경영학석사 학위논문

The Effect of Discrete Components of Inventory and Operational Slack on Future Performance

재고와 유휴 자원이 실적에 미치는 영향

2021년 8월

서울대학교 대학원

경영학과 회계학 전공

신 민 하

The Effect of Discrete Components of Inventory and Operational Slack on Future Performance

재고와 유휴 자원이 실적에 미치는 영향

지도 교수 황 인 이

이 논문을 경영학 석사 학위논문으로 제출함

2021 년 7 월

서울대학교 대학원

경영학과 회계학 전공

신 민 하

신민하의 경영학 석사 학위논문을 인준함

2021 년 7 월

위 원 장 최 종 학

부 위 원 장 최 선 화

위 원 황 인 이

The Effect of Discrete Components of Inventory and Operational Slack on Future Performance

Minha Shin
College of Business Administration
The Graduate School
Seoul National University

ABSTRACT

This study focuses on the relationship between discrete components of inventory and future performance and extends it to the operational slack and future performance. I use the U.S. manufacturing industries data from 1972 to 1999. Consistent with the predictions, I find that both raw materials and finished goods are negatively and significantly associated with firm future performance. Additionally, I further investigate how the operational slack using DOI and SOP with discrete components of inventory affects the future performance. I find that the moderating effect of operational slack and discrete components of inventory varies, depending on the types of operational slack and inventory. It shows that DOI and finished goods and raw materials are negatively associated with future performance, however, the SOP and finished goods and raw materials are positively and negatively related to future performance, respectively.

Keyword : operational slack; finished goods; raw materials; performance

Student Number : 2019-26497

Table of Contents

I. INTRODUCTION

Inventory is the largest and most valuable assets to the manufacturing industry. Prior literature has examined the relationship between firm performance and inventory. Specifically, Chen et al. (2005) focuses on the long-term stock returns and inventory in manufacturing firms. In addition, composite industries are used to investigate the effect of inventory on profitability (Shah and Shin 2007). However, various studies employ total inventory instead of discrete components of inventory: raw materials, work-in-process, and finished-goods (Claycomb et al. 1999; Gaur et al. 2005; Roumiantsev and Netessine 2007; Swamidass 2007; Koumanakos 2008; Capkun et al. 2009; Eroglu and Hofer 2011; Hofer et al. 2012; Eroglu and Hofer 2014; Isaksson and Seifert 2014).

Previous studies also have not considered operational leanness with different inventory components. There are different definitions regarding to operational slack. James Thompson (1967) was the first to explain operational slack as "buffer the technical core from the variances and discontinuities presented by environmental demands." Generally, slack plays two roles. Firstly, slack is the spare resources which the firm may be able to deal with the unexpected circumstances (March 1958). Also, slack is "the margin or surplus or performance exceeding satisficing level which permits an organization's dominant coalition to adopt structural arrangements which accord with their own preferences even at some extra administrative cost." Secondly, slack is "an agent of top management in initiating and executing

strategic changes" (Child 1972; Bourgeois 1981).

The empirical analysis of the paper is based on the data of U.S. manufacturing firms with SIC codes from 2000 to 3999. I obtain the annual and quarterly data from Compustat File. Both annual and quarterly data are required due to the sales volatility. Additionally, gross domestic product dataset acquired from World Bank from 1972 to 1999.

As explained in the previous study, each inventory component serves a different function in the supply chain (Capkun et al. 2009). However, I do not consider work-in-process in the analysis. Compared to raw materials and finished goods inventory, work-in-process inventory does not directly relate to customers or suppliers (Balakrishnan et al. 1996). To investigate the operational slack, I employ sales to net property, plant, and equipment and days of inventory (Hendricks et al. 2009). I test that firms with high raw materials inventory are more likely to be associated with negative future performance, suggesting that firms often fail to meet the demand in the market. They purchase the raw materials more than expected, and the excess materials are kept in the warehouse. The similar concept applies to the finished goods. Due to the supply in excess of demand, finished goods are not sold in the market, it becomes obsolete. The remained inventories are costly. I perform additional analyses how the operational slack and each inventory with operational slack affect the future sales. Raw materials and days of inventory and finished goods and days of inventory are negatively associated with future sales. It supports that high days of inventory or slow inventory turnover

indicates that firm do not replace the inventories that it has sold as many as they can, and it leads to weak sales or possible excess inventory. On the other hand, I find that raw materials and sales to net property, plant, and equipment and finished goods and net property, plant, and equipment are negatively and positively related to future sales, respectively. Even though there is already enough slack in the warehouse, firms still purchase raw material and make more finished goods because they believe that the future demand will increase.

