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Investment and Firm Performance Variability

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Abstract

Purpose – The study analyzed 90 online firms worldwise and observed them for ten years to investigate their investments and firm performance variabilities. This study attemped to verify the existence of agency problems in online firms. Through this, the paper intends to expand the scope of research in the fields of investment and firm value both empirically and in theory. This study also attempted to supplement the insufficient logic of previous studies by analyzing the relationship between investment and profitability.

Design/methodology – In this study, the investment is subdivided into over-, under-, and neutral investments, and an empirical analysis of the firm performance was conducted. As investment generally has long-term effects, the impact of a firm's investment on future firm performance and variabilities in firm performance was considered over the short-and medium-term period.

Findings – It was found that there was a negative relationship between firms with an overinvestment and future firm performance. Underinvestment has no clear statistically significant results on firm performance. This implies that overinvestment causes more reduction in future firm performance than underinvestment. It was also found that underinvestment and overinvestment significantly increased the variability of firm performance. A positive significance was found between under- and over- investment with a variability of 3 years and overinvestment with a variability of 4 years in the future. A negative relationship was found between neutral investment propensity and future performance variabilities. Neutral investment has less effect on the future performance variability of a firm than a firm's overinvestment and underinvestment. For online firms, underinvestment and overinvestment have a greater effect on the firm's future performance variability than neutral investment.

Originality/value – The agency theory predicts that information asymmetry and adverse selection problems exacerbate conflicts of interest among stakeholders, thus firm performance. The study contributed to accumulating research on online firms that are currently underexplored by analyzing the investment behavior of major firms in the online industry.

Keywords: Firm Performance, Overinvestment, Performance Variability, Underinvestment
JEL Classifications: G11, G14, L21, L81

1. Introduction

Investment is an essential condition for sustainable growth for the firm. Investment changes a firm's output affects sales, price, market share, etc., and is also related to financial activities to raise funds. Theoretically, firms should make optimal investments, but it is not the reality. The overinvestment of a firm puts pressure on its cash flow and acts as an opportunity cost, weakening the growth and leading to a vicious cycle of underinvestment. Investment beyond the firm's ability can lead to insolvency and fall into a long-term recession. However, firms are likely to overinvest despite these risks.

In order to establish the theory of Miller and Modigliani (1961) that an increase in firm

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investment increases firm value, the capital market must be perfect, information asymmetry must not occur, and capital raising and investment decisions must be independent of each other. However, in reality, markets are imperfect and information asymmetry exists. Therefore, in an imperfect market, it may occur a positive NPV investment plan not adopted, rather a negative NPV investment plan adopted. In a situation of information asymmetry, under-or over-investment may occur due to conflicts of interest between stakeholders.

Studies on the relationship between investment and firm performance found inconsistent results (Richardson, 2006; Titman et al., 2004; Farooq et al., 2014). Many studies divided investment into overinvestment and underinvestment and the relationship with firm performance was analyzed. If the investment propensity is classified into overinvestment and underinvestment, the research result of overinvestment is interpreted as such a result compared with underinvestment, it is difficult to interpret accurately. Also, if the investment is classified into optimum and non-optimum, it implies that non-optimal investment will inevitably result in negative firm performance. In this study, investment is subdivided into over-, under-, and neutral investments, and an empirical analysis of the firm performance is conducted.

The sample firms used in the previous studies were mainly the manufacturing industry or all industries in a specific country. The firms analyzed in this study are online firms worldwide. The study contributes to accumulating research on online firms that are currently underexplored by analyzing the investment behavior of major firms in the online industry. The agency theory predicts that the conflicts of interest among stakeholders exacerbate the investment problem, thus firm performance. This study attempts to verify whether information asymmetry or agency problem exists in online firms and intends to expand the scope of research in the fields of investment and firm value both empirically and in theory. In addition, in the existing research on firm investment and firm value, investment and firm value were analyzed without analyzing how capital investment affects profitability and thus variability of firm profitability. This study attempts to supplement the insufficient logic of previous studies by analyzing the relationship between investment and profitability in the short and medium term.

This paper is organized as follows. The next chapter introduces the theoretical background and hypothesis, and the research model is designed in Section III. The empirical analysis is carried out in Section IV and conclusions are drawn in Section V.

2. Literature Review and Hypothesis

2.1. Literature Rreview

There are conflicting theories about the impact of investment on firm value. There are theories that an increase in firm investment increases the firm value and there are theories that it decreases. The former is a firm value valuation theory based on the value-maximizing hypothesis. The value maximization theory is that an increase in the investment amount increases the firm value because managers only implement when the net present value (NPV) expected from the investment plan is positive (+) when making an investment decision. Miller and Modigliani (1961) asserted that the market value of a firm is determined by the sum of the expected future income from its assets and the present value of the investment expected to be realized in the future.

If a top manager's investment decision is made with the maximization of firm value in mind, the firm's investment announcement will deliver a positive signal to the firm value because it means that they have an investment plan which is expected to have an investment return that is higher than the market required rate of return. In this case, an increase in investment exceeding the amount expected by investors will increase the firm value, whereas a decrease in investment less than expected will decrease the firm value. According to this theory, as managers always act for the sake of increasing shareholder value, they adopt only investment plans which increase firm value. Investors judge that the unexpected increase in investment is decided by the top manager with good private information, and the firm value increases (McConnell and Muscarella, 1985; Kerstein and Kim, 1995).

McConnell and Muscarella (1985) empirically tested this theory. From 1975 to 1981, they observed the investment plan announcement and stock prices of 658 American firms. In firms belonging to general industries, if the amount of the investment plan increased than the investors expected, the abnormal return at the time of disclosure was statistically high. In the case of public corporations, this was not the result.

