Inventory Investment, Firm Value, and Growth: Evidence from Korea

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Abstract

We investigate the role of growth opportunities in the relationship between inventory investment and firm value. Using a sample of non-financial Korean firms from 2010 to 2018, we find that firms with higher inventory holdings are more likely to have higher firm values. This finding is consistent with the signaling hypothesis and the liquidity risk hypothesis. We also document that the positive relationship between inventory and firm value is more pronounced for firms with high growth opportunities than those with low growth opportunities. The evidence implies that higher inventory investment in firms with high growth opportunities mitigates the problems of information asymmetry and adverse selection, whereby inventory investment sends a more positive signal to the capital market.

Keywords: Inventory, Tobin's q, firm value, signaling hypothesis, liquidity hypothesis.

JEL classification: G32; G13

1. Introduction

The choice of firms' inventory investment is considered as very important factor in corporate financial policy (Yang et al., 2022). In this context, the impact of inventory investment on firm performance has been extensively studied in corporate finance (Lev and Thiagarajan, 1993; Chen et al.,2005; Lai, 2006; Basu and Wang, 2011: Kieschnick et al., 2013; Isaksson and Seifert, 2014; Afrifa et al., 2021). However, several studies show mixed results. For example, some studies find that the link between inventory investment and firm performance is positive, underscoring that the change in inventory is significantly influenced by future sales expectations (Lai, 2006; Kieschnick et al., 2013). Other studies find that the relation is negative, arguing that the increase in inventory level prejudices a company's profitability (Deloof, 2003: Basu and Wang, 2011). A limitation of prior literature is that it mainly focuses on inventory management, such as optimal inventory level relevant for determining inventory investment decisions. If inventory investments have a signaling effect on the stock market, however, then the firm's growth opportunities may be critical determinants for understanding the link between inventory investment and firm value (Chen et al., 2005). Huang (2016) notes that a firm's inventory investment is related to its growth opportunities. Lev and Thiagarajan (1993) document that inventory investment positively signals a manager's sales growth expectation.

This paper explores the effects of growth opportunities on the relationship between inventory investment and firm value in Korean-listed firms. We perform a panel regression using 30,609 firm-year observations from 2000 to 2018 for listed Korean manufacturing firms on the Korea Stock Exchange (KSE). Examining this issue in the Korean context is particularly meaningful because an emerging market allows us to incorporate inefficiencies in the capital market into our analysis. Many Korean business groups have recently experienced a significant surge in inventory holdings. Companies increased their purchases of raw materials in anticipation of global price spikes, but lower-than-expected demand has led to an accumulation of inventory, thereby dampening their firm performance. However, in some business groups, the increase in inventory has shown a positive effect on firm performance. For example, although Hyundai Steel's inventory has increased rapidly, the market predicts that rising steel prices will positively impact firm performance. This is not due to sluggish sales but because the prices of secured raw materials and manufactured products are expected

to rise, significantly boosting asset valuation. Additionally, the positive impact within business groups may be related to the strong internal market (i.e., internal transactions between affiliates) in the Hyundai Motor Group. Furthermore, as in China, changes in inventories in Korea are considered a leading indicator of overall economic performance (Trading Economics, 2020; Yang et al., 2022).

How does inventory investment affect firm value? The first hypothesis is that managers extend inventory to mitigate the stock-out risk generated by increased demand (henceforth, the signaling hypothesis). Managers may face risky situations due to uncertainty about heterogeneous changes in sales. In particular, managers use inventory to reduce liquidity risk arising from the market (henceforth, the liquidity hypothesis). The second hypothesis is that managers with high growth opportunities may use inventory to reduce adverse selection and information asymmetry arising from the capital market.

We perform a t-test to analyze firm-specific characteristics, such as inventories, between firms with high growth opportunities and firms with low growth opportunities. We find that the inventories of firms with high growth opportunities are higher than those of firms with low growth opportunities. The results suggest that firms with high growth opportunities are inclined to engage in inventory activities to enhance firm value.

As the primary analysis, we examine the signaling hypothesis and liquidity hypothesis. The initial evidence that the positive relationship between inventory and firm value supports the view that inventory helps managers manage business risks. We find that firms with higher inventories are more likely to have higher firm values, which is consistent with the signaling hypothesis related to information asymmetry and the liquidity risk hypothesis. These factors appear to be important determinants of firm value.

Furthermore, to investigate the role of growth opportunities more thoroughly, we study their effects on the relationship between inventory investment and firm value. Consistent with these arguments, we find evidence that increasing inventory in firms with high growth opportunities enhances firm value by mitigating information asymmetry.

We run several tests to verify the robustness of our conclusion. We consider abnormal returns as a dependent variable and divide the sample into high-growth and low-growth firm groups. Additionally, we examine the non-linear relationship between inventory and firm value. Our results confirm a positive relationship between inventory and firm value for

growth firms, using abnormal firm performance as our dependent variable. This finding reinforces our previous results. By dividing the sample into high-growth and low-growth firms, we find that higher inventory in high-growth firms is associated with higher firm performance regardless of the performance measure and model employed. Finally, we find a non-linear relationship between inventory and firm value using ROA as a performance variable, indicating that firm performance increases with inventory assets up to a certain point and then declines after reaching a peak.

Our main contribution is introducing the growth opportunities channel to understand the positive relationship between inventory investments and firm value. In addition, our research contributes to the literature in the following ways. First, there are limited studies for emerging markets regarding the impact of inventory on firm performance. Our work in the Korean market provides unique evidence from an emerging market. Unlike a prior study that dealt with U.S. firms, Korean firms are pertinent to the emerging market with a slightly inefficient capital market. Asymmetric information is relevant in the emerging market because of relatively undiversified equity shareholders and the high monitoring cost. Managers in these countries are more interested in short-term performance than long-term performance. Thus, increasing inventory will lead to different impacts on firm value compared to markets with more efficient information dissemination. Second, existing inventory research in emerging markets does not consider the role of growth opportunities. We investigate whether inventory affects firm value by considering the impact of growth opportunities in an emerging market context.

The remainder of the article is organized as follows. Section 2 presents the literature review. Sections 3 and 4 report the data and methodology. Section 5 presents our empirical results on inventory and firm performance. Section 6 provides a summary and conclusion.