This paper makes a contribution. The findings in the study contribute to literature by examining the discrete components of inventory on firm performance in terms of future revenue. None of the prior literature has examined this relationship. I carefully expect that this paper may resolve the existence problem that improvement in inventory performance is actually related to improvement in overall performance. Several studies suggest that improvement in inventory performance may reduce overall performance, whereas others do not.

In the remainder of this paper, section 2 describes the prior literature and hypotheses regarding discrete components of inventory and operational slack and develops into four hypotheses. Section 3 provides the sample, empirical, models, descriptive statistics, and Pearson and Spearman correlation. Section 4 provides the empirical findings. Lastly, section 5 concludes with the summarized findings, contributions, and limitations of the research.

II. PRIOR LITERATURE AND HYPOTHESES

2.1. Prior literature on Inventory

A wide stream of conventional studies examines firm performance of inventory management because of the role of inventories in manufacturing industries. The prior literature on the inventory has mainly focused on the total inventory rather than discrete components of inventory (Claycomb et al. 1999; Gaur et al. 2005; Roumiantsev and Netessine 2007; Swamidass 2007; Koumanakos 2008; Capkun et al. 2009; Eroglu and Hofer 2011; Hofer et al. 2012; Eroglu and Hofer 2014; Isaksson and Seifert 2014). Chen et al. (2005) investigate the association between long-term stock returns and inventory in manufacturing industries. Lieberman et al. (1999) analyze the change in discrete components of inventory of automotive industry. Furthermore, Shah and Shin (2007) use three different industries, which are manufacturing, retail, and wholesale, to find the relation between inventory and profitability. Recent study that investigated the discrete components of inventory shows the association between discrete components and the financial performance with respect to gross profit and operational level. However, none of the above studies analyze the relationship between inventory performance and financial performance of manufacturing industries at the firm level. Besides, prior studies did not employ different financial performance measures, including future revenue, with inventory performance. As pointed out, previous studies have not examined the relationship between the discrete components of

inventory with firm performance measure in terms of future revenue and further extended to inventory leanness.

Hertzel et al. (2008) find that weak raw material management is a risk signal to suppliers, and the managers eventually modify their supply chain strategy. In addition, raw material volatility is positively related to operational risk, which will lead investors to demand higher returns by taking higher risk. However, the main reason that firm keeps finished goods inventory mainly due to the unanticipated demand shocks (Kahn 1987; Chen et al., 2005; Hendricks and Singhal 2009; Bendig et al. 2018).

2.2. Prior literature on Operational Slack

Generally, slack has two roles. Firstly, March (1958) describes slack as the spare resources which the firm may be able to deal with the unexpected circumstances. On the other hand, slack is "the margin or surplus or performance exceeding satisficing level which permits an organization's dominant coalition to adopt structural arrangements which accord with their own preferences even at some extra administrative cost." Secondly, slack is "an agent of top management in initiating and executing strategic changes" (Child 1972; Bourgeois 1981). In addition, Moch and Pondy (1977) describes that slack is choice opportunity to management. In this case, slack makes a company to modify its gross shits in accordance with the external shock, and the management may deal with various issues.

Chen et al. (2005) find that total inventory days declined by 2 percent from 1981 to 2000. Specifically, raw material inventory declined approximately 3 percent, but finished goods inventory did not decline. Prior studies find the positive relationship between inventory leanness and firm profitability in terms of total inventory components (Capkun et al. 2009; Eroglu and Hofer 2011; Isaksson and Seifert 2014). Furthermore, even though environmental uncertainty increases, the probability of disruption does not increase because of the slack (Azadegan et al. 2013).

2.3. Hypotheses Development

Generally, people do not prefer uncertainty. As industry perspective, inventors and suppliers strive to avoid risk or lower the risk. Therefore, they keep the stock, but these could be risk in the case of inadequate raw materials inventory and the increase in marginal cost of inventory. Specifically, manufacturing industries tend to operate the inventory at lower capacity, but controlling stock efficiently is difficult task. Management is faced with stock problems, including inadequate raw materials, obsolete materials, or storage cost. Stock-out negatively affects the company's profit, on the other hand overstocking only leads to obsolescence.

Finished goods inventory is the highest of among the inventory components, because it contains both direct materials and labor and overhead costs (Rumyantsev and Netessine, 2007). Positive demand shocks result in

lost sales if firms do not have enough number of finished goods in hand. Thus, firm prefers to maintain adequate stocks on hand not to miss revenue opportunities (Dion et al., 1991; Hendricks and Singhal, 2009).

In contrast to the prior studies, I do not consider work-in-process as suggested in prior research. Balakrishnan et al. (1996) report that work-in-process inventory is not directly related to market in comparison with raw material and finished goods inventory and thus imposes fewer implementation costs. The hypotheses of the paper are as follows.