However, the non-value maximizing theory that an increase in firm investment leads to a decrease in firm value is based on the size maximization hypothesis and the free cash flow hypothesis. Jensen and Meckling (1976), Myers and Majluf (1984) and others developed investment decision theory focusing on the role of information asymmetry. They explained the problem of information asymmetry between shareholders and creditors and between current and future shareholders. They presented the problem of underinvestment in that the investment proposal could be rejected if there was an information asymmetry problem even though the net present value of the investment proposal was positive. According to the free cash flow hypothesis, overinvestment in which an investment proposal with a negative net present value is adopted may occur and may be exacerbated by conflicts of interest between shareholders and managers.

Shareholders prefer risky investments as the firm has limited liability even if the firm goes bankrupt. Shareholders expect that a successful risky investment will result in greater profits than their creditors, while they believe they can pass on losses to creditors in case of investment failure (Jensen and Meckling, 1976). In this case, asset substitution problems may arise. In the case of information asymmetry, if interest rates rise or constraints on capital raising and investment decisions are enforced, implementing an investment plan is difficult. In an information asymmetry situation, as the cost of raising capital increases, shareholders take the issue of future asset replacement seriously, while creditors tend to underestimate it. Therefore, the problem of asset substitution between shareholders and creditors can lead to the problem of underinvestment.

Moral hazards among shareholders and creditors may cause underinvestment problems (Minshik Shin et al., 2014). If a firm goes bankrupt, as creditors have priority over the stockholders to dispose of assets, shareholders assume that if the firm goes bankrupt, creditors can seize the firm value they have created. In this moral hazard situation, creditors try to prevent suboptimal investments by shareholders by shortening loans and strengthening supervision and control. But it is not a fundamental solution.

Conflicts of interest between shareholders and creditors can lead to underinvestment due to the problem of adverse selection. As creditors have inferior information to shareholders, they cannot distinguish qualitative differences in investments and thus are exposed to the risk of adverse selection (Stiglitz and Weiss, 1981). When creditors demand a risk premium that reflects the adverse selection risk, the cost of debt increases. In this case, if the amount of investment required for the positive (+) NPV investment exceeds the funds that can be raised from within the firm, the problem of underinvestment may arise, in which the investment is partially abandoned even if the investment has a positive (+) NPV. The information asymmetry between existing and future shareholders regarding the investment proposal leads to an abandoned positive NPV investment proposal. Future shareholders with inferior information to existing shareholders may overcharge the cost of capital for the capital they will provide to the firm. Existing shareholders choose to under-invest because adopting a new investment plan at a higher cost of capital may incur losses.

Muller (1969) argued that managers pursue continuous growth policies to maximize scale rather than maximize firm value. Since managers' compensation increases as the size of the firm increases, inefficient investment is made because even investment plans with negative NPV are adopted. From the manager's point of view, continuing to expand the business is advantageous in terms of remuneration, promotions, and maintaining a reputation as a manager of a large corporation. The policy of scale-up continues to be pursued, incurring losses to shareholders and reducing the firm value.

The non-value increase theory assumes that managers invest in increasing the size of the firm. In this case, the increase in investment expenditure with the negative NPV will have a negative effect on the firm value because of the inefficient investment. The firm size expansion theory was formulated by Mueller (1969) was developed into the agency theory by Jensen and Meckling (1976) and was developed into the free cash flow theory by Jensen (1986).

The free cash flow hypothesis is a theory which explains the possibility that managers will expand the size of a firm beyond an appropriate size. Free cash flow is cash flows in excess of the funds required for an investment project with a positive net present value. In order to maximize shareholder values, free cash flow must be paid out as dividends to shareholders. However, outflow to the outside of the firm through dividends reduces the resources under control and weakens the management's control over the firm. In addition, if funds are raised from the capital market, managers are subject to monitoring by the capital market, thereby further weakening the control of managers. Therefore, managers do not spend free cash flow as dividends but make investments to expand the firm's size in order to obtain more compensation.

Titman et al. (2004) investigated the relationship between the excess facility investment and stock return one year after the investment using data from 1973 to 1996 of the firms listed on the US stock market. They found that firms which significantly increased investment recorded negative excess returns one year later. The negative impact of such investment was more pronounced in firms with high cash flow and low debt ratios. Managers were more likely to invest, and the risk of a hostile takeover from outside was low. These results imply that investors negatively evaluate the economic motivation of managers to build their own empires, increasing investment.

The debt ratio indicates dependence on debt capital and is an indicator of a firm's financial soundness (Kim Do-Yun, 2017). Creditors can assess the level of risk they have to bear by understanding the debt ratio of the firm, and the firm should strive to maintain an appropriate level of debt to protect its creditors. However, since the compensation of the manager is mainly based on the external growth of the firm, the manager concentrates on increasing the external growth, such as the expansion of the firm size or sales, in order to maximize the compensation. Therefore, managers tend to overinvest by adopting investment plans with negative net present value. The firm's firm size expansion policy causes the firm value to fall and shareholders to suffer losses.

Choi Jeong-Ho (2014) found a negative relationship between overinvestment and the future performance of a firm. The more severe the overinvestment, the more negative the effect of overinvestment on the future performance of a firm. Park Yeon-Hee (2011) argued that it is appropriate to apply the debt-to-equity ratio to individual firms or industries because even if the debt-to-equity ratio is high, future financial risks can be reduced when a firm's profitability is high. Despite a high debt ratio, firms with a low tendency to overinvest have room to improve their financial structure and profitability in the future.