2. Literature review

Empirical studies on the impact of inventory on firm performance have mainly been analyzed as a component of working capital focusing on firm performance. Deloof (2003) examines the relationship between working capital management and profitability among 1,009 Belgian firms over the 1992-1996 period. The author documents that a large inventory may lead to higher sales, reducing the risk of a stock-out. Furthermore, she finds that inventory holding

harms profitability, indicating that the relation can be caused by declining sales, leading to lower profits and more inventory. Similarly, Kieschnick et al. (2013) examine the relationship between working capital management and shareholders' wealth through 3,789 U.S. public corporations from 1990 through 2006. Specifically, they find that inventory is positively associated with shareholder wealth, breaking down net working capital into its components (i.e., accounts receivable, accounts payable, and inventory). Smith (1980) points out the tradeoffs between liquidity and profitability in determining working capital policies. The author emphasizes the importance of working capital management because of its effect on a firm's profitability, risk, and value. Prior empirical literature (i.e., Shin and Soenen, 1998; Deloof, 2003) on working capital management focuses on its effect on profitability. For example, Shin and Soenen (1998) argue that efficient working capital management is essential for corporate strategy and creating value for shareholders. The authors use the cash conversion cycle to measure working capital and examine the relations between the cash conversion cycle and firm profitability for a large sample of U.S. firms for the 1975-1994 period. They find negative interactions. Hahn et al. (2016), using a sample of 405 firms between 2010 and 2014, find that firms with consistently growing return on equity (ROE) differ from firms that always exhibit more efficient working capital management. Finally, Boisjoly et al. (2020) investigate the longitudinal impact of continuous improvement programs and aggressive working capital practices on accounts receivable turnover, inventory turnover, days payables outstanding, and cash conversion cycle between 1990 and 2017. Their findings show statistically significant shifts in the means and the skewness for these variables consistent with stricter financial management and less risk-taking in trade credit policies.

Among studies focusing on the impact of inventory management on firm value, Isaksson and Seifert (2014) analyze that inventory leanness positively affects firm performance using 4324 publicly traded U.S. manufacturing companies between 1980 and 2008. They find a nonlinear relationship between inventory leanness and financial performance. Basu and Wang (2011) explore the relationship between inventory change and firm performance using 85,000 observations from 1950 to 2005. They find that the relationship is negative for firms in the wholesale and manufacturing industry and firms that typically carry low inventory levels. Michalski (2009) argues that inventory management must contribute to the financial

goal, that is, the maximization of shareholder wealth through the value-based economic order quantity (*EOQ)* model and the value-based production order quantity (*POQ)* model. In particular, he suggests that too much money tied to inventory burden the firm with high inventory service costs. In contrast, the higher inventory stock could help increase sales income because purchasers have greater flexibility in purchasing decisions.

To our knowledge, Chen et al. (2005) is the first study to investigate the direct relationship between inventory and firm value. The authors empirically examine the inventory holdings of U.S. manufacturing firms between 1981 and 2000. They find that abnormal inventory holdings do not affect the cross-section's market-to-book ratio or Tobin's Q. In contrast, firms with abnormally high inventories over the long term have poor long-term stock returns. In addition, they argue that firms with slightly lower than average inventories have good stock returns, but firms with the lowest inventories have only expected stock returns. Conversely, Lai (2006) and Tribo (2009) study how the stock market affects inventory decisions. Lai (2006) finds that stock price correlates positively with inventory holdings. In particular, the author hypothesizes three channels through which inefficient markets might affect inventory. In the financing channel view, overvaluation allows firms to raise financing and increase inventory to optimal levels for constrained firms. As the market misvalues firms in the dissipation channel view, firms become less disciplined and let inventory rise. In the catering channel view, as the market discounts firms with high inventory, firms decrease their inventory. The author finds that equity coefficients are significant and positive for the financing channel, but the debt coefficients are statistically insignificant. In addition, she finds that coefficients related to the catering channel are significantly negative. Furthermore, Tribo (2009) argues that a firm's stock market flotation affects inventory policy. The author documents that firms that floated on the stock market are subject to scrutiny, which hinders them from implementing the types of empire-building overinvestment policies that may generate inventory accumulation as informative signals of inventories. Beauchamp et al. (2014) examine an unbalanced panel of 34,351 firm-year observations for 5,292 U.S. firms from 1981 to 2010 with the firm's value variable – excess returns. They find that inventory is associated positively with shareholder wealth effects. In addition, they indicate that the wealth effects of inventory are also conditional on operational and financing friction. Further, they find that operating conditions, financial constraints, and working capital behavior affect

inventory value, suggesting that shareholders price the strategic advantages accompanying inventory. Xu and Yao (2008) find a non-linear relationship between financial performance and inventory holdings. Capkun et al. (2009) also show a positive relationship between US firms' inventory holdings and financial performance.

3. Hypothesis development

3.1 The relationship between inventory investments and firm value

Beauchamp et al. (2014) find that inventory positively affects shareholder wealth, arguing that inventory investments allow firms to hedge uncertainty, such as stock-out risk production buffering risk. Further, they document that the low adjustment costs of inventory enhance firm value. For example, a low adjustment cost of inventory is generally seen as beneficial for a company, as it allows for greater flexibility in responding to changes in customer demand, production capacity, or supply chain disruption. Several hypotheses explain the positive relationship between inventory investment and firm value. First of all, regarding the signaling hypothesis, the literature focuses on asymmetric information's effect on inventory policy. Lev and Thiagarajan (1993) and Tribo (2009) argue that an excessive inventory accumulation might provide a positive signal about a manager's expectation of sales increases. Atnafu and Balda (2018) argue that higher levels of inventory management practice can lead to an enhanced competitive advantage in firms. They show that a company’s inadequate inventory leads to breaks in production planning, thereby hindering its effective firm growth. Furthermore, under the signaling perspective, Cook et al. (2022) suggest that investors respond positively to inventory growth based on an expectation of increased future sales. Hence, a firm’s inventory investments would positively impact firm value. In addition, Tribo (2009) points out that under the liquidity hypothesis, inventory investment involves some risk mitigation. Inventory is essential in hedging liquidity shock because it changes inventory assets to cashable assets. For example, inventory liquidity can increase available cash reserves if a firm faces an immediate financial crisis. Consequently, the increase in inventory investments will lead to better value for the company. In light of the above, we propose the following hypothesis.

Hypothesis 1: *Inventory investments are positively associated with firm value.*

3.2 The effect of growth opportunities on the relationship between inventory investments and firm value

Firms with growth opportunities facing high market demand might actively enlarge inventory investment to increase the company's sales. In particular, increasing inventory investment in firms with high growth opportunities gives a positive signal to the capital market. For example, since firms with high growth opportunities have high information asymmetry, a firm's inventory investment might mitigate adverse selection costs, thereby enhancing firm value. Consequently, we predict that inventory investments positively relate to firm value as firms increase growth opportunities. Under the above explanations, we propose the following hypothesis.