H1: Raw materials and finished goods inventory are negatively associated with future revenue

Slack acts either positively and negatively to the firm. These resources are used as buffers against environmental uncertainty. However, Galbraith (1973) describes slack is costly. More specifically, slack is merely an additional cost to the firm or the risk of operating with lean inventories gives rise to disruptions (Galbraith 1973).

Following the prior literature, low level of inventory may prevent firm overstocking, however, it intensifies the negative effect of supply chain disruptions. However, the inventory buffers can lower the likelihood of disruptions and reduce the negative impact of disruptions.

According to the report of Deloitte Consulting (2007), they consider how the efficiency in terms of lean operations is related to the disruption of supply chains. Prior study suggests that “lean operations can be more vulnerable to disruptions, therefore, firms have to balance the need for

efficiency against the risks and expected cost of disruptions" (Stauffer 2003). Overall, efficiency on slack may alleviate the negative effect of disruptions. The hypotheses of this paper are as follows.

H2a: Raw materials and finished goods with operational slack are positively associated with future revenue

H2b: Raw materials and finished goods with operational slack are negatively associated with future revenue

III. SAMPLE, MODELS, AND DATA

3.1. Sample Selection

To test whether discrete components of inventory is positively or negatively related with future revenue, I create a sample of US manufacturing firms with SIC codes from 2000 to 3999 from the Compustat database for the 1972-1999 period. I also obtain the data from the Annual and Quarterly Compustat File for the sales volatility. Furthermore, gross domestic product dataset acquired from World Bank for the 1972-1999 period. I exclude all firm-year observations without data available on raw material, finished goods, and gross domestic product. I also exclude all firm-year observations with data unavailable on sales, cost of goods sold, property, plant, and equipment, common shares outstanding, annual closing price, and common and ordinary equity. I winsorize the variables at the 1^{st} and 99^{th} percentiles to reduce the influence of the outliers. The final sample of firm observations is 11,507.

3.2. Empirical Models

3.2.1 Discrete components of inventory model

I use the following empirical model to test H1: the effect of discrete components of inventory performance on future performance. Equation (1) shows the relationship between finished goods and future revenue, and equation (2) presents how the raw material is associated with future revenue.

$$\Delta Sales_{i,t+1} = \beta_1 \Delta Sales_{i,t} + \beta_2 \Delta FG_{i,t} + \beta_3 MB_{i,t} + \beta_4 \Delta PPE_{i,t} + \beta_5 \Delta GDP_t + \beta_6 Sales\ Volatility_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$\Delta Sales_{i,t+1} = \beta_1 \Delta Sales_{i,t} + \beta_2 \Delta RM_{i,t} + \beta_3 MB_{i,t} + \beta_4 \Delta PPE_{i,t} + \beta_5 \Delta GDP_t + \beta_6 Sales\ Volatility_{i,t} + \varepsilon_{i,t} \quad (2)$$

I estimate equations (1) and (2) using ordinary least squares (OLS) regressions. The dependent variable, $\Delta Sales_{i,t+1}$, is a proxy for firm performance, defined as the change in sales for firm i and scaled by market value of equity (MVE), where MVE is the price per share of common stock multiplies by number of common shares outstanding. The independent variables are change in sales ($\Delta Sales_{i,t}$), change in finished goods ($\Delta FG_{i,t}$), change in raw materials ($\Delta RM_{i,t}$), change in property, plant, and equipment ($\Delta PPE_{i,t}$), change in gross domestic product (ΔGDP_t) are scaled by market value of equity. I predict that the value of β_2 in equations (1) and (2) would be negative. I also include the firm market to book ratio ($MB_{i,t}$), sales volatility ($Sales\ Volatility_t$). $Sales\ Volatility_{i,t}$ is divided into annual volatility and quarterly volatility based on three-year. I define raw materials

as inputs are converted into finished goods through manufacturing process and finished goods are manufactured products that are ready for sale (Tunji 2012)[1]. The specific definition of each variable are provided in Appendix A.

3.2.2 Discrete components of inventory with operational slack model

The following empirical models are to test H2a and H2b: the moderating effect of SOP and FG, SOP and RM, DOI and FG and DOI and RM using ordinary least squares regression.

$$\Delta Sales_{i,t+1} = \beta_1 \Delta Sales_{i,t} + \beta_2 OS_{i,t} + \beta_3 \Delta FG_{i,t} + \beta_4 OS_{i,t} \times \Delta FG_{i,t} + \beta_5 MB_{i,t} + \beta_6 \Delta PPE_{i,t} + \beta_7 \Delta GDP_t + \beta_8 Sales\ Volatility_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$\Delta Sales_{i,t+1} = \beta_1 \Delta Sales_{i,t} + \beta_2 OS_{i,t} + \beta_3 \Delta RM_{i,t} + \beta_4 OS_{i,t} \times \Delta RM_{i,t} + \beta_5 MB_{i,t} + \beta_6 \Delta PPE_{i,t} + \beta_7 \Delta GDP_{i,t} + \beta_8 Sales\ Volatility_{i,t} + \varepsilon_{i,t} \quad (4)$$