Overinvestment results from conflicts of interest between shareholders and managers. Jensen (1986) stated that in a situation of information asymmetry, managers can use free cash flow to forcefully promote negative NPV investment for their own personal gain. The free cash flow problem arises when the cash flow generated within the firm is greater than the amount invested in the positive NPV investment. Instead of distributing free cash flow to shareholders, managers can overinvest in negative NPV investments. If the level of free cash is excessively high, the problem of underinvestment may not occur if managers raise negative NPV investment capital through external capital markets.

Vogt (1994) argued that underinvestment and overinvestment problems depend on the qualitative level of investment opportunities. In firms with low-quality investment opportunities, the overinvestment hypothesis holds that investment and cash flow have a positive (+) relationship, whereas in firms with high-quality investment opportunities, investment and cash flow have a negative (-) relationship. It is argued that the underinvestment hypothesis by Lang et al. (1996) proved the overinvestment hypothesis by finding that firms with low-quality investment opportunities have high debt-to-equity ratios, which can limit investment decisions. Miguel and Pindado (2001) argued that underinvestment and overinvestment problems differ according to the level of cash flow and debt under information asymmetry.

2.2. Hypothesis

Investment is one of the most important decisions for a firm and has a very large impact on firm value. The investment provides a foothold for long-term growth by securing a competitive advantage for a firm.

Investment efficiency means a firm chooses an investment that brings a positive NPV (Biddle et al., 2009). When a firm invests efficiently, the problem of overinvestment or underinvestment does not arise. Biddle et al. (2009) found that overinvestment or underinvestment decreased as the investment efficiency increased and that the higher the investment efficiency, the less sensitive to various macroeconomic environments.

Lee Wa-deuk and Oh Sang-Hoon (2018) analyzed the relationship between future profitability fluctuations and investment divided into appropriate, insufficient, and excessive. They found that appropriate capital investment does not have much effect on future profitability, but excessive or underinvestment significantly affects future profitability. They argued that underinvestment or overinvestment increases the operating risk of a firm.

Choi Jeong-Ho (2014) measured the investment efficiency as the difference between actual and expected investment levels in a study related to the efficiency of facility investment and firm performance. If the actual investment level deviates from the expected level of investment, the firm value is expected to decrease because it is an inefficient investment. However, it is difficult to predict which of the underinvestment and overinvestment has the greater effect on the firm performance of a firm.

Therefore, over-or under-investment of the firm will affect the firm performance of the firm. This leads to the Hypothesis 1.

Hypothesis 1: A firm's over- or underinvestment will have a negative effect on the firm's future profitability.

Capital investments can affect the future profitability of a firm over the long term. However, this impact does not appear in all firms year-over-year. Therefore, it is necessary to further understand the variability in profitability over multiple years and analyze the investment level. The firm's investment level is divided into three categories: overinvestment, under-investment, and neutral investment propensity. Based on the amount of investment of a firm, depending on how far it deviated from the median investment in the same industry, the top 25% is classified as overinvestment, the bottom 25% as underinvestment and the rest are classified as neutral.

If a firm over-invests, it may face an increase in financial costs due to matching financing costs or a fall in product prices due to overproduction. In contrast, underinvestment will lead to deterioration in profitability and market share loss due to loss of sales and an increase in product prices due to a shortage of supply. As such, it can be predicted that the overinvestment and underinvestment of a firm will affect the volatility of a firm's performance. Therefore, the following hypothesis is established.

Hypothesis 2: A firm's overinvestment and underinvestment will have a greater impact on the future profitability of a firm than its neutral investment propensity.

In contrast, it can be predicted that the neutral investment propensity will have less influence on the future profitability variability than the overinvestment propensity and underinvestment propensity. Therefore, the following hypothesis is established:

Hypothesis 3: A firm's neutral investment will have less impact on future profitability fluctuations than non-neutral investments.

3. Research Methodology and Data Description

3.1. Research Model

To test Hypothesis 1, the following Equation (1) was used.

$$\begin{aligned} Perf_{\ i} = \beta_0 + \beta_1 OIVT_{i,t} + \beta_2 UIVT_{i,t} + \beta_3 SIZE_{i,t} \\ + \beta_4 LEV_{i,t} + \beta_5 OFC_{i,t} + \beta_6 ROA_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

Perf$_i$: *future performance(net income/total assets) for the firm i from (t+1) to (t+4)*

OIVT$_{i,t}$: *1 if the firm i has a tendency to overinvest in year t, otherwise 0*

UIVT$_{i,t}$: *1 if the firm i has a tendency to underinvest in year t, otherwise 0*

SIZE$_{i,t}$: *Natural logarithm of total asset of the firm i in year t*

LEV$_{i,t}$: *debt ratio(debt/equity) of the firm i in year t*

OCF$_{i,t}$: *cash flow from operating activity(operating cash flow/total assets) of the firm i in year t*

ROA$_{i,t}$: *return on assets(net income/total assets) of the firm i in year t*

$\varepsilon_{i,t}$: *error of the firm i in year t*

The future firm performance (Perf) was measured by the return on assets (ROA). The future firm performance by year is calculated such that the performance of (t+1) is the average of the ROA in years t and (t+1), the firm performance in year (t+2) is the average of the ROA from year t to (t+2), and the firm performance in year (t+3) is the ROA in the four years from year t to (t+3). The firm performance in year (t+4) is the average of the five-year ROA from year t to year (t+4).

The tendency of overinvestment (OIVT) and underinvestment (UIVT) was determined by performing a regression analysis with the asset growth rate as the dependent variable and the sales growth rate as the independent variable according to the methods of Schrand and Zechman (2012) and Jinhee Park Chulgyu Hong (2021). The residual was extracted. The residuals were again divided into four quantiles, and those in the top 25% were classified as overinvestment (OIVT) and those in the bottom 25% as underinvestment (UIVT).