Hypothesis 2: *The positive relationship between inventory investments and firm value is more pronounced for firms with high growth opportunities than those with low growth opportunities.*

4. Data and Sample

We obtained the data from Korea Investors Services Value (KIS-VALUE) supplied by National Information and Credit Evaluation (NICE) to investigate our proposed hypotheses. The KIS-Value includes company files and financial statement information for all public and non-public firms. Using data from KIS-VALUE, we further limit our sample to non-financial firms listed on the Korea Exchanges, for which all relevant data are available. In particular, we exclude financial service companies since the accounting scheme is incompatible with firms in other countries (Chang, 2003). We delete firm-year observations with missing values and extreme outliers. Our final sample consists of 30,609 firm-year observations from 2000 to 2018 for listed Korean firms on the Korea Stock Exchange (KSE).

5. Research Methodology

We perform a *t*-test to analyze firm-specific characteristics for inventory and the panel regression model to test the hypothesis. The advantage of panel data methodology is that it allows us to control for unobservable heterogeneity. To analyze the relationship between inventory level and firm value, we use an estimated panel regression equation that takes the following form:

$$\begin{aligned}\text{Firmvalue}_{i,t} &= \alpha+\beta_1\text{InvAsset}_{i,t}+ \beta_2\text{InvAsset}_{i,t}\times\text{AssetGr}_{i,t}+ \beta_3\text{AssetGr}_{i,t}+ \beta_4\text{Leverage}_{i,t} \\ &+ \beta_5\text{LnAsset}_{i,t} + \beta_6\text{FirmAge}_{i,t} + \beta_7\text{Profitability}_{i,t}+ \beta_8\text{CashHolding}_{i,t} + \beta_9\text{FixedAsset}_{i,t}+ \beta_{10} \\ &2008\text{Dummy}_{i,t}+ u_i + \lambda_t + e_{i,t}. \end{aligned} \quad (1)$$

Panel regression is one of the most applied methodologies to adjust for the possibility of endogeneity. Simultaneity bias may occur in the relationship between inventory and firm value. For instance, while inventory could affect the firm value, that, in turn, could also affect inventory. In this case, estimation of Equation (1) using OLS can transpire biased coefficient estimates; we control for firm fixed effects to mitigate any potential correlation between trade credit and unobserved heterogeneity that may influence firm performance. The parameter u_i is the firm's unobservable individual effect that captures the unique characteristics of each firm. The parameter t is a time dummy variable that aims to capture the influence of economic factors that may also affect the determinants of corporate trade credit and firm performance, but firms cannot control it. Furthermore, the parameter $e_{i,t}$ is the random disturbance. Appendix A reports a description of the variables.

We use *Tobin's Q* as a proxy for the dependent variable to measure the firm value. First, we measure future growth opportunities using *Tobin's Q* for each firm. *Tobin's Q* is defined as the book value of total assets minus the book value of equity plus the market value of equity divided by the book value of total assets (Chen et al., 2005; Buchanan et al., 2018). Mainly as the market-based measurement, *Tobin's Q* represents long-term and forward-looking firm performance reflecting the shareholders' expectations concerning future growth opportunities. In addition, we use *ROA* as a proxy for measuring firm performance. We define *ROA* as earnings before interest taxes divided by the book value of total assets.

As independent variables, we use a proxy variable of *InvAsset* to measure the firm's inventory. *The inventory (InvAsset)* variable is defined as inventory holdings divided by the book value of total assets. Specifically, we consider *asset growth rate to be* a proxy variable for growth. We include asset growth rate as an explanatory variable because high-growth firms are often characterized as companies that would be vulnerable to financial distress costs and asymmetric information. *Asset growth rate (AssetGr)* is measured by subtracting total assets in year t-1 from total assets in year t divided by total assets in year t-1[(total assets in year t - total assets in year t-1)/ total assets in year t-1].

As control variables, we use *Leverage* as a proxy variable to analyze the impact of firms on financial distress costs. *Total debt divided by total assets measures Leverage*. Small and young firms are typically less diversified and more likely to be distressed. They would have high debt-related costs and equity-related adverse selection costs. We measure the size of firms by *LnAsset,* which is the natural logarithm of total assets. While we define *FirmAge* as the natural logarithm of the difference between 2018 and the year the firm was established, we measure cash holdings as total cash divided by total assets. We quantity fixed assets as total fixed assets divided by total assets.

In addition, we investigate the impact of risk factors on inventory holdings. Chen et al. (2005) suggest that abnormal inventory can serve as a proxy for a known risk factor. We introduce a standard empirical asset-pricing framework from Fama and French (1993) to examine this. Let *i* be the portfolio index. We run an expected return regression using Equation (2):

$$R_i - R_f = \alpha + \beta_1 (R_m - R_f) + \beta_2 \text{SMB portfolio} + \beta_3 \text{HML portfolio} + e_{i,t}. \quad (2)$$

The risk factors are market risk premium (Rm-Rf), firm size premium (SML), and book-to-market premium (HML portfolio). While separating 10 decile portfolios of inventory assets, we run regression equation (2) based on the Fama and French model. In particular, the coefficients define how sensitive a given portfolio returns are to the individual risk factors. If the risk factors explain the returns, the intercept should equal zero. A value of intercept (alpha) that differs significantly from zero indicates a return that is not interpreted by the

factors. Based on our hypotheses, we test whether the abnormal intercept values are shown in the highest decile as expected.

Furthermore, to examine whether our analysis has robust results, we measure firms' excessive performance and abnormal returns (AR) as a proxy variable for firm value using the market model as the pricing benchmark using Equation (3):

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We define:

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \quad (3)$$

Where R_{it} and R_{mt} are the daily returns of the firm *i* at time *t* and the corresponding daily returns of the market index at time *t*, respectively, the coefficients $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the ordinary least squares estimates of the intercept and slope of the market model regression, respectively.

6. Empirical results

6.1. Descriptive statistics

Table 1 reports a brief description of the variables used in the study. The data spans from 2010 to 2018. We initially use *Tobin's Q* as our dependent variable and define it as the equity market value plus the debt value divided by the total assets' book value. *Tobin's Q* is often used in empirical finance studies, encompassing market opinion about forward-looking market valuation (Buchanan et al., 2018). The average and median *Tobin's Q* values are 1.230 and 0.679, respectively, indicating that *Tobin's Q* is right-skewed with a standard deviation of 1.370. We also use an alternative performance measure, *ROA*, with a smaller variation and an average value of 0.062 for the entire period. The sample, on average, experiences 10.8 percent average growth, has a leverage of 46 percent, and the average age of firms is about 25 years. Inventory assets are about 10.8 percent of total assets, fixed assets constitute about 31.4 percent of total assets, and firms' cash holdings, on average, are about 8.8 percent of the total assets.