The dependent variable is the same as previous equations. All else being equal to the previous equations, but the only new and main variable is operational slack ($OS_{i,t}$). The main measure of operational slack is developed by Hendricks et al. (2009). I utilize two different measures of operational slack. These measures can be considered as measures that are internal to firm and based on information reported in the most recent fiscal year. Conventional

[1] The American Institute of Accounting research bulletin no. 43 of 1972 defines raw material, work-in-process, and finished goods as "for sales on the ordinary course of business; in process of production for such sale or; to be currently consumed in the production of goods or services to be available for sale".

studies show that slack can be effective in dealing with disruptions (Chopra and Sodhi 2004; Kleindorfer and Saad 2005; Tang 2006). I use the ratio of annual sales to net property, plant, and equipment (SOP) as a measure of slack. All else being equal, firms with high SOP are more likely to operate with little slack. Tight slack makes firms difficult to recover from unexpected shock. Given our hypothesis about operational slack and the expected future revenue, firms with high SOP will experience a more negative future revenue.

The second measure of operational slack is days of inventory. As industry perspective, the economic impact of firm's disruption is more likely to be negative for firms with low levels of inventories. I follow the measure days of inventory from the previous studies. Days of inventory is 365 times the ratio of the average of beginning and ending inventory to cost of goods sold. The predicted sign of days of inventory is negative.

3.3. Descriptive Statistics and Correlations

[Insert Table 1 about here]

Table 1 presents descriptive statistics for all variables used in the analyses. The mean of change of finished goods (ΔFG_t) is 0.69 and the standard deviation is 53.96. The mean of change in raw material (ΔRM_t) is 0.39 and the standard deviation is 23.35. The inventory level of finished goods is higher than raw material, which indicating that firm keeps more finished goods compared to raw material in the warehouse. The mean (median)

of operational measures, SOP and DOI, are 8.21 (4.64) and 39.52 (91.78), respectively. These statistics indicate that manufacturing industry has higher SOP, DOI, and inventories.

[Insert Table 2 about here]

Table 2 shows the Pearson and Spearman correlation coefficients of the main variables used in the analyses. According to the Pearson correlation, change in future sales ($\Delta Sales_{i,t+1}$) is positively and significantly correlated with change in current sales ($\Delta Sales_{i,t}$), change in finished goods ($\Delta FG_{i,t}$), change in raw material ($\Delta RM_{i,t}$), and change in property, plant, and equipment ($\Delta PPE_{i,t}$). Spearman correlation also presents the similar results with Pearson. Change in future sales is positively and significantly related to the most of variables except for days of inventory ($DOI_{i,t}$), annual sales volatility ($Annual\ Volatility_{i,t}$), and quarterly sales volatility ($Quarterly\ Volatility_{i,t}$). Regarding to the operational slack, sales to net property, plant, and equipment ($SOP_{i,t}$) is positively related to change in future sales ($\Delta Sales_{i,t+1}$), whereas days of inventory ($SOP_{i,t}$) is negatively associated with change in future sales ($\Delta Sales_{i,t+1}$).

IV. EMPIRICAL FINDINGS

[Insert Table 3 about here]

Results of estimating equations (1) and (2) are presented in Table 3. In Panel A, columns (1) and (2) examine the relationship between finished goods and future revenue with respect to annual volatility and quarterly volatility, respectively. Column 1 reports that $\Delta Sales_{i,t+1}$ is positive and significant (p<0.01). $\Delta FG_{i,t}$ is negative and significant (p<0.01). $MB_{i,t}$ is positive and insignificant. $\Delta PPE_{i,t}$ is positive and significant (p<0.01). ΔGDP_t and $Annual\ Volatility_{i,t}$ are negative and insignificant. The same picture emerges from column (2). In Panel B, columns (1) and (2) present the link between raw material and future revenue in terms of annual volatility and quarterly volatility, respectively. I observe the consistent results with Panel A. As predicted in H1, generally, manufacturing companies are faced with stock problems. Management may fail to predict the future demand. They purchase the raw material more than expected or inadequate to the demand, and these decisions affect finished goods as well. It is consistent with the prior literature that the holding period of finished goods did not decline (Chen et al. 2005). Both stock-out and overstocking affects negatively to the firm's profit.

