentioned in the previous section, that builds double sorted portfolios of 25 quantiles on market capitalization and firm size, aimed to confirm the size effect by market capitalization-adjusted firm size or firm size-adjusted market capitalization. On the other hand, dividing a group of companies having the same level of market capitalizations into quantiles with the size of book value or sales is almost synonymous with building each quantile in descending order of the book value / market capitalization ratio (B/P) or sales / market capitalization ratio (S/P). With all companies in the universe divided into quintiles by market capitalization and each quantile divided into quintiles by book value and sales,[6] the average ratio in each of 25 quantile is shown in **Table 5**.[7] Building quantiles with market capitalization and book value, **Table 5 (a)** shows each average B/P. In **Table 5 (b)**, the average S/P of the quantiles built with market capitalization and sales is shown.

[5] *Berk claims that the existence of risk premium is inextricably linked with market capitalization, and he does not discuss the source of expected returns. The author wants to indicate that the result of this article is not one that directly denies the credit risk premium theory for the size effect.*
[6] *This is to confirm the market capitalization-adjusted size effect.*
[7] *The average value of each stocks ratio value included in a quantile portfolio.*

Table 5: Firm size / Market capitalization ratio of the 25-quantile portfolios

(a) B/P ratio according to market capitalization adjusted-book value quantile

B/P ratios		Book value Max	2	3	4	Min	Average
Market capitalization	Max	0.551	0.640	0.629	0.536	0.278	0.527
	2	1.114	0.858	0.700	0.501	0.221	0.679
	3	1.416	1.000	0.773	0.534	0.194	0.784
	4	1.675	1.139	0.870	0.607	0.251	0.909
	Min	1.824	1.248	0.996	0.746	-0.621	0.839
	Average	1.316	0.977	0.794	0.585	0.065	0.747
	1-4	1.189	0.909	0.743	0.544	0.236	0.724

(b) S/P ratio according to market capitalization adjusted-sales quantile

S/P ratios		Sales Max	2	3	4	Min	Average
Market capitalization	Max	2.856	1.132	0.846	0.679	0.343	1.171
	2	4.428	1.316	0.927	0.643	0.302	1.523
	3	5.058	1.572	1.076	0.725	0.334	1.753
	4	4.346	1.844	1.306	0.884	0.431	1.762
	Min	6.604	2.410	1.761	1.312	0.832	2.584
	Average	4.658	1.655	1.183	0.848	0.449	1.759
	1-4	4.172	1.466	1.039	0.733	0.353	1.552

According to these tables, almost all respective ratios with identical market capitalization quantiles indicate large values as firm size becomes larger.[8] This shows that large-sized stocks like members of the fifth quantile portfolios of market capitalization-adjusted book value or sales are an aggregation of value stocks. The large-sized stock effect, which Berk pointed out, may only be observing the value effect. Furthermore, when ratios of same market capitalization-adjusted firm size quantile portfolio are compared,[9] the smaller market capitalization becomes the larger the indicated ratios become. This observation suggests the possibility that the original size effect by market capitalization can even be described by the value effect.

To clarify this point, **figures 2** and **3** plot the ratio and average return of the respective quantile portfolios. **Figure 2** is a scattered plot of the 25-quantile portfolios built based on market capitalization quintiles with each quantile divided secondly into book value quintiles. **Figure 2 (a)** links the identical market capitalization quantile portfolios with dotted lines, and attaches numbers to the quantiles that are based on book value. **Figure 2 (b)** links the identical

[8] *Comparison on the horizontal axis in Table 5 is indicated.*
[9] *Comparison on the vertical axis in Table 5 is indicated.*