[Insert Table 1 about here]

We examine the inventory-to-asset ratios for our sub-sample of firms with high and low-growth opportunities. Figure 1 shows inventory-to-asset ratios during the 2000-2018 period. Although these ratios alternate during the study period for firms with high and low-growth opportunities, the firms with high growth opportunities exhibit higher level in inventory asset ratios as expected. On the other hand, the low-growth firms showed more stable asset ratios during the study period.

[Insert Figure 1 about here]

Table 2 compares high- and low-growth firms for the sub-sample of firms with high- and low-inventory inventories. Starting with Panel A, we note that within high-inventory firms, there are significant differences among variables between high and low-growth firms. For example, *Tobin's Q* appears to be lower for high-asset growth firms (1.200) than for low-asset growth firms (1.245). On the other hand, *ROA* is significantly higher for high-growth firms (9.308) than for low-growth firms (3.814). The difference is statistically significant at a 1 percent level. Similarly, we observe significantly higher profitability and cash holdings for high-growth companies. On the other hand, low-growth companies have substantially higher fixed assets and are younger than high-growth firms. Finally, we examine inventory assets. We note that high-asset growth firms have higher inventory holdings (0.179) than low-growth firms (0.176), and the difference is marginally significant at the 5 percent level. Panel B of Table 2 reports the identical comparison for firms with low inventory. The results resemble the previous findings with the following exceptions. High-growth firms in this sub-sample are older and have higher inventory holdings than low-growth firms. Furthermore, the firm's size is significantly larger than low-growth firms.

[Insert Table 2 about here]

Table 3 shows Pearson correlation coefficients for dependent and independent variables. Overall, the correlation among variables is low, and multicollinearity does not appear to impact our findings and interpretations. For example, the highest correlation is 0.458 between

firm size (measured by the log of assets) and firm age. In particular, inventory assets appear to be inversely correlated with *Tobin's Q* and directly associated with *ROA* measures.

[Insert Table 3 about here]

6.2. The relationship between inventory and firm value

We start our empirical analysis by examining the relationship between inventory and firm value as outlined in Equation (1). We report our results in Table 4. In Panel A of Table 4, we initially used *Tobin's Q* as our dependent variable and ran three models. Our first model, a standard OLS model (not reported here), may fail to control the time-invariant unobserved firm characteristics that correlate with our model's explanatory variables. As a result, we rely on the panel fixed effects model (Fahlenbrach, 2009) in our interpretations of results. We also note that the panel fixed effects model may suffer from endogeneity problems. We include Arellano and Bond's (1991) panel GMM in our analysis to account for endogeneity problems. We, however, report our empirical results for the latter two models with two variations each.

While we focus on the relationship between inventory and firm value, we control for growth, leverage, size, firm age, profitability, cash holdings, and fixed assets. Panel A of Table 4 reports the adjusted R^2 ranging from a low of 0.68 to a high of 0.72 for all models. The inventory (*InvAsset*) coefficient is statistically significant across all models at a 1% level. For example, the coefficients of *InvAsset* are 0.607 and 0.674 for the panel fixed effects and panel GMM models. These results indicate that a 1 percent increase in inventory to total asset ratio would increase firm value, measured by *Tobin's Q*, by 0.604 and 0.674 percent, respectively. Based on these two models, we conclude that inventory assets are directly related to the firm's *performance* using *Tobin's Q* as a performance measure. When we control for other variables, our primary findings remain the same. The *InvAsset* variable is statistically significant at a 1% level with coefficients of 0.327 and 0.337 for the panel fixed effects and panel GMM Models, respectively.

Additionally, we find the following for control variables. First, leverage increases firm performance as the coefficients of the *Leverage* variable are positive and highly statistically significant at a 1 % level, irrespective of the model used. Hence, we conclude that leverage

increases firm performance. Second, we note that smaller firms perform better than larger ones as the coefficient of size (*LnAsset*) variable is negative and statistically significant for all models. We also find that firms with a higher proportion of cash holdings relative to total assets experience higher *Tobin's Q,* which holds across all models. A similar result is reported for the fixed assets (*FixedAsset)* variable. So, firms with more fixed assets have higher *Tobin's Q* and better performance. To our surprise, *Tobin's Q* is negatively associated with the *Profitability* variable across all models. The remaining variables are not statistically significant.

We then move to Panel B, using *ROA* as our dependent variable. The coefficient *InvAsset* variable has a positive sign across the models used. The coefficients are 0.028, 0.087, 0.024, and 0.090, respectively, and statistically significant at a 1% level. These findings reinforce our previous results that inventory assets positively affect firm performance. A one percent increase in inventory assets is associated with about a nine percent increase in firm performance measured by ROA while controlling other variables.

When we examine our control variables, we note that the growth variable (*AssetGr*) coefficient is also positive and highly significant across the models. Size variable (*LnAsset*) and cash holdings relative to total asset (*CashHolding*) variables continue to have significant expected signs. The coefficient of the *Profitability* variable now has the expected positive sign and is highly significant across all models. The remaining variables do not appear to impact firm performance in the last two models.

[Insert Table 4 about here]

6.2.1 Fama-French Regression for Inventory Decile Portfolio

In this section, we examine whether the level of inventory has abnormal returns. Table 5 shows abnormally high returns from decile three through decile six portfolios. Furthermore, the decile ten portfolios with the highest inventory do not have abnormal returns. The results show that inventory provides relevant information for stock returns.

[Insert Table 5 about here]

6.3. The impact of growth opportunities on the relationship between inventory investment and firm value

In this section, we analyze the impact of growth opportunities on the relationship between inventory investment and firm value. As we reported in Panel A of Table 6, the coefficient of the interaction variable (InvAsset*AssetGr) is positive and significant for all models using *Tobin's Q* as the dependent variable. Furthermore, in Panel B of Table 6, the coefficient of the interaction variable (InvAsset*AssetGr) is positive and significant for all models using *ROA* as the dependent variable.

[Insert Table 6 about here]

Thus, we need to analyze the impact of inventory on firm value by dividing our sample into high-growth and low-growth firms. Panel A of Table 7 reports regression estimates for high-growth companies using *Tobin's Q* and *ROA* as performance measures. We find that the high-growth firm group experiences a better performance for both measures. Using *Tobin's Q* as a performance measure, we find that the coefficients of the *InvAsset* variable are 0.486 and 0.513 using panel fixed-effects and panel GMM models, respectively. We find that high-growth firms also experience better performance with higher inventory assets. Both are statistically significant at a 1 % level. The findings for the control variables are similar to those reported before. In the last two columns of Table 7, using *ROA* as a performance measure, our results show that the *InvAsset* variable continues to be statistically significant at a 1 % level with estimated coefficients of 0.120 for both panel fixed-effects and panel GMM models.