In addition, firm size (SIZE), operating cash flow (OCF), return on assets (ROA), and debt ratio (LEV) were used as control variables. The firm size was calculated using the natural logarithm of total assets, operating cash flow was calculated by dividing the operating cash flow of total assets, and debt ratio was calculated by dividing total liabilities by total assets.

To test Hypotheses 2 and 3, the following Equations (2) and (3) were used.

$$VARPerf_{\,i} = \beta_0 + \beta_1 OIVT_{i,t} + \beta_2 UIVT_{i,t} + \beta_3 OCF_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 ROA_{i,t} + \beta_6 LEV_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$VARPerf_i = \beta_0 + \beta_1 NIVT_{\,i,t} + \beta_2 OCF_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t}\ \varepsilon_{i,t} \quad (3)$$

VARPerf$_i$: *standard deviation of the ROA of the firm i from year t to year t+2,*

: *standard deviation of the ROA of the firm i from year t to year t+3*

NIVT$_{i,t}$: *1 if the firm i is neutral in investment in year t, otherwise 0*

For the change in future profitability, which is a dependent variable, the 3-year standard deviation of the total return on assets from year t to (t+2) after capital investment and the 4-year standard deviation of the return on total assets from year t to (t+3) were used. The overinvestment (OIVT) and underinvestment (UIVT) tendencies were categorized after extracting the residuals according to the method of Schrand and Zechman (2012) and Park Jin-hee, Hong Chul-gyu (2021). Investment was divided into four quantiles; overinvestment

(OIVT) in the top 25% and underinvestment(UIVT) in the bottom 25%. Firms distributed in the 2nd and 3rd quantiles were classified as a neutral investments (NIVT). Variabilities in profitability can be interpreted as risks to the investment, a risk evaluation index.

3.2. Data Collection and Description

For the empirical analysis, financial statements of online firms around the world were collected from 2011 to 2020. During the sampling year, firms that went bankrupt or were acquired through mergers & acquisitions, or start-ups were excluded from the analysis. To reduce the influence of outlier data in the empirical analysis, the upper and lower 1% were winsorized. Finally, 897 observations from 90 online firms were used for analysis.

Table 1 shows the country distribution of the firms used in the analysis. Online firms are distributed in 20 countries, and their market share of online firms in China and the US was high.

Table 1. Distribution of country

No.	Country	Frequency
1	Argentina	10
2	Australia	10
3	Brazil	10
4	China	150
5	Germany	30
6	Greece	10
7	Israel	10
8	Japan	80
9	Korea	50
10	Luxembourg	20
11	Netherlands	20
12	Norway	10
13	Portugal	10
14	Russian Federation	10
15	Spain	10
16	Sweden	10
17	Taiwan	20
18	UK	30
19	USA	387
20	Zimbabwe	10
	Total obs.	897

4. Empirical Study

4.1. Basic Statistics

Table 2 shows the descriptive statistics of the variables used in the analysis. The average total return on assets from (t+1) to (t+2), (t+3), and (t+4) years was about 0.37%, and the median value was 0.36% to 0.38%. Firms in the bottom 25% of the total return on assets were performing negatively. In contrast, the top 25% of firms were showing performance of approximately 10%, and some firms have achieved a profit margin of up to 40%. Regarding the ratio of overinvestment (OIVT), underinvestment (UIVT), and neutral (MIVT) investment propensity, 26% of the sample firm were over-invested, which was more than under-invested firms. The mean of cash flows was 0.121 and the median was 0.1. The average debt-to-equity ratio was 0.554 and the median was 0.547. Approximately 55% of the online firm's assets were liabilities.

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min.	p25	p50	p75	Max.
$Perf_{t+1}$	0.0373	0.1052	-0.499	-0.0130	0.0360	0.0970	0.4170
$Perf_{t+2}$	0.0368	0.0985	-0.355	-0.0105	0.0370	0.0950	0.4050
$Perf_{t+3}$	0.0364	0.0956	-0.361	-0.0150	0.0370	0.0980	0.3160
$Perf_{t+4}$	0.0375	0.0926	-0.346	-0.0110	0.0385	0.1000	0.3080
UIVT	0.2550	0.4361	0	0	0	1	1
OIVT	0.2620	0.4400	0	0	0	1	1
NIVT	0.4873	0.5001	0	0	0	1	1
ROA	0.0373	0.1319	-1.134	-0.0090	0.0375	0.0975	0.7820
FCF	0.1210	0.1410	-0.800	0.040	0.100	0.180	0.770
SIZE	7.8372	1.8536	2.980	6.580	7.685	8.920	12.680
LEV	0.5545	0.2907	-0.824	0.3720	0.5470	0.7070	1.8040

Notes: p25, p50, and p75 equal the first, the second and the third quantiles respectively.

4.2. Results of Empirical Study

4.2.1. Firm Investment Propensity and Performance

In this section, the relationship between overinvestment and underinvestment and the profitability of firms was tested to verify Hypothesis 1. Panel data analysis was conducted as the firms were observed for ten years. Panel series modeling centers around addressing the likely dependence across data observations within the same group. The panel data model differs depending on how the individual-specific and the time-specific effects of the error term remaining unobserved and unexplained are considered. If a linear regression model is run by pooling the data, the error must conform to the linear regression model's assumptions. That is, the error variance must be homogeneous, the error terms must be independent of each other, and the error terms at different time points of a specific individual must also be time-independent without correlation. Homogenous(or pooled) panel data models assume that the model parameters are common across individuals. The cross-sectional methods such as pooled model may not be valid in this heterogeneity. Panel data models allow for heterogeneity across groups and introduce individual-specific effects. Therefore, the pooled model and the fixed effect model should be compared. Heterogeneous models allow for any or all of the model parameters to vary across individuals. Fixed effects and random effects models are both examples of heterogeneous panel data models.