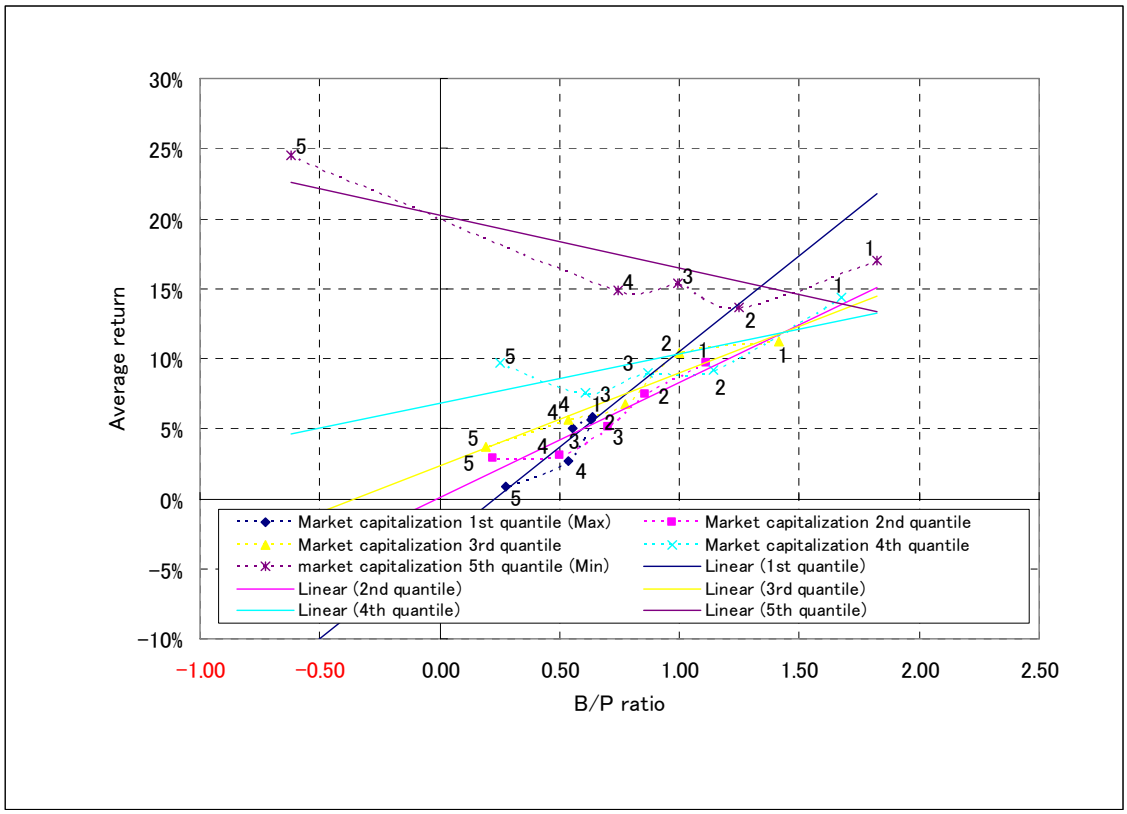
book value quantile portfolios with the dotted lines, and indicates the original market capitalization quantiles with the numbers on the graph. Additionally, the linear approximated curve is drawn in this figure for five portfolios linked with the dotted lines. Observing **Figure 2 (a)**, on the first to fourth quantile portfolios, average return improves as book value become large,[10] and, at the same time, the B/P ratio shows large values. Hence, it can be said that the large-sized stock effect indicated by Berk can be almost explained as the value effect. On the other hand, although B/P ratios increased as book value became large in the quintiles having the smallest market capitalization, the tendency for average return to drop has been recognized. In other words, the size effect appears more related to firm size than the value effect. Additionally, on the linear approximations shown in the first to fourth quantiles, the slope became moderate as market capitalization became smaller. In particular, the performance of the fifth quintile portfolio of each book value is confirmed on the upper side of the line, which indicates that other than value effect, size effect might exist.

On another front, according to **Figure 2 (b)** which shows the influence of market capitalization on standardized book value quantiles, the B/P ratio shows a smaller value as market capitalization becomes larger, so it leads to poor performance. Such a tendency is confirmed in almost all book value quantiles. Namely, it shows that the market capitalization effect within the standardized firm size largely equals the value effect. In this regard, however, the slope of the line becomes steep as standardized book value size becomes smaller. Then, a performance gap, generated due to the size of market capitalization, can be observed rather than a performance gap produced by B/P. Hence, it is possible to conclude that the smaller the book value a group of stocks has, the more the size effect based on market capitalization exists after taking into consideration the value effect. The same type of scatter plot based on the relationship between market capitalization and sales is shown in **Figure 3.** Almost the same result is also obtained here. It is observed that the smaller sales a group of companies has, the more significant the size effect becomes, rather than the value effect.

[10] *The first quantile is maximum and the fifth quantile minimum.*

Figure 2: Book value / Market capitalization ratio and return of the 25 quantile portfolios

(a) Linear approximation according to market capitalization quantiles (B/P ratio)



(b) Linear approximation according to book value quantiles (B/P ratio)