[Insert Table 4 about here]

Table 4 reports the regression estimates for the equations (3) and (4). It provides the results for the relationship between future revenue and

operational slack to investigate the moderating effects of operational slack. As explained in the measurement section, I employ sales to property, plant, and equipment (SOP) and days of inventory (DOI) as the operational slack.

Panel A of Table 4 presents the results of moderating effect of DOI and finished goods. In columns (1) and (2), $\Delta Sales_{i,t}$ is positive and significant (p<0.01). $DOI_{i,t}$ and $\Delta FG_{i,t}$ are negatively and significantly associated with future revenue (p<0.01). A high ratio of DOI implies that company did not fully sell and replace inventory during a given period. This low or slow turnover supports weak sales and possibly excess inventory. Additionally, the interaction term of DOI and finished goods ($DOI_{i,t}$x$\Delta FG_{i,t}$) is negative and significant (p<0.01). A high ratio of DOI implies that company did not fully sell and replace inventory during a given period. This low or slow turnover supports weak sales Finished goods itself is negatively associated with future sales. Even though the finished goods is not sold, the increase in finished goods is not a good signal to the future. It supports that the slow turnover of finished goods does not generate sales or profit because the excess inventory kept in the warehouse. $\Delta PPE_{i,t}$ is positive and significant (p<0.01). However, the other control variables are not significant.

Panel B of Table 4 reports the results of moderating effect of DOI and raw material. Both columns show that $\Delta Sales_{i,t}$ is positive and significant (p<0.01). The coefficients of $DOI_{i,t}$, $\Delta RM_{i,t}$, and $DOI_{i,t} \times \Delta RM_{i,t}$ are negative and statistically significant (p<0.01). It is similar

concept to Penal A of Table 5. The existed raw materials is still not converted into finished goods. Purchasing new raw materials does not generate future sales. In other words, there is no future demand. The low turnover of raw materials does not generate revenues. The excess raw materials is not transformed into the finished goods because of the low demand of the firm products in the market $\Delta PPE_{i,t}$ is the positive and significant (p<0.01). ΔGDP_t,$Annual\ Volatility$, and $Quarterly\ Volatility$ are negative.

Panel C of Table 4 focuses on the moderating effect of SOP and finished goods. The results of column (1) is based on annual sales volatility. $\Delta Sales_{i,t}$ is positive and significant (p<0.01). $SOP_{i,t}$ is negative and insignificant. $\Delta FG_{i,t}$ is negative and significant (p<0.01). The main coefficient in this analysis is the moderating effect of operational slack and inventory. The coefficient of the interaction term of SOP and finished goods ($\Delta SOP_{i,t} X \Delta FG_{i,t}$) is positively and significantly related to $\Delta Sales_{t+1}$ (p<0.01). A high ratio of SOP supports that firm efficiently uses its fixed assets to generate sales. On the other hand, finished goods inventory is negative, but its interaction term with SOP is positive. Finished goods itself is negatively associated with future sales. Even though the finished goods is not sold, the increase in finished goods is not a good signal to the future. Firms sold most of the stocks (low slack). At the same time, they make more finished goods because they believe the future demand will increase. $MB_{i,t}$, $\Delta PPE_{i,t}$, and $\Delta GDP_{i,t}$ are positive and significant (p<0.01). I repeat

the analyses on the basis of quarterly volatility in column (2), and the results are identical to column (1). Panel D of Table 4 provides the moderating effect of SOP and raw material. In column (1), $\Delta Sales_{i,t}$ is positive and significant (p<0.01). $SOP_{i,t}$ is negative and significant (p<0.01). $\Delta RM_{i,t}$ is negative and insignificant. Interaction term of SOP and raw material is negative and significant (p<0.01). The result is different from the Panel A of Table 5. It supports that slack is a cost item, which is an additional cost to the firm or the risk of operating with lean inventories leads to disruptions. Lean operation of raw materials can also be more vulnerable to disruptions, firms must balance the need for efficiency against the risks and expected cost of disruptions. $MB_{i,t}$, $\Delta PPE_{i,t}$, and ΔGDP_t are positive and significant (p<0.10, p<0.01, and p<0.01, respectively). Again, I performed the same analyses in terms of quarterly volatility in column (2), and results are the consistent with column (1). It is difficult to conclude that raw material itself is positively and negatively associated with future demand or sales. Even though there is already enough slack in the firm, firms still purchase the raw material because they believe that the future demand will increase