The Chow Test is a method used to test whether the fixed-effects model is more suitable than the pooled OLS model. This test method is a fixed-effect model, that is, a model that compares the full model, including the individual effect or time effect as a dummy variable with the reduced model without the dummy variable. The Chow Test can be viewed as a test for the null hypothesis that all dummy variables included in the fixed effect model are '0'. The fixed effect model is a method of estimating the intercept of the characteristics of individuals assuming that heterogeneity exists.

Table 3 shows the results of panel data regression- FE effect using Equation (1). F-value represents a Chow test. As all models rejected the null hypothesis that all dummy variables included in the fixed-effect model are 0, it can be said that the fixed-effect model is more suitable than the pooled model. That is, there is an individual-specific effect across to time.

The performance in year (t+1) is the average of the ROA in years t and (t+1), and the performance in year (t+2) is from year t to (t+2). The average of the firm performance in year (t+3) is the average of the ROA for four years from year t to the year (t+3), and the firm performance in year (t+4) is from year t to (t+4). Table 3 shows the relationship between investment propensity and firm performance. The control variables, cash flow (FCF) and debt ratio (LEV) have a significant negative relationship with future firm performance, and return on assets (ROA), and firm size (SIZE) has a significant positive relationship.

The Breusch and Pagan Lagrangian multiplier (LM) was performed to test whether the random effects model is more suitable than the pooled model. The LM test showed whether the variance of the temporal effects included in the random effects model is zero. If the variance is 0, there is no need to use the random effects model, and the pooled model should be used. Table 4 shows the results of the random effect regression and LM test. As all except the first model of underinvestment rejected the null hypothesis of the LM test, the random effect model is more suitable than the pooled model.

Since there was an individual effect over time through the Chow test, it was necessary to determine whether this individual effect was fixed or random. The Hausman test was performed to test which model was more suitable between the fixed effect model and the random effect model in panel data with individual-specific effects, and found which model's estimator was more efficient. The Hausman test permits determining whether there is a correlation between the explanatory variable (x_{it}) and the individual-specific effects, or whether they are independent of each other.

The Hausman test assumes that the random effects model is a more consistent and efficient model. If the null hypothesis of $cov(\alpha_i, x_{it})=0$ is accepted, then the GLS estimator by the random effect model is more consistent and efficient. If the null hypothesis is rejected, the fixed-effects model is more suitable. Table 5 and 6 show the results of the Hausman test on underinvestment and overinvestment. Since the null hypothesis of the Hausman test was rejected in all models, the fixed effect model can be considered efficient.

If there is a problem of autocorrelation or heteroscedasticity, the estimator is a consistent but inefficient estimator. It affects the standard error of the estimator and reduces the reliability of the estimator. Therefore, the Wald test was performed to diagnose the heteroscedasticity of the panel model, and the Woooldridge test was performed to diagnose autocorrelation. Tables 7 and 8 showed heteroscedasticity and autocorrelation of the underinvestment and overinvestment models. The test result showed that $p = 0.0000$, and the null hypothesis was rejected, showing that the panel model has heteroscedasticity and autocorrelation.

Table 9 shows the estimated results of the regression analysis performed after correcting for heteroscedasticity and autocorrelation. In the fixed effect model, the significance of the estimated coefficients of the explanatory variables in overinvestment and underinvest was not found, but significance was found in the estimated regression coefficients performed after correcting for heteroscedasticity and autocorrelation. If both heteroscedasticity and autocorrelation are not controlled, it can be considered that the estimated coefficient is underestimated.

As a result of empirical analysis, it was found that there was a negative relationship between firms with an overinvestment and future firm performance. Underinvestment did have unclear statistically significant results with firm performance. This is similar to the findings of Titman et al. (2004). This implies that overinvestment causes more reduction in future firm performance than underinvestment. Especially overinvestment affects firm performance in the medium term. This verifies Hypothesis 1.

In a situation of information asymmetry, since the governance structure that aligns the interests of shareholders and managers does not work efficiently, managers can use free cash flow to pursue negative NPV investments for their own personal gain (Jensen, 1986). The free cash flow problem occurs when the cash flow generated within a firm is greater than the investment capital of a positive NPV project (Shin Min-sik et al., 2014). The results of the analysis showed a negative relationship between cash flow and firm performance of online firms revealing that firms are highly dependent on internal cash flow for investment.

4.2.2. Investment and Variability of Future Firm Performance

Table 10 shows the results of FGLS with heteroscedasticity and autocorrelation corrected using Equations (2) and (3) to test Hypothesis 2 and 3 on the relationship between firms with insufficient, excessive and neutral investment propensity and future profitability variabilities. The dependent variable, future profitability variability, was obtained by calculating the 3-year standard deviation of the total return on assets from year t to (t+2) and the 4-year standard deviation of the total return on assets from year t to (t+3).

As a result of regression analysis, it was found that underinvestment, overinvestment, and cash flow significantly increased the variability of firm performance. A positive significance was found between under-and over-investment with a variability of 3 years and overinvest with a variability of 4 years in the future. This verifies Hypothesis 2.

Table 10 also shows the relationship between firms with a neutral investment propensity and future profitability variabilities. As in Hypothesis 2, the dependent variable is a change in future profitability. The three-year standard deviation of the total return on assets from year t to (t+2) after capital investment, and the four-year standard of return on total assets from year t to (t+3). Neutral investment propensity (NIVT), cash flow (FCF), and firm size (SIZE) showed a significant relationship with future profitability changes. The neutral investment propensity was found to be negatively related to both the standard deviation of three years in the future and the standard deviation of four years in the future. A negative relationship between neutral investment propensity and future profitability variability shows that the neutral investment propensity has less effect on the future profitability change of a firm than a firm's overinvestment and underinvestment. For online firms, it can be considered that underinvestment and overinvestment have a greater effect on the firm's future profitability change than neutral investment propensity. This proves Hypothesis 3.