[Insert Table 7 about here]

6.5. Robustness tests

We finally performed a series of robustness tests to confirm our findings. These include the following.

6.5.1. The relationship between inventory and firm value using Abnormal Returns as a dependent variable

We test the relationship between inventory and firm value using abnormal firm performance as our dependent variable. We report our findings in the first two columns of Table 8. While the first columns only show the impact of inventory on abnormal firm performance, the last two columns also include the *InvAsset*AssetGr* interaction variable. Findings in the first two columns reinforce our previous results that the *InvAsset* has a statistically significant effect on firm performance using panel fixed effects and panel GMM with coefficients of 0.161 and 0.165, respectively. *AssetGr*, *Leverage, Cashholding*, and *Profitability* variables have statistically significant positive coefficients among the remaining variables. These findings show that firms with higher asset growth, highly leveraged with higher cash holdings, and profitability have higher performance using excess returns as the dependent variable. We also note that smaller firms tend to perform poorly relative to large firms. In the last two columns, we add the interaction variable of the "*InvAsset*AssetGr*" variable in our analysis. This variable is statistically significant using both panel fixed Effects and panel GMM models with coefficients of 0.780 and 0.773, respectively. These findings align with our previous results that firms with high inventory assets and higher asset growth experience higher firm performance proxied by abnormal returns.

[Insert Table 8 about here]

6.5.2. The non-linear relationship between inventory and firm value

We also examine the non-linear relationship between inventory and firm value by incorporating the square of the *InvAsset* variable. We report our findings in Table 9. While the first two columns of Table 9 use *Tobin's Q*, and the last two use *ROA* as performance measures. Our results show that the *InvAsset* variable is positive and statistically significant at a 1 % level for both performance measures under panel fixed-effects and panel GMM models. $InvAsset^2$ variable has a negative sign across both measures but is only statistically significant

for the *ROA* performance measure. For example, the coefficients are -0.284 and -0.253 for the panel fixed effects and panel GMM models. A positive coefficient for the inventory variable and a negative coefficient for the $InvAsset^2$ show that firm performance increases to a point with increases in inventory assets. Then declines after reaching a peak. Among the remaining variables, Cash holdings, asset growth, and leverage appear to be positively related to firm performance, while profitability and size are negatively associated with firm performance.

[Insert Table 9 about here]

6. Conclusion

There has been a noticeable increase in financial managers' interest in inventory management to optimize inventory holdings. While the task seems more procurement-sale managers oriented, financial managers are accountable for efficiently managing funds consistent with shareholder wealth maximization. Inventory costs include acquisition, ordering, carrying, and shortage as failure to deliver, causing a deficit of capital and reducing sales. Thus, as part of working capital management, inventory management has an essential role in financial and operations management. Kieschnick et al. (2013) argue that inventory management is a critical performance indicator of their firm.

This paper contributes to the debate by highlighting the importance of inventory on firm value. This study contributes to the growing literature on the relationship between inventory and firm performance. Based on a panel data set of 763 firms in Korea, this study provides strong evidence that inventory policy affects firm value. More specifically, inventory positively impacts *Tobin's Q*. High inventory levels may benefit shareholders. Our work in the Korean market provides unique evidence from an emerging market. Inventory research on the emerging market is limited mainly to firms with average growth. We also investigate whether inventory affects the firm value in the context of growth firms in an emerging market. In addition, asymmetric information is relevant in emerging markets because of relatively undiversified equity shareholders and the high monitoring cost. Managers in these countries are more interested in short-term performance than long-term performance. Thus, increasing inventory will affect firm value differently relative to markets with limited information asymmetry.

In summary, higher inventory firms are likelier to have higher firm values. The result is consistent with the signaling hypothesis related to information asymmetry. Second, we find that inventory has a nonlinear impact on firm performance. In particular, we find that *ROA* increases with the increases in inventory level, while it decreases with the inventory after reaching a peak. More importantly, these empirical results show a significantly nonlinear relationship even after controlling for firm-specific variables. Finally, we find that the inventory of growth firms is higher than those of non-growth firms. The results suggest that growth firms are inclined to engage in inventory activities to enhance firm value actively.

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Figure 1. The trend of inventory to asset ratios across high growth opportunities vs. low growth opportunities

The figure illustrates the trend of our sample's inventory-to-asset ratio for firms with high and low growth opportunities during the 2000-2018 period.

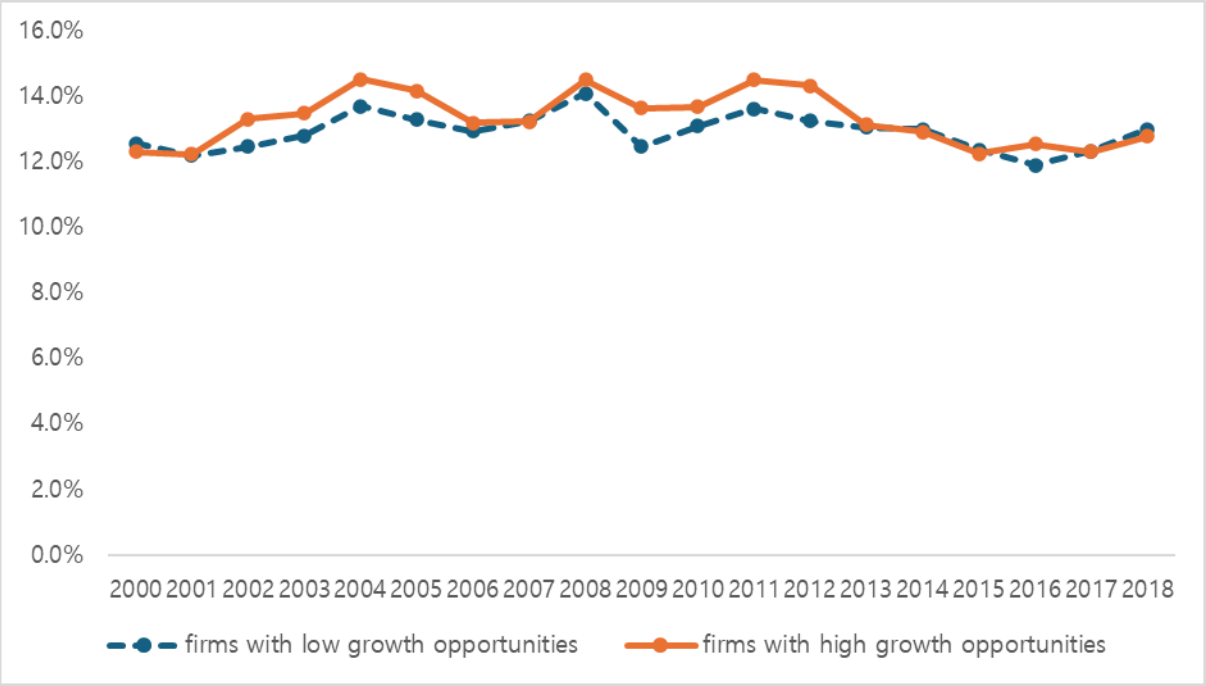

Table 1. Descriptive Statistics

This table reports the descriptive statistics of our sample observations during the study period.