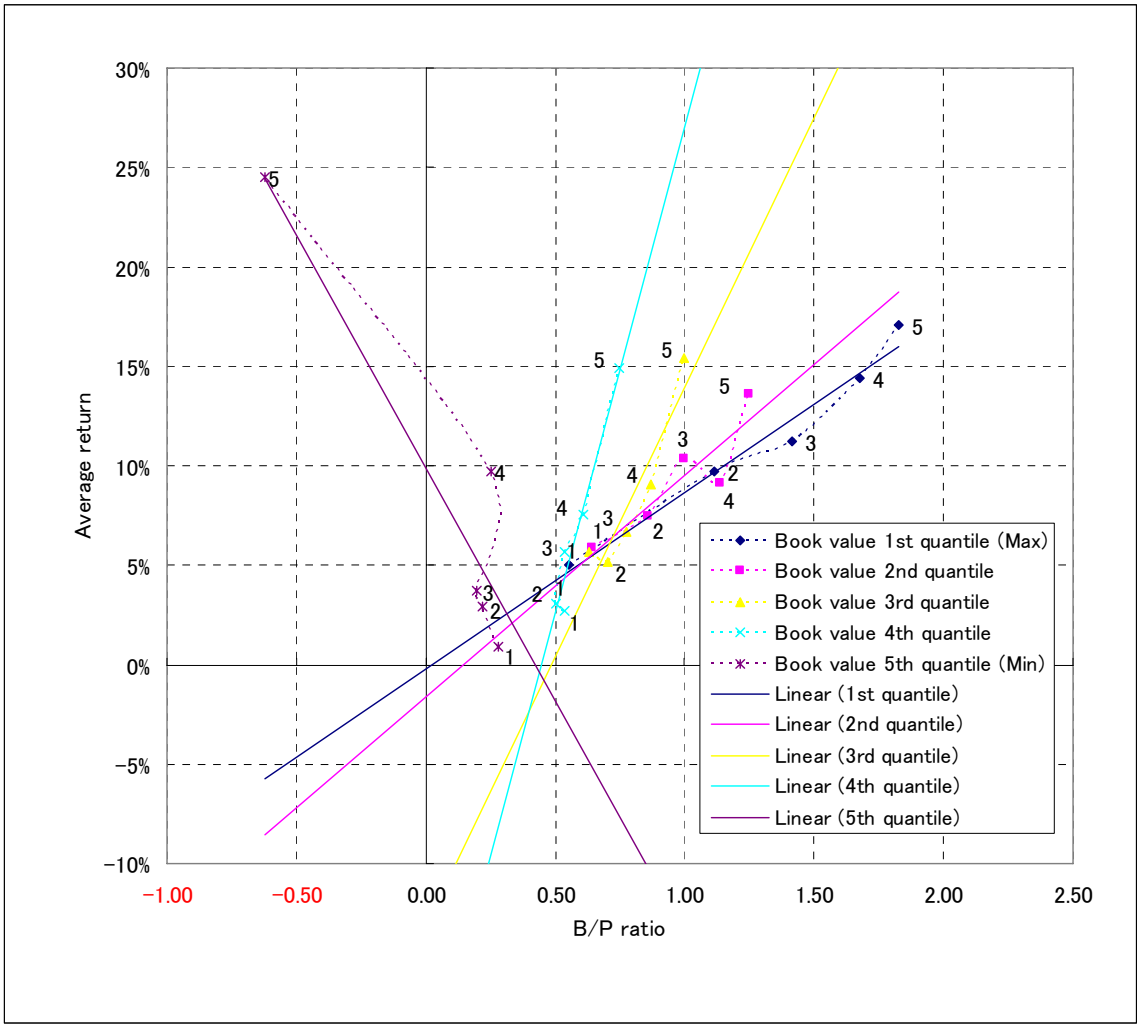
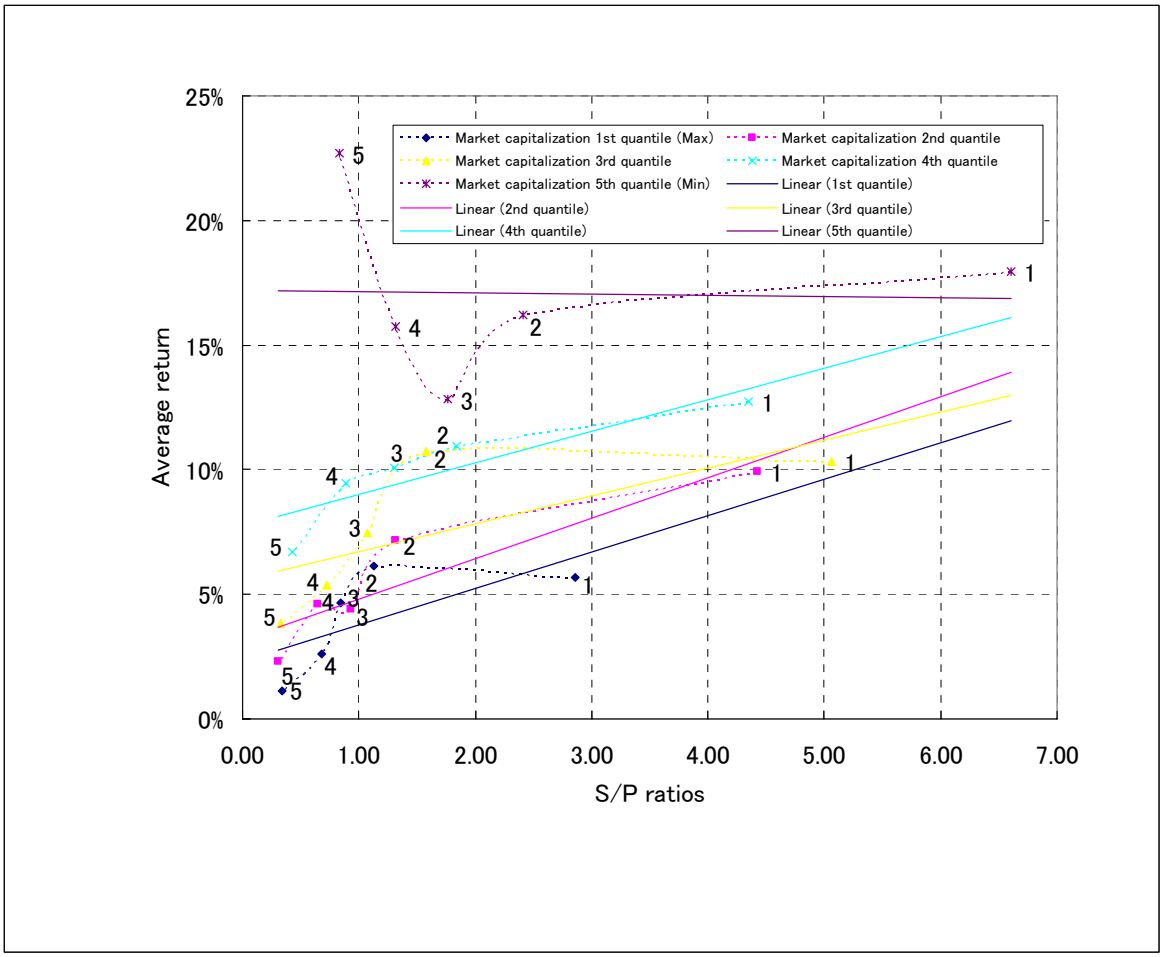