Table 3. Panel Data Regression-FE Effect

		Underinvestment				Overinvestment		
	$Perf_{t+1}$ coefficient (std. error)	**$Perf_{t+2}$ coefficient (std. error)**	**$Perf_{t+3}$ coefficient (std. error)**	**$Perf_{t+4}$ coefficient (std. error)**	**$Perf_{t+1}$ coefficient (std. error)**	**$Perf_{t+2}$ coefficient (std. error)**	**$Perf_{t+3}$ coefficient (std. error)**	**$Perf_{t+4}$ coefficient (std. error)**
Constant	0.0224	0.0269	0.0821 **	0.0810 **	0.0209	0.0149	0.0808 **	0.0808 **
	(0.0252)	(0.0311)	(0.0348)	(0.0357)	(0.0245)	(0.0303)	(0.0357)	(0.0357)
UIVT	-0.0031	-0.0009	-0.0014	0.0036				
	(0.0045)	(0.0048)	(0.0046)	(0.0042)				
OIVT					0.0017	-0.0038	-0.0047	-0.0047
					(0.0042)	(0.0048)	(0.0044)	(0.0044)
FCF	-0.0330 **	-0.0539 **	-0.0419 **	-0.0266	-0.0355 **	-0.0423 **	-0.0334 *	-0.0334 *
	(0.0163)	(0.0179)	(0.0173)	(0.0168)	(0.0163)	(0.0182)	(0.0170)	(0.0170)
ROA	0.5635 ***	0.3406 ***	0.2203 ***	0.1713 ***	0.5852 ***	0.3795 ***	0.1663 ***	0.1663 ***
	(0.0198)	(0.0212)	(0.0199)	(0.0181)	(0.0206)	(0.0221)	(0.0189)	(0.0189)
LEV	-0.0072	-0.0022	-0.0072	-0.0022	-0.0089	-0.0080	-0.0005	-0.0005
	(0.0095)	(0.0103)	(0.0101)	(0.0091)	(0.0094)	(0.0102)	(0.0091)	(0.0091)
SIZE	0.0003	0.0007	-0.0053	-0.0056	0.0004	0.0022	-0.0053	-0.0053
	(0.0031)	(0.0038)	(0.0042)	(0.0042)	(0.0030)	(0.0037)	(0.0042)	(0.0042)
F	165.29	52.98	25.83	18.87	163.01	59.08	23.20	16.59
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
sigma(u)	0.0371	0.05668	0.0701	0.0768	0.0366	0.0556	0.0671	0.0748
sigma(ε)	0.0429	0.0426	0.0368	0.0298	0.0417	0.0415	0.0367	0.0296
ρ	0.4278	0.6389	0.7834	0.8688	0.4355	0.6428	0.7698	0.8646
R^2 within	0.5831	0.3472	0.2404	0.2272	0.5842	0.3775	0.2252	0.2090
R^2 between	0.9716	0.8900	0.6708	0.4346	0.9383	0.8275	0.7458	0.4267
R^2 overall	0.7735	0.6331	0.4615	0.3063	0.7629	0.6347	0.5024	0.3024
F test	2.98 (0.000)	6.09 (0.000)	9.94 (0.000)	16.00 (0.000)	2.82 (0.000)	5.58 (0.000)	8.75 (0.000)	13.60 (0.000)
Observation	686	593	503	413	675	582	493	406

Notes: *$p<.1$, **$p<.05$, ***$p<.01$ respectively.

Table 4. Panel Data Regression-RE Effect

		Underinvestment				Overinvestment			
		$Perf_{t+1}$ coefficient (std. error)	**$Perf_{t+2}$ coefficient (std. error)**	**$Perf_{t+3}$ coefficient (std. error)**	**$Perf_{t+4}$ coefficient (std. error)**	**$Perf_{t+1}$ coefficient (std. error)**	**$Perf_{t+2}$ coefficient (std. error)**	**$Perf_{t+3}$ coefficient (std. error)**	**$Perf_{t+4}$ coefficient (std. error)**
Constant		0.0000 (0.0097)	-0.0037 (0.0154)	0.0065 (0.0196)	-0.0074 (0.0232)	0.0006 (0.0103)	-0.0089 (0.0167)	-0.0013 (0.0196)	-0.0035 (0.0224)
UIVT		0.0028 (0.0043)	0.0018 (0.0052)	-0.0003 (0.0051)	0.0045 (0.0047)				
OIVT						-0.0060 (0.0041)	-0.0095* (0.0049)	-0.0122** (0.0051)	-0.0035** (0.0048)
FCF		-0.0182 (0.0136)	-0.0463*** (0.0174)	-0.0533*** (0.0181)	-0.0396** (0.0181)	-0.0253* (0.0141)	-0.0467*** (0.0174)	-0.0505*** (0.0179)	-0.0417** (0.0180)
ROA		0.7493*** (0.0167)	0.5046*** (0.0210)	0.3313*** (0.0212)	0.2367*** (0.0200)	0.7226*** (0.0179)	0.4783*** (0.0216)	0.3232*** (0.0223)	0.2311*** (0.0204)
LEV		-0.0293*** (0.0064)	-0.0357*** (0.0087)	-0.0380*** (0.0094)	-0.0258*** (0.0091)	-0.0289*** (0.0067)	-0.0320*** (0.0088)	-0.0365*** (0.0094)	-0.0240*** (0.0090)
SIZE		0.0033*** (0.0010)	0.0058*** (0.0017)	0.0056*** (0.0021)	0.0063** (0.0025)	0.0037*** (0.0011)	0.0065*** (0.0019)	0.0067*** (0.0022)	0.0063** (0.0025)
Wald χ^2		2404.66***	699.44***	308.10***	170.31***	1852.85***	553.60***	260.44***	156.88***
sigma(u)		0	0.01883	0.0300	0.0396	0.0104	0.0284	0.0337	0.0403
sigma(ε)		0.0429	0.0426	0.0368	0.0298	0.0417	0.0415	0.0367	0.0296
ρ		0	0.1634	0.3988	0.6376	0.0585	0.3196	0.4581	0.6494
R^2	within	0.5794	0.3386	0.2268	0.2061	0.5802	0.3729	0.2153	0.1888
	between	0.9698	0.8851	0.7866	0.6841	0.9380	0.8152	0.7375	0.6731
	overall	0.7796	0.6544	0.5855	0.5279	0.7698	0.6420	0.5584	0.5144
LM test		0.00(1.0000)	79.86(0.0000)	152.42(0.0000)	195.24(0.0000)	7.40 (0.0033)	58.42(0.0000)	117.44(0.0000)	141.65(0.0000)
Observation		686	593	503	413	675	582	493	406