	Obs.	*Mean*	*Median*	*Max.*	*Min.*	*Std.Dev.*
Tobin's Q	31341	1.230	0.679	4.997	0.090	1.370
ROA	31341	0.062	0.042	0.330	0.000	0.071
InvAsset	31341	0.109	0.095	0.348	0.000	0.086
AssetGr	31341	0.108	0.051	0.368	0.000	0.130
Leverage	31341	0.460	0.461	0.929	0.000	0.213
LnAsset	31341	18.676	18.444	26.550	13.103	1.663
FirmAge	31341	24.506	21.000	121.000	0.000	16.791
Profitability	31341	0.072	0.052	0.341	0.000	0.074
CashHodings	31341	0.088	0.059	0.444	0.001	0.090
FixedAsset	31341	0.314	0.306	0.795	0.000	0.195

Table 2. Comparison between firms with high inventory firms and firms with low inventory

This table compares high and low-asset growth firms within high and low-inventory samples.

Panel A. *Firms with high inventory*

Variables	*High Asset growth*		*Low Asset growth*			
	Obs.	Mean	Obs.	Mean	Difference	p-value
Tobin' Q	7375	1.200	8455	1.245	-0.045**	0.037
ROA	7466	9.308	8095	3.814	5.494***	0.000
InvAsset	7466	0.179	8575	0.176	0.002**	0.036
Leverage	7466	0.470	8575	0.481	-0.011***	0.001
Assets+	7466	752.537	8575	677.114	75.423	0.275
FirmAge	7377	23.435	8455	27.413	-3.978***	0.000
Profitability	7466	0.080	8575	0.049	0.031***	0.000
CashHoldings	7466	0.081	8575	0.069	0.012***	0.000
FixedAsset	7466	0.312	8575	0.336	-0.024***	0.000

Panel B. *Firms with low inventory*

Variables	*High Asset growth*		*Low Asset growth*			
	Obs.	Mean	Obs.	Mean	*Difference*	*p-value*
Tobin' Q	7689	1.236	8531	1.280	-0.044**	0.048
ROA	7750	9.146	8014	3.584	5.562***	0.000
InvAsset	7577	0.038	8412	0.039	-0.001	0.171
Leverage	7750	0.441	15773	0.247	0.195***	0.000
Assets+	7750	1,560.0	8642	1,320.7	239.3	0.102
FirmAge	7701	21.444	11274	20.109	1.335***	0.000
Profitability	7750	0.099	15773	0.034	0.064***	0.000
CashHoldings	7750	0.109	8642	0.093	0.016***	0.000
FixedAsset	7750	0.280	8642	0.316	-0.036***	0.000

+Assets (in billions won)

***, ** and * represent 1% , 5% , and 10% significance levels, respectively.

Table 3. Correlation matrix

This table reports the correlation among the variables used.

	Tobin' Q	ROA	InvAsset	AssetGr	Leverage	LnAsset	FirmAge	Profit-ability	Cash-Holdings	Fixed Asset
Tobin' Q	1.000									
ROA	-0.045	1.000								
InvAsset	-0.003	0.023	1.000							
AssetGr	0.010	0.428	-0.022	1.000						
Leverage	0.079	-0.208	0.088	0.000	1.000					
LnAsset	-0.255	-0.091	-0.058	-0.081	0.208	1.000				
FirmAge	-0.093	-0.184	0.042	-0.185	0.061	0.458	1.000			
Profitability	-0.061	0.690	-0.118	0.237	-0.288	-0.046	-0.183	1.000		
CashHoldings	0.093	0.172	-0.172	0.124	-0.278	-0.175	-0.212	0.171	1.000	
FixedAsset	-0.042	-0.091	0.038	-0.110	0.229	0.165	0.161	-0.070	-0.360	1.000

Table 4. Panel Regression Estimates for all Firms

The following table reports the panel regression estimates of firm value using Tobin's Q and ROA as proxies.

Panel A: Dependent variable: Tobin's Q

Variables	*Panel Fixed Effects*	*Panel Fixed Effects*	*Panel GMM*	*Panel GMM*
	(1)	*(2)*	*(3)*	*(4)*
Intercept	1.179***	7.792	1.1491***	6.765
	(102.72)	(1.18)	(99.21)	(0.92)
InvAsset	0.607***	0.327***	0.674***	0.337***
	(6.29)	(3.51)	(6.90)	(3.57)
AssetGr		0.032		0.011
		(0.84)		(0.23)
Leverage		1.149***		1.119***
		(33.99)		(32.45)
LnAsset		-0.384***		-0.390***
		-(43.96)		-(42.83)
Firm Age		-0.003		0.045
		-(0.01)		(0.15)
Profitability		-0.210**		-0.242***
		-(2.47)		-(2.78)
CashHoldings		0.412***		0.333***
		(6.09)		(4.81)
FixedAsset		0.250***		0.236***
		(5.67)		(5.33)
Firm fixed effects	o	o	o	o
Period fixed effects	o	o	o	o
Adjusted R^2	0.68	0.71	0.69	0.72
Observations	30910	30609	29609	29609