V. CONCLUSION

This research focused on examining the association between discrete components of inventory and operational slack on firm performance with respect to future revenue. Inventory is very consequential to manufacturing companies. Therefore, a wide stream of prior studies has investigated total inventory performance, but they have not associated the inventory with operational slack concept. Previous literature rarely employs discrete components of inventory, and there is no research to find the link between these components and future revenue. To investigate the operational slack, I use sales to net property, plant, and equipment (SOP) and days of inventory (DOI) from the prior study (Hendricks et al. 2009). I collect the data from Annual and Quarterly Compustat database, specifically, U.S. manufacturing industries (SIC 2000-3999) from 1972 to 1999. With these measures, this paper finds that individual component of inventory is negatively associated with firm future revenue. It suggests that management fails to predict the future demand precisely and is probably that management tends to avoid uncertainty, including disruption and natural disaster. I extend the analyses by including operational slack measures. In terms of DOI, both raw materials and finished goods are negatively associated with future revenue. The existed raw materials is still not converted into finished good. The excess raw materials is not transformed into the finished goods because the low demand of the firm products in the market. The slow turnover of finished goods does not generate sales because the excess inventory kept in the warehouse. On the

other hand I observe that the moderating effect of SOP and raw materials is negatively correlated with future sales. Firms still purchase the raw material because they believe that the future demand will increase. However, the moderating effect of SOP and finished goods is positive. Firms sold most of the stock. At the same time, they make more finished goods because firms believe the future demand will increase in the future.

This paper makes a contribution. The findings of this paper add to accounting literature, which is the association between inventory and firm performance. This paper investigates the discrete components of inventory with operational slack on firm performance with respect to future revenue. Prior literature has not examined this topic. I expect that this paper may be helpful to explain the mix evidence that improvement in inventory performance is associated with improvement in overall performance. Several studies suggest that improvement in inventory performance may reduce overall performance, whereas others do not.

REFERENCES

Azadegan A., Patel P., Parida V., 2013. Operational Slack and Venture Survival. Production and Operations Management. 22 (1), 1-18.

Balakrishnan, R., Linsmeier, T.J., Venkatachalam, M., 1996. Financial benefits from JIT adoption. Effects of customer concentration and cost structure. Account. Rev. 71 (2), 183–205.

Bendig D., Brettel M., Downar B., 2018. Inventory component volatility and its relation to returns. International Journal of Production Economics. Vol. 200 (C), 37-49.

Bourgeois, L. J. On the measurement of organizational slack. Academy of Management Review, Vol. 6, No. 1, 29-39.

Capkun, V., Hameri, A.-P., Weiss, L.A., 2009. On the relationship between inventory and financial performance in manufacturing companies. Int. J. Oper. Prod. Manag. 29 (8), 789–806.

Chen, H., Frank, M.Z., Wu, O.Q., 2005. What actually happened to the inventories of American companies between 1981 and 2000? Manag. Sci. 51 (7), 1015–1031.

Child, John. Organizational structure, environment, and performance: The role of strategic choice. *Sociology,* 1972, 6(1), 2-22.

Chopra, S., Sodhi, M.S., 2004. Managing risk to avoid supply-chain breakdown. Sloan Management Review, 46 (Fall) 53–61.

Claycomb, C., Germain, R. and Droge, C. (1999), "Total system JIT outcomes: inventory, organization and financial effects", International Journal of Physical Distribution & Logistics, Vol. 29 No. 10, pp. 612-30.

Deloitte Consulting, 2007. Supply chain's last straw: A vicious cycle of risk. Report by Deloitte Touche´Tohmatsu

Dion, P.A., Hasey, L.M., Dorin, P.C., Lundin, J., 1991. Consequences of inventory stockouts. Ind. Mark. Manag. 20 (1), 23–27.

Eroglu, C., Hofer, C., 2011. Inventory types and firm performance. Vector autoregressive and vector error correction models. J. Bus. Logist. 32 (3), 227–239.

Eroglu, C., Hofer, C., 2014. The effect of environmental dynamism on returns to inventory leanness. J. Oper. Manag. 32 (6), 347–356.

Galbraith, Jay. Designing complex organizations. Reading, Mass.: Addison-Wesley, 1973.

Gaur, V., Fisher, M.L. and Raman, A. (2005), "An econometric analysis of inventory turnover performance in retail services", Management Science, Vol. 51 No. 2, pp. 181-94.

Hendricks, K.B., Singhal, V.R., 2009. Demand-supply mismatches and stock market reaction. Evidence from excess inventory announcements. Manuf. Serv. Oper. Manag. 11 (3), 509–524.

Hendricks K., Singhal V., Zhang R., 2009. The effect of operational slack, diversification ,and vertical relatedness on the stock market reaction to supply chain disruptions. Journal of Operations Management. 27 (3), 233-246.

Hertzel, M., Li, Z., Officer, M., Rodgers, K., 2008. Inter-firm linkages and the wealth effects of financial distress along the supply chain. J. Financ. Econ. 87 (2), 374–387.

Hofer, C., Eroglu, C., Rossiter Hofer, A., 2012. The effect of lean production on financial performance. The mediating role of inventory leanness. Int. J. Prod. Econ. 138 (2), 242–253.