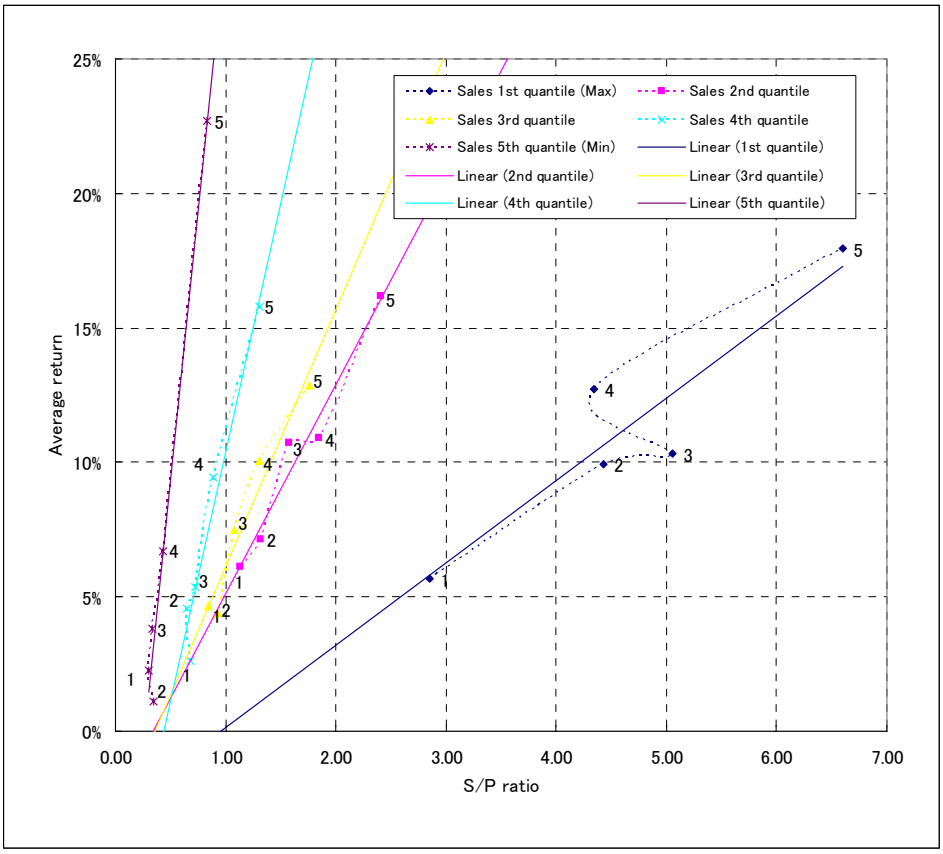