***, ** and * represent 1%, 5%, and 10% significance levels, respectively.

Panel B: Dependent variable: ROA

Variables	*Panel fixed effects*	*Panel fixed effects*	*Panel GMM*	*Panel GMM*
	(1)	*(2)*	*(3)*	*(4)*
Intercept	0.059***	0.055	0.062***	0.257
	(67.12)	(0.15)	(70.24)	(0.91)
InvAsset	0.028***	0.087***	0.024***	0.090***
	(3.84)	(17.44)	(3.257)	(20.17)
AssetGr		0.130***		0.089***
		(64.57)		(49.44)
Leverage		-0.014***		0.002
		-(7.62)		(1.52)
LnAsset		-0.005***		-0.015***
		-(11.07)		-(33.92)
Firm Age		0.001		0.0001
		(0.08)		(0.01)
Profitability		0.705***		0.795***
		(155.81)		(191.73)
CashHoldings		0.027***		0.037***
		(7.45)		(11.17)
FixedAsset		0.003		0.0001
		(1.47)		-(0.18)
Firm fixed effects	o	o	o	o
Period fixed effects	o	o	o	o
Adjusted R^2	0.28	0.69	0.34	0.77
Observations	31285	30955	29923	29923

***, **, and * represent 1 percent, 5 percent, and 10 percent significance levels, respectively.

Table 5. *Fama-French Regression for Inventory Decile Portfolio*

Inventory decile portfolio	Intercept	Rm-Ri	SMB	HML	R^2
1	0.004	-0.073	-0.087	-0.313***	0.159
	(0.969)	-(0.603)	-(1.150)	-(3.750)	
2	0.001	-0.047	0.089	-0.508***	0.373
	(0.279)	-(0.500)	(1.240)	-(6.927)	
3	**0.007***	-0.107	0.082	-0.271***	0.082
	(1.805)	-(0.990)	(0.728)	-(2.810)	
4	0.004	0.010	0.247***	-0.372***	0.169
	(1.026)	(0.100)	(2.776)	-(4.471)	
5	**0.007***	-0.051	0.230***	-0.074	0.073
	(1.818)	-(0.495)	(2.834)	-(0.812)	
6	**0.006***	-0.134	0.144	-0.249**	0.064
	(1.739)	-(1.349)	(1.370)	-(2.163)	
7	0.004	0.002	0.125**	-0.314***	0.629
	(1.256)	(0.021)	(2.214)	-(6.489)	
8	0.003	0.127	0.141	-0.058	0.053
	(1.090)	(1.479)	(1.634)	-(0.757)	
9	0.002	0.001	0.037	-0.327**	0.262
	(0.582)	(0.007)	(0.594)	-(5.905)	
10	0.001	0.320***	-0.065	-0.145**	0.235
	(0.101)	(4.594)	-(0.964)	-(2.122)	

***, ** and * represent 1%, 5%, and 10% significance levels, respectively. t statisitics are reported in brackets

Table 6. The Effects of Growth Opportunity on the Relationship between Inventory Investment and Firm Value

This table reports the regression estimates for growth firms using Tobin's Q and ROA as performance measures.

Panel A: Dependent variable: Tobin's Q

Variables	*Panel fixed effects*	*Panel fixed effects*	*Panel GMM*	*Panel GMM*
	(1)	*(2)*	*(3)*	*(4)*
Intercept	1.212	7.795	1.176	6.795
	(91.26)	(1.18)	(86.59)	(0.93)
InvAsset	0.541***	0.291***	0.629***	0.328***
	(4.29)	(2.78)	(5.69)	(3.07)
InvAsset*AssetGr	0.581**	0.579**	0.600**	0.61**
	(2.10)	(2.00)	(2.47)	(2.55)
AssetGr	-0.291***	0.0001	-0.159***	0.002
	(-5.08)	-(0.03)	-(2.76)	(0.03)
Leverage		1.149***		1.119***
		(33.98)		(32.44)
LnAsset		-0.384***		-0.390***
		-(43.95)		-(42.83)
Firm Age		-0.003		0.044
		-(0.01)		(0.15)
Profitability		-0.210**		-0.243***
		-(2.48)		-(2.78)
CashHoldings		0.412***		0.333***
		(6.09)		(4.80)
FixedAsset		0.251***		0.237***
		(5.67)		(5.33)
Firm fixed effects	o	o	o	o
Period fixed effects	o	o	o	o
Adjusted R^2	0.68	0.71	0.69	0.72
Observations	30910	30609	29609	29609

***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

Panel B: Dependent variable: ROA

Variables	*Panel fixed effects*	*Panel fixed effects*	*Panel GMM*	*Panel GMM*
	(1)	*(2)*	*(3)*	*(4)*
Intercept	0.039***	0.059	0.043***	0.259
	(41.14)	(0.16)	(45.25)	(0.92)
InvAsset	0.011	0.070***	0.010	0.074***
	(1.50)	(12.65)	(1.34)	(14.56)
InvAsset*AssetGr	0.170***	0.138***	0.168***	0.133***
	(5.88)	(6.52)	(5.74)	(7.06)
AssetGr	0.184***	0.115***	0.158***	0.075***
	(46.02)	(38.83)	(38.78)	(28.316)
Leverage		-0.014***		0.002
		-(7.67)		(1.48)
LnAsset		-0.005***		-0.015***
		-(11.01)		-(33.91)
Firm Age		0.001		0.0001
		(0.08)		-(0.03)
Profitability		0.705***		0.795***
		(155.87)		(191.84)
CashHoldings		0.027***		0.037***
		(7.45)		(11.23)
FixedAsset		0.004		0.0001
		(1.52)		(0.26)
Firm fixed effects	o	o	o	o
Period fixed effects	o	o	o	o
Adjusted R^2	0.40	0.68	0.43	0.77
Observations	31284	30955	29837	29923

***, ** and * represent 1%, 5%, and 10% significance levels, respectively.

Table 7. Panel Regression Estimates for the High-growth and Low-growth firms groups

This table shows the regression estimates for high-growth and low-growth firms using Tobin's Q and ROA as dependent variables.

Panel A: High-growth firms group

Variables	*Tobin's Q*		*ROA*	
	Panel fixed effects	*Panel GMM*	*Panel fixed effects*	*Panel GMM*
	(1)	*(2)*	*(3)*	*(4)*
Intercept	7.272***	7.413***	0.351***	0.350***
	(27.73)	(28.36)	(29.01)	(28.82)
InvAsset	0.486***	0.513***	0.120***	0.120***
	(3.52)	(3.72)	(18.77)	(18.65)
AssetGr	-0.002	0.002	0.059***	0.059***
	-(0.03)	(0.03)	(19.35)	(19.30)
Leverage	1.133***	1.133***	0.017***	0.017***
	(20.57)	(20.64)	(6.77)	(6.80)
LnAsset	-0.360***	-0.368***	-0.021***	-0.020***
	-(25.58)	-(26.23)	-(31.52)	-(31.34)
Profitability	0.092	0.026	0.954***	0.952***
	(0.73)	(0.21)	(163.89)	(162.56)
CashHoldings	0.311***	0.320***	0.053***	0.053***
	(3.22)	(3.33)	(11.86)	(11.89)
FixedAsset	0.148***	0.158**	-0.005*	-0.005
	(2.16)	(2.32)	-(1.72)	-(1.61)
Firm fixed effects	o	o	o	o
Period fixed effects	o	o	o	o
Adjusted R^2	0.72	0.73	0.82	0.83
Observations	14515	14393	14666	14534