Notes: *p<.1, **p<.05, ***p<.01 respectively.

Table 5. Hausman Test- Underinvestment

	Underinvestment							
	$Perf_{t+1}$ coefficient		$Perf_{t+2}$ coefficient		$Perf_{t+3}$ coefficient		$Perf_{t+4}$ coefficient	
	fe	re	fe	re	fe	re	fe	re
UIVT	-0.0030	0.0028	-0.0009	0.0018	-0.0014	-0.0003	0.0036	0.0045
FCF	-0.0330	-0.0182	-0.0539	-0.0463	-0.0419	-0.0533	-0.0266	-0.0396
ROA	0.5635	0.7493	0.3406	0.5046	0.2203	0.3313	0.1713	0.2367
LEV	-0.0072	-0.0293	-0.0022	-0.0357	-0.0072	-0.0380	-0.0022	-0.0258
SIZE	0.0003	0.0033	0.0007	0.0058	-0.0053	0.0056	-0.0056	0.0063
χ^2 -test	318.37^{***}		167.87^{***}		140.69^{***}		108.78^{***}	
Prob> χ^2	0.0000		0.0000		0.0000		0.0000	

Notes: *p<.1, **p<.05, ***p<.01 respectively.

Table 6. Hausman Test- Overinvestment

	Overinvestment							
	$Perf_{t+1}$ coefficient		$Perf_{t+2}$ coefficient		$Perf_{t+3}$ coefficient		$Perf_{t+4}$ coefficient	
	fe	re	fe	re	fe	re	fe	re
OIVT	0.0017	-0.0060	-0.0038	-0.0095	-0.0054	-0.0122	-0.0047	-0.0114
FCF	-0.0355	-0.0253	-0.0423	-0.0467	-0.0411	-0.0505	-0.0334	-0.0417
ROA	0.5852	0.7226	0.3795	0.4783	0.2279	0.3232	0.1663	0.2311
LEV	-0.0089	-0.0289	-0.0080	-0.0320	-0.0088	-0.0365	-0.0005	-0.0240
SIZE	0.0004	0.0037	0.0022	0.0065	-0.0024	0.0067	-0.0053	0.0063
χ^2 -test	113.91^{***}		97.58^{***}		106.03^{***}		96.49^{***}	
Prob> χ^2	0.0000		0.0000		0.0000		0.0000	

Notes: *p<.1, **p<.05, ***p<.01 respectively.

Table 7. Wald Test for Heteroscedasticity

	Underinvestment				Overinvestment			
	$Perf_{t+1}$	**$Perf_{t+2}$**	**$Perf_{t+3}$**	**$Perf_{t+4}$**	**$Perf_{t+1}$**	**$Perf_{t+2}$**	**$Perf_{t+3}$**	**$Perf_{t+4}$**
Wald χ^2	χ^2 (90)= 1.4e+05	χ^2(90)= 1.7e+05	χ^2 (90)= 1.4e+05	χ^2 (90)= 61523.07	χ^2 (90)= 6.4e+31	χ^2 (90)= 1.3e+05	χ^2 (90)= 4.1e+29	χ^2 (90)= 2.0e+30
Prob> χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 8. Wooldridge Test for Autocorrelation

	Underinvestment				Overinvestment			
	$Perf_{t+1}$	**$Perf_{t+2}$**	**$Perf_{t+3}$**	**$Perf_{t+4}$**	**$Perf_{t+1}$**	**$Perf_{t+2}$**	**$Perf_{t+3}$**	**$Perf_{t+4}$**
F- stat. value	10.150	71.187	87.739	199.242	9.894	74.773	79.085	344.587
Prob> F	0.0020	0.0000	0.0000	0.0000	0.0023	0.0000	0.0000	0.0000