Figure 3: Sales / Market capitalization ratio and return of the 25 quantile portfolio

(a) Linear approximation according to market capitalization quantiles (S/P ratio)



(b) Linear approximation according to sales (S/P ratio)



To the contrary, the same analysis is also conducted where quintile portfolios are built with firm size (book value and sales), and then each quantile is divided into five quantiles by market capitalization. In other words, this analysis confirms the relationship between firm size-adjusted market capitalization effect and value effect. **Table 6** shows the ratio of each of the 25 quantiles. It is also confirmed that there is the tendency of value effect, because quantiles which have larger book value or sales, or smaller market capitalization, have larger ratio.

Figures 4 and **5** show these 25 portfolios by scatter plots. The relationship of **(a)** and **(b)** is similar to that in **figures 2** and **3**. Namely, **(a)** links identical firm size quantiles with dotted lines and numbers the standardized market capitalization quantiles. **(b)** links the identical standardized market capitalization quantiles with dotted lines and indicates original firm size quantiles with numbers. On the first to fourth book value quantiles in **Figure 4 (a)**, a very close result was obtained. Within each quantile, the smaller market capitalization becomes, the larger the values of the B/P ratios become with improved performance. Hence, the improvement of return can be explained as the value effect, also in the market capitalization effect standardized by firm size. On the other hand, it has been shown that the fifth quantile having the smallest

book value has higher than average profitability compared to the other portfolios having the same level of B/P. This point can also be considered when the size effect by firm size does exist, which means a company having an extremely small book value has good performance results.

Figure 4 (b) makes it easier to realize this point. In this figure, standardized market capitalization quantiles are linked with dotted lines. The aggregation of plots appears in the upper right as the quantile becomes smaller. On average, the smaller standardized market capitalization becomes, the more the B/P ratio increases. In addition, the value effect can be observed which improves performance. However, a very interesting result is obtained when observing the relationship between book value quantiles in each quantile. In stocks where a certain book value size exists (mainly in the first to third quantiles), the relationship close to the value effect is observed within a quantile. On the other hand, performance improves in quantiles having smaller book value (mainly in the fourth to fifth quantiles) even though the B/P ratio becomes relatively high compared to the first through third quantiles. In stocks with small book value, this fact suggests that there exists a notable size effect that exceeds the value effect.

Table 6: Firm size / Market capitalization ratio of the 25 quantile portfolios

(a) B/P ratios according to book value-adjusted market capitalization quantiles

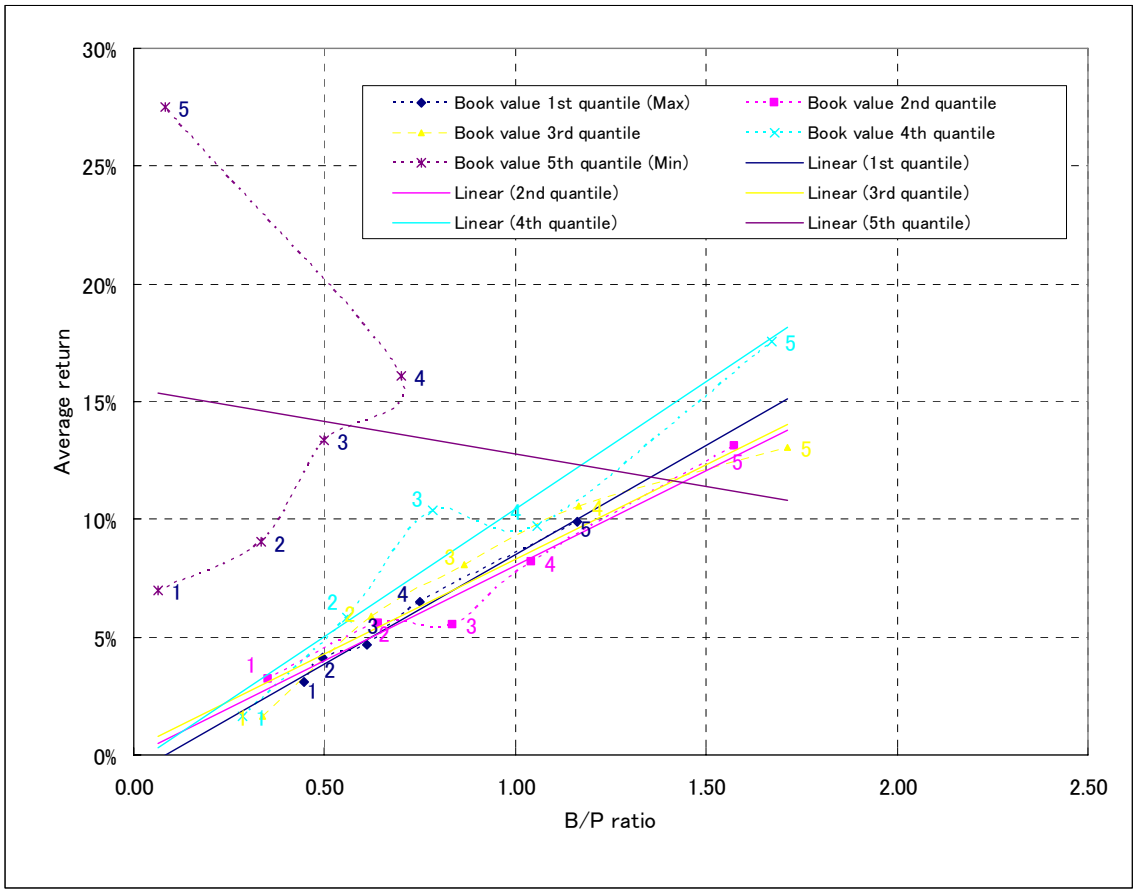
		Market capitalization					
B/P ratios		Max	2	3	4	Min	Average
Book value	Max	0.445	0.493	0.611	0.749	1.163	0.692
	2	0.353	0.639	0.836	1.041	1.575	0.889
	3	0.337	0.624	0.867	1.167	1.712	0.941
	4	0.283	0.558	0.784	1.058	1.670	0.871
	Min	0.063	0.335	0.498	0.702	0.084	0.336
	Average	0.296	0.530	0.719	0.943	1.241	0.746
	1-4	0.354	0.578	0.774	1.004	1.530	0.848