***, ** and * represent 1%, 5%, and 10% significance levels, respectively.

Panel B: Low-growth firms group

A. Variables	*Tobin's Q*		*ROA*	
	Panel Fixed Effects	*Panel GMM*	*Panel Fixed Effects*	*Panel GMM*
	(1)	*(2)*	*(3)*	*(4)*
Intercept	7.982***	8.067***	-0.123***	-0.121***
	(35.38)	(35.55)	-(12.24)	-(11.96)
InvAsset	0.205	0.179	0.046***	0.046***
	(1.53)	(1.33)	(7.62)	(7.50)
AssetGr	-0.629*	-0.620	0.339***	0.332***
	-(1.65)	-(1.63)	(19.55)	(19.26)
Leverage	1.157***	1.159***	-0.019***	-0.018***
	(25.22)	(25.14)	-(9.14)	-(8.75)
LnAsset	-0.397***	-0.401***	0.007***	0.007***
	-(32.93)	-(33.15)	(13.04)	(12.73)
Profitability	-0.311**	-0.281**	0.446***	0.450***
	-(2.46)	-(2.21)	(77.48)	(78.13)
CashHolding	0.589***	0.560***	0.014***	0.016***
	(5.85)	(5.52)	(3.11)	(3.47)
FixedAsset	0.265***	0.264***	0.006**	0.005*
	(4.33)	(4.32)	(2.04)	(1.91)
Firm fixed effects	o	o	o	o
Period fixed effects	o	o	o	o
Adjusted R^2	0.72	0.71	0.49	0.50
Observations	16395	16216	16619	16421

***, ** and * represent 1%, 5%, and 10% significance levels, respectively.

Table 8. Panel Regression Estimates of the Impact of Inventory on Firm Value using the abnormal returns as the dependent variable.
This table reports the regression estimates for the firms using abnormal returns as a proxy for firm value to provide an additional robustness test.

	With Abnormal Return		*With Abnormal Returns with InvAsset and AssetGr interaction*	
Variables	*Panel fixed effects*	*Panel GMM*	*Panel fixed effects*	*Panel GMM*
	(1)	*(2)*	*(1)*	*(2)*
Intercept	0.860	1.298	0.863	1.300
	(0.133)	(0.293)	(0.133)	(0.293)
InvAsset	0.161*	0.165**	0.080	0.086
	(1.921)	(1.974)	(0.873)	(0.928)
InvAsset*AssetGr	-	-	0.780**	0.773**
			(2.101)	(2.081)
AssetGr	0.457***	0.455***	0.376***	0.374***
	(13.286)	(13.199)	(7.260)	d(7.217)
Leverage	0.100***	0.101***	0.099***	0.100***
	(3.112)	(3.133)	(3.088)	(3.110)
LnAsset	-0.082***	-0.082***	-0.081***	-0.082***
	-(9.026)	-(9.087)	-(8.991)	-(9.054)
Firm Age	0.015	0.000	0.015	0.0001
	(0.066)	-(0.002)	(0.066)	-(0.002)
CashHoldings	0.226***	0.232***	0.228***	0.234***
	(3.651)	(3.743)	(3.679)	(3.770)
Profitability	1.524***	1.538***	1.520***	1.535***
	(18.408)	(18.520)	(18.362)	(18.477)
Adjusted R^2	0.06	0.06	0.06	0.06
Observations	22762	22740	22762	22740

***, ** and * represent 1%, 5%, and 10% significance levels, respectively.

Table 9. Panel Regression Estimates of the Non-linear Relationship between Inventory and Firm Performance

This table reports the regression estimates using a non-linear estimation between inventory and firm performance.

	Tobin's Q		*ROA*	
Variables	*Panel fixed effects*	*Panel GMM*	*Panel fixed effects*	*Panel GMM*
	(1)	*(2)*	*(1)*	*(2)*
Intercept	7.759	7.091	0.051	0.255
	(1.061)	(0.910)	(0.135)	(0.894)
InvAsset	0.651***	0.479*	0.176***	0.170***
	(2.553)	(1.856)	(12.934)	(13.890)
$InvAsset^2$	-1.029	-0.451	-0.284***	-0.253***
	-(1.365)	-(0.592)	-(7.046)	-(6.999)
AssetGr	0.032	0.009	0.130***	0.089***
	(0.857)	(0.247)	(64.694)	(49.571)
Leverage	1.150***	1.119***	-0.014***	0.003
	(34.010)	(32.450)	-(7.492)	(1.629)
LnAsset	-0.384***	-0.390***	-0.005***	-0.015***
	-(43.980)	-(42.828)	-(11.383)	-(34.146)
Firm Age	-0.002	0.034	0.001	0.0001
	-(0.006)	(0.111)	(0.088)	(0.003)
Profitability	-0.204	-0.240	0.707***	0.796***
	-(2.407)	-(2.748)	(156.096)	(191.994)
CashHoldings	0.410***	0.332***	0.026***	0.036***
	(6.055)	(4.789)	(7.265)	(10.979)
Adjusted R^2	0.71	0.72	0.68	0.77
observations	30609	29609	30995	29923

***, ** and * represent 1%, 5%, and 10% significance levels, respectively.

Appendix A. Description of variables

Variables	Description
Tobin's Q	The book value of total assets minus the book value of equity plus the market value of equity divided by the book value of the total asset
ROA	Earnings before interest taxes (EBIT) divided by the book value of total assets.
Abnormal Return	$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt})$ Where R_{it} and R_{mt} are the daily returns of the firm *i* at time *t* and the corresponding daily returns of the market index at time *t*, respectively, the coefficients $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the ordinary least squares estimates of the intercept and slope, respectively, of the market model regression.
InvAsset	Inventory divided by the book value of total assets
Leverage	Total debt divided by total assets
AssetGr	Subtracting total assets in year t-1 from total assets in year t divided by total assets in year t-1[(total assets in year t - total assets in year t-1)/ total assets in year t-1
LnAsset	The natural logarithm of the book value of total assets. This variable intends to proxy for size.
FirmAge	The natural logarithm of the difference between 2018 and the year the firm was established.
CashHoldings	Total cash divided by total assets
Profitability	EBIT divided by total sales
FixedAsset	Fixed asset divided by total assets