Isaksson, O.H.D., Seifert, R.W., 2014. Inventory leanness and the financial performance of firms. Prod. Plan. Control 25 (12), 999–1014.

Kahn, J., 1987. Inventories and the volatility of production. Am. Econ. Rev. 77 (4), 667–679.

Kleindorfer, P.R., Saad, G.H., 2005. Managing disruption risks in supply chain. Production and Operations Management Journal 14, 53–68.

Koumanakos, D.P., 2008. The effect of inventory management on firm performance. Int. J. Prod. Perform. Manag. 57 (5), 355–369.

Lieberman, M.B., Helper, S. and Demeester, L. (1999), "The empirical determinants of inventory levels in high-volume manufacturing", Production and Operations Management, Vol. 8 No. 1, pp. 44-55.

March, J.G.; & Simon, H. A. *Organizations.* New York: Wiley, 1958.

Moch, M.K., & Pondy, L.R. The structure of chaos: Organized anarchy as a response to ambiguity (Review of March and Olsen's Ambiguity and Choice). *Administrative Science Quarterly*, 1977, 22(2), 351-362.

Roumiantsev, S. and Netessine, S. (2007), "What can be learned from classical inventory models: a cross-industry exploratory investigation", Manufacturing and Service Operations Management, Vol. 9 No. 4, pp. 409-29.

Rumyantsev, S., Netessine, S., 2007. Should Inventory Policy Be Lean or Responsive? Evidence for US Public Companies. SSRN Working Paper.

Stauffer, D., 2003. Risk: The weak link in your supply chain. Harvard Business Review 81, 3–5. The American Institute of Accounting research bulletin no 43 of 1972 refers

Shah, R. and Shin, H. (2007), "Relationships among information technology, inventory, and profitability: an investigation of level invariance using sector level data", Journal of Operations Management, Vol. 25 No. 4, pp. 768-84.

Swamidass, P.M., 2007. The effect of TPS on US manufacturing during 1981–1998. Inventory increased or decreased as a function of plant performance. Int. J. Prod. Res. 45 (16), 3763–3778.

Tang, C., 2006. Robust strategies for mitigating supply chain disruptions. International Journal of Logistics: Research and Applications 9, 33–45.

Thompson J. D. *Organizations in action*. New York: McGraw-Hill, 1967.

Trimisiu T. Siyanbola. 2012. Impact of stock valuation on profitability of manufacturing industries. International Journal of Advanced Research in Management and Social Sciences, Vol. 1 No. 1, pp. 35-46.

Appendix A

Definition of Variables

Variables	Description
$\Delta SALE_{t+1}$	Change in revenue in year t+1 scaled by market value of equity
Δsale	Change in revenue in year t scaled by market value of equity
ΔRM	Raw materials is input to be converted into finished goods through manufacturing process (Siyanbola 2012). Change in raw materials in year t scaled by market value of equity
ΔFG	Finished goods is fully manufactured goods are ready for sale (Siyanbola 2012). Change in finished goods in year t scaled by market value of equity
SOP	The ratio of annual sales to net property, plant, and equipment
DOI	Days of inventory = 365 x (average inventory/annual cost of goods sold)
MB	Market equity to book equity ratio at the end of fiscal year t
ΔPPE	Change in net total property, plant, and equipment in year t scaled by market value of equity
ΔGDP	Change in gross domestic produc in year t scaled by market value of equity
Annual Volatility	Standard deviation of annual sales volatility based on three-year
Quarterly Volatility	Stabdard deviation of quarterly sales volatility based on three-year

Table 1

Descriptive Statistics on Inventory Components and Operational Slack Measures

Variables	Mean	STD	Q1	Median	Q3
ΔSale	7.940	409.721	-0.008	0.081	0.267
ΔFG	0.687	53.963	-0.004	0.002	0.018
ΔRM	0.386	23.347	-0.005	0.002	0.016
SOP	8.208	19.154	2.898	4.640	7.862
DOI	39.520	12.550	57.547	91.782	144.247
MB	1.229	50.730	0.273	0.500	0.862
ΔPPE	-4.571	813.023	-0.008	0.012	0.051
ΔGDP	-1.030	4.770	2.500	2.140	1.340
Annual Volatility	1.450	4.300	1.140	1.570	1.700
Quarterly Volatility	1.880	1.240	0.946	1.040	3.170

Table 1 presents the descriptive statistics for variables in the analyses. The sample period is between 2000 and 2018. Variable definitions are in Appendix A.