Table 9. Cross-Sectional Time-Series FGLS Regression

	Underinvestment				Overinvestment			
	$Perf_{t+1}$ coefficient (T-value)	**$Perf_{t+2}$ coefficient (T-value)**	**$Perf_{t+3}$ coefficient (T-value)**	**$Perf_{t+4}$ coefficient (T-value)**	**$Perf_{t+1}$ coefficient (T-value)**	**$Perf_{t+2}$ coefficient (T-value)**	**$Perf_{t+3}$ coefficient (T-value)**	**$Perf_{t+4}$ coefficient (T-value)**
Constant	0.0107** (2.07)	-0.0043 (-0.63)	-0.0058 (-0.73)	-0.0122 (-1.36)	0.0124** (2.55)	-0.0040 (-0.61)	-0.0037 (-0.49)	-0.0071 (-0.87)
UIVT	0.0002 (0.15)	-0.0001 (-0.10)	0.0008 (0.60)	0.0036** (2.30)				
OIVT					-0.0023 (-1.40)	-0.0030 (-1.55)	-0.0038** (-2.07)	-0.0040* (-1.89)
FCF	0.0021 (0.28)	-0.0035 (-0.40)	-0.0152* (-1.69)	-0.0288*** (-3.63)	-0.0013 (-0.18)	-0.0028*** (-0.30)	-0.0149 (-1.58)	-0.0245*** (-2.64)
ROA	0.6725*** (43.42)	0.3740*** (24.56)	0.2565*** (19.16)	0.2089*** (16.24)	0.6763*** (43.74)	0.3873*** (24.77)	0.2642*** (18.53)	0.2178*** (15.93)
LEV	-0.0328*** (-7.63)	-0.0325*** (-6.31)	-0.0408*** (-7.48)	-0.0347*** (-6.87)	-0.0342*** (-8.02)	-0.0369*** (-7.11)	-0.0422*** (-7.53)	-0.0364*** (-6.33)
SIZE	0.0025*** (4.51)	0.0057*** (7.75)	0.0070*** (8.65)	0.0075*** (8.44)	0.0025*** (4.65)	0.0059*** (8.09)	0.0069*** (8.54)	0.0072*** (8.37)
χ^2	2561.35***	848.08***	616.66***	456.36***	2568.86***	883.80***	576.09***	446.97***
Estimated covariances	90	90	87	87	90	89	87	87
Estimated autocorrelations	1	1	1	1	1	1	1	1
Observation	686	593	503	413	675	582	493	406

Notes: *p<.1, **p<.05, ***p<.01 respectively.

Table 10. FGLS Regression Analysis

	Underinvestment and Overinvestment		Neutral Investment	
	$VARPerf_{t+1\ t+3}$ coefficient (T-value)	**$VARPerf_{t+1\ t+4}$ coefficient (T-value)**	**$VARPerf_{t+1\ t+3}$ coefficient (T-value)**	**$VARPerf_{t+1\ t+4}$ coefficient (T-value)**
Constant	0.0463 ***	0.0609 ***	0.0576 ***	0.0634 ***
	(5.32)	(6.15)	(6.47)	(6.28)
UIVT	0.0042 **	0.0022		
	(2.00)	(1.16)		
OIVT	0.0036 **	0.0032 **		
	(2.00)	(2.13)		
NIVT			-0.0029 *	-0.0027 **
			(-1.93)	(-2.08)
FCF	0.0249 **	0.0169 *	0.0336 ***	0.0199 **
	(2.54)	(1.88)	(3.33)	(2.26)
ROA	-0.0031	0.0161	-0.0056	0.0006
	(-0.18)	(1.04)	(-0.34)	(0.040)
LEV	0.0011	0.0046	0.0026	0.0051
	(0.25)	(1.09)	(0.60)	(1.16)
SIZE	-0.0026 ***	-0.0038 ***	-0.0037 ***	-0.0038 ***
	(2.89)	(-3.8)	(-4.11)	(3.80)
Wald χ^2	22.52 ***	23.89 ***	30.93 ***	24.52 ***
Estimated covariances	88	88	90	88
Estimated autocorrelations	1	1	1	1
observation	576	492	589	501

Notes: *p<.1, **p<.05, ***p<.01 respectively.

5. Concluding Remarks

This study analyzed how a firm's investment affects future firm performance. To analyze the investment propensity, panel data analysis was performed on firms belonging to the online industry by subdividing investment into an overinvestment, underinvestment, and neutral investment. As investment generally has long-term effects, the impact of a firm's investment on future firm performance and variabilities in firm performance was considered over the short-and medium-term period.

Underinvestment arises from conflicts of interest between shareholders and creditors, existing shareholders and future shareholders, and overinvestment arises from conflicts of interest between major stakeholders, such as conflicts of interest between shareholders and managers. Moreover, information asymmetry exacerbates these conflicts of interest. Under-investment can be caused by information asymmetry between shareholders and creditors, current shareholders and future shareholders, and by moral hazard and adverse selection between shareholders and creditors. Overinvestment can arise from agency problems and information asymmetry between shareholders and managers.

The result of this study showed that there was a negative relationship between firms with an overinvestment and future firm performance. This implies that overinvestment causes more reduction in future firm performance than underinvestment in the medium term. In addition, the analysis of the relationship between variability in firm performance and investment showed that underinvestment and overinvestment in online firms had a greater effect on the firm's future profitability variabilities than neutral investment.

The contributions of the results of this study are as follows. First, the investment propensity of firms in the online industry was subdivided into overinvestment, underinvestment, and neutral investment. The study analyzed major firms in the global online industry, not in a specific country, to verify the agency theory. It is better to collect a large size of sample to verify a theory. To do this, the top 90 listed online firms worldwide with a ten-year period sample year data were collected. To the author's knowledge, it is the first attempt to generalize the agency theory in the online industry. Second, the analysis of the risks of overinvestment and underinvestment provides information necessary for investors' decision-making. Third, an analysis of the management risks of overinvested firms was presented. As the study found that the agency problem and information asymmetry exist in online firms, firms can adopt the traditional remedy to reduce these problems. By alleviating the agency problem between shareholders and managers and alleviating information asymmetry, the risk of negative NPV investment can be reduced, and firm value can be increased.

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