(b) S/P ratios according to sales-adjusted market capitalization quantiles

		Market capitalization					
S/P ratios		Max	2	3	4	Min	Average
Sales	Max	0.840	1.073	1.551	2.883	8.556	2.981
	2	0.452	0.864	1.264	1.904	4.751	1.847
	3	0.418	0.824	1.236	1.837	3.883	1.639
	4	0.361	0.753	1.124	1.573	3.124	1.387
	Min	0.234	0.511	0.775	1.164	1.881	0.913
	Average	0.461	0.805	1.190	1.872	4.439	1.753
	1-4	0.518	0.878	1.294	2.049	5.078	1.963

Figure 4: Book value / Market capitalization ratio and return of the 25 quantile portfolios

(a) Linear approximation according to book value quantiles (B/P ratio)



(b) Linear approximation according to market capitalization quantiles (B/P ratio)

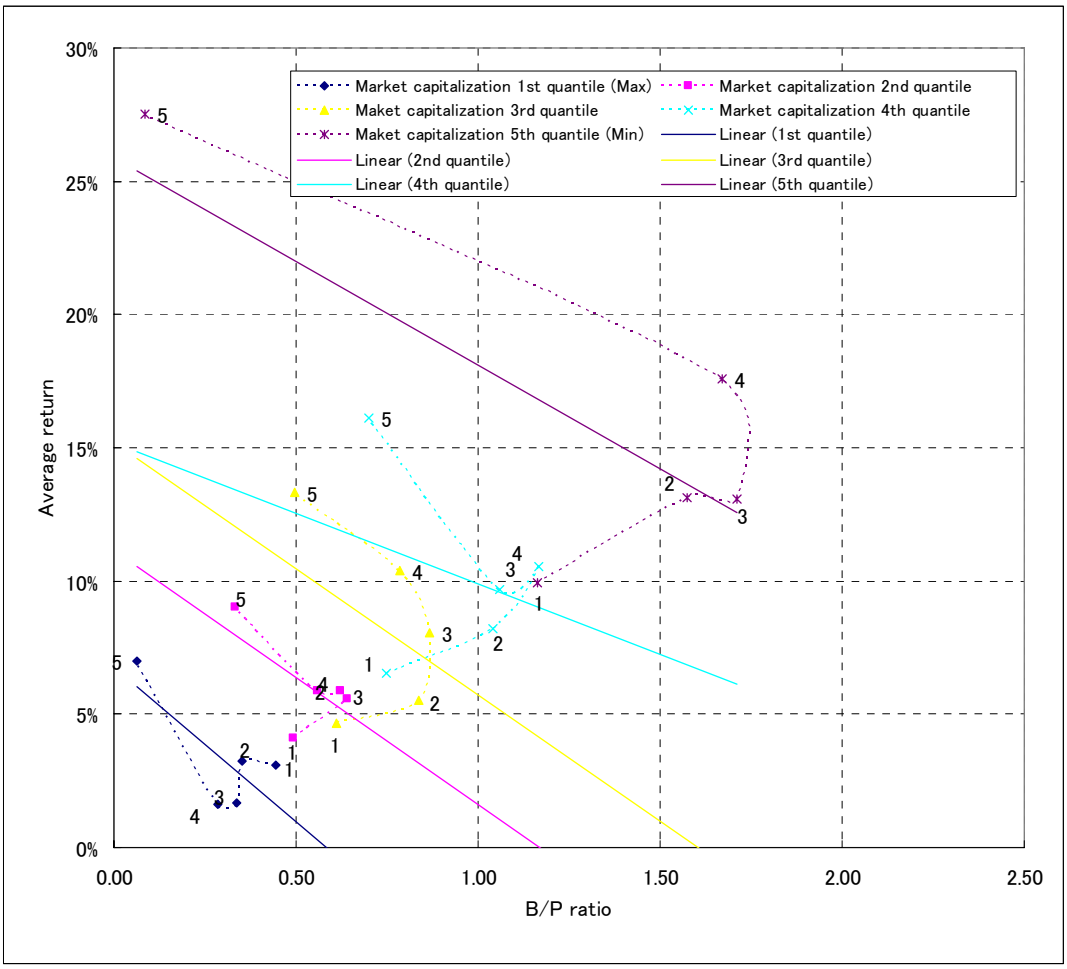
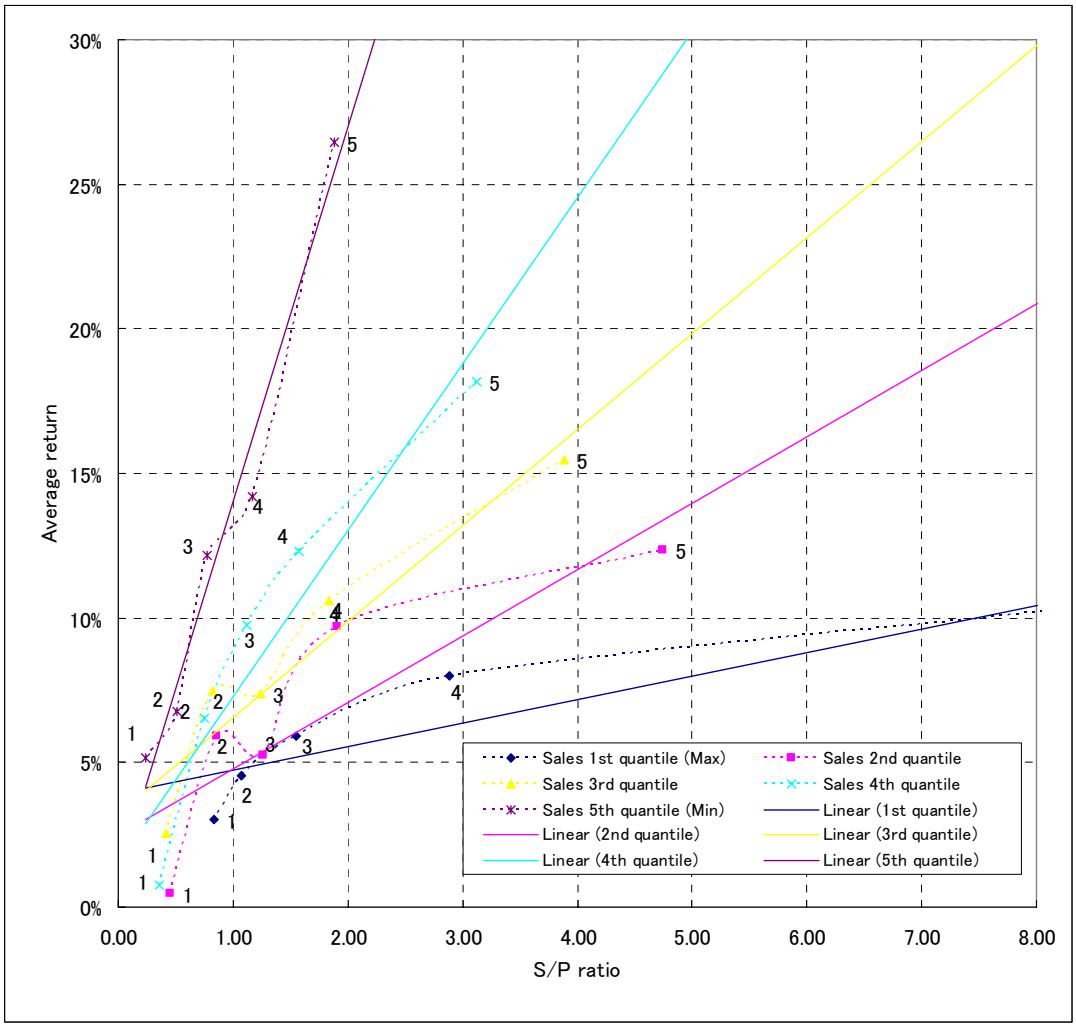
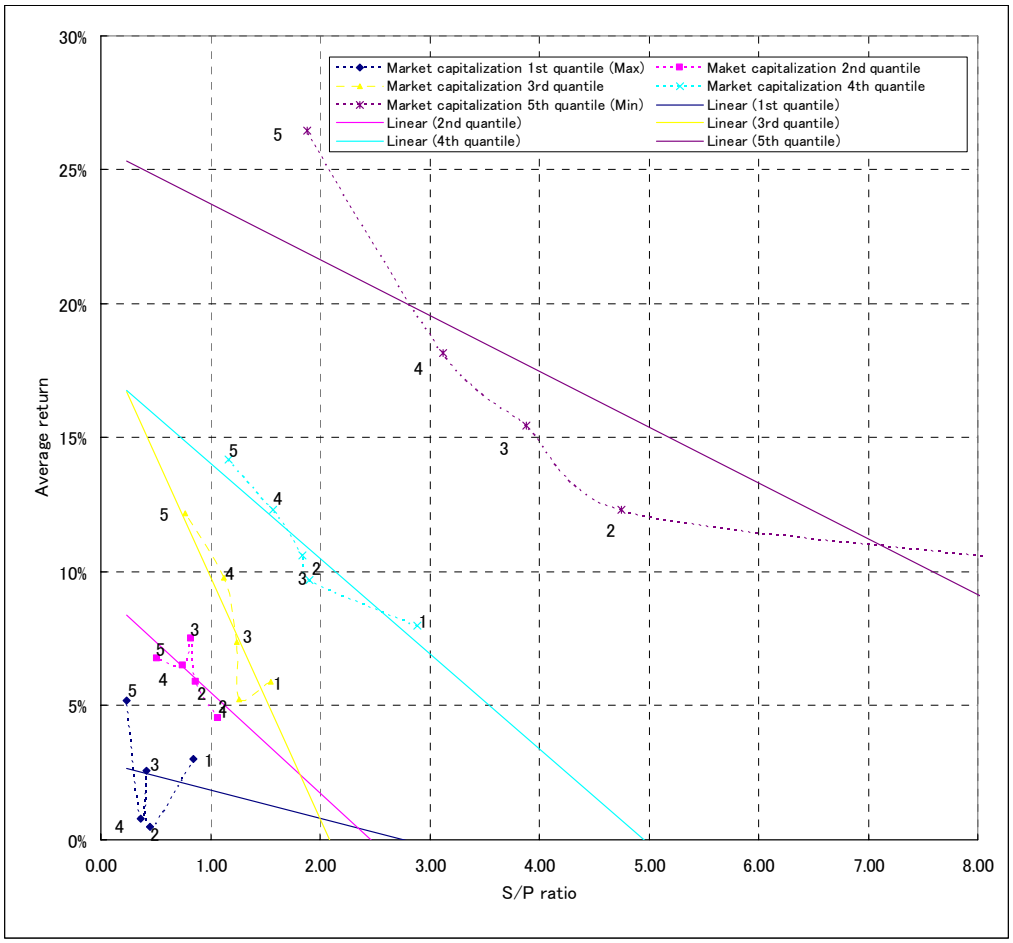


Figure 5: Sales / Market capitalization ratio and return of the 25 quantile portfolios

(a) Linear approximation according to sales quantiles (S/P ratios)



(b) Linear approximation according to market capitalization quantiles (S/P ratios)



From this standpoint, a more interesting result is obtained when observing **Figure 5** which shows the relationship between sales and market capitalization. In **Figure 5 (a)** which groups together each sales size, the market capitalization downsizing in each quantile leads S/P to increase, and improves performance by the facet of the value effect. However, a relationship that can be viewed as the overvalue effect is derived in **Figure 5 (b)** which groups together each standardized market capitalization. If the standardized market capitalization quantile is the same, a higher return rate is obtained even though the S/P ratio becomes relatively high due to small sales. This result can illustrate the fact that the size effect exists as sales, not as market capitalization.

As described above, analysis was conducted, based on Berk's method which observed the size effect among market capitalization quantile portfolios, taking into consideration the relationship of the value effect. In other words, considering the value effect, that size effect differing from the value effect has been confirmed using any of the size indicators, such as market capitalization, book value, or sales.

4. Conclusion and Future Issues

In accordance with the method used by Berk (1997), this article conducted empirical analysis of the size effect in Japan to consider the relationship with the value effect. According to the decile portfolios built based on the three indicators, market capitalization, book value, and sales, a strong size effect was confirmed from the quantile portfolios based on market capitalization. On the other hand, a constant level of size effect was also confirmed based on book value and sales. Another analysis was conducted by building quintile portfolios based on market capitalization to divide each quintile portfolio based on book value and sales into five quantile portfolios, so that 25 quantiles of double sorted portfolios were built. This analysis showed that the large-sized stock effect on standardized book value and standardized sales indicated by Berk also exists in Japan. On the other hand, when the average ratio values of firm size and market capitalization were applied to the respective 25 portfolios in order to consider the relationship between this current analysis and the value effect, it was confirmed that a significant portion of the large-sized stock effect indicated by Berk could be explained by the value effect. In addition, it was found that a size effect differing from the value effect could be obtained by using market capitalization, book value, or sales.

Hence, at least two anomalies, the value effect and size effect, were confirmed in Japan. Additionally, with this current analysis, it was confirmed that the size effect could exist as a pure firm size effect, not as the market capitalization effect claimed by Berk (1997). Several factors can be cited as to what generates the size effect, for example, 1) the credit risk premium, which means that a company with less book value and sales has relatively high risk of bankruptcy, 2) the liquidity premium, which is the high cost required to conduct arbitrage, due to the low stock liquidity of a small company by book value and sales. The relationship between these factors should be considered in future studies. The results obtained currently, however, could be considered to show that the possibility exists that there is theoretical justification for investing in small stocks.

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