Table 2

Pearson/Spearman Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9	10	11
1 $\Delta SALE_{t+1}$	1	**0.914**	**0.860**	**0.841**	-0.003	-0.001	-0.003	**0.142**	**-0.132**	-0.002	-0.008
2. ΔSale	**0.342**	1	**0.956**	**0.974**	-0.004	-0.001	-0.010	**0.950**	**-0.270**	-0.001	-0.006
3. ΔFG	**0.187**	**0.401**	1	**0.981**	-0.004	0.000	0.000	**0.958**	**-0.264**	0.000	-0.008
4. ΔRM	**0.237**	**0.450**	**0.339**	1	-0.004	0.000	**-0.038**	**0.972**	**-0.336**	0.002	-0.005
5. SOP	**0.055**	**0.147**	**0.039**	**0.044**	1	-0.005	-0.004	0.000	0.000	**0.033**	0.009
6. DOI	**-0.050**	**-0.207**	**-0.032**	**-0.069**	**0.082**	1	-0.001	0.000	0.000	**-0.016**	-0.013
7. MB	**0.077**	**0.114**	**0.072**	**0.024**	**0.051**	**0.067**	1	0.000	0.000	-0.002	-0.011
8. ΔPPE	**0.271**	**0.488**	**0.375**	**0.400**	**-0.166**	**-0.178**	**0.061**	1	**0.890**	**0.023**	0.010
9. ΔGDP	**0.045**	**0.105**	**0.020**	**0.061**	**0.212**	-0.006	**0.225**	**-0.085**	1	**0.026**	0.015
10. Annual Volatility	**-0.210**	**-0.140**	**-0.061**	**-0.060**	**-0.050**	**-0.110**	**-0.251**	**-0.128**	**0.037**	1	**0.786**
11. Quarterly Volatility	**-0.217**	**-0.132**	**-0.057**	**-0.063**	**-0.042**	**-0.109**	**-0.253**	**-0.119**	**0.043**	**0.941**	1

Table 2 reports Pearson and Spearman correlations of variables from the main variables. Bold denotes significant correlation coefficients at 10 percent or better levels. Variable definitions are in Appendix A.

Table 3

Regression of Inventory on Future Performance

Panel A: Finished goods

	$\Delta SALE_{t+1}$	
Independent variables	**(1)**	**(2)**
ΔSale	0.278***	0.278***
	(24.27)	(24.28)
ΔFG	-2.400***	-2.401***
	(-22.06)	(-22.06)
MB	0.004	0.004
	(1.51)	(1.5)
ΔPPE	0.142***	0.142***
	(10.39)	(10.39)
ΔGDP	-0.000	-0.000
	(-0.36)	(-0.36)
Annual Volatility	-0.000	
	(-1.62)	
Quarterly Volatility		-0.000
		(-1.56)
Observations	18358	18358
Adjusted R^2	0.110	0.110

Table 3 (Continued)

Panel B: Raw Materials

	$\Delta SALE_{t+1}$	
Independent variables	**(1)**	**(2)**
ΔSale	0.231***	0.231***
	(21.88)	(21.89)
ΔRM	-2.337***	-2.339***
	(-19.37)	(-19.38)
MB	0.000	0.000
	(0.09)	(0.09)
ΔPPE	0.304***	0.304***
	(21.06)	(21.07)
ΔGDP	-0.000	-0.000
	(-0.40)	(-0.40)
Annual Volatility	-0.000	
	(-1.45)	
Quarterly Volatility		-0.000
		(-1.52)
Observations	18412	18412
Adjusted R^2	0.099	0.099

Table 3 reports the estimation results of discrete components of inventory and firm future perofrmance using OLS regression, where all t-statistics results are presented in the paranthesis.

*, **, *** Denote significance, based on two-tailed tests, at or below 10 percent, 5 percent, and 1 percent, respectively.

Table 4

Regression of moderating effect of operational slack on Future Performance

Panel A: Moderating effect of DOI and FG

	$\Delta SALE_{t+1}$	
Independent variables	**(1)**	**(2)**
ΔSale	0.288***	0.288***
	(25.07)	(25.08)
DOI	-0.000***	-0.000***
	(-5.83)	(-5.83)
ΔFG	-2.331***	-2.331***
	(-21.4)	(-21.41)
DOI x ΔFG	-0.000***	-0.001***
	(-8.70)	(-8.70)
MB	0.004	0.004
	(1.50)	(1.50)
ΔPPE	0.143***	0.143***
	(10.45)	(10.45)
ΔGDP	-0.000	-0.000
	(-0.48)	(-0.47)
Annual Volatility	-0.000	
	(-1.56)	
Quarterly Volatility		-0.000
		(-1.49)
Observations	18235	18235
Adjusted R^2	0.114	0.114

Table 4 (Continued)

Panel B: Moderating effect of DOI and RM

	$\Delta SALE_{t+1}$	
Independent variables	**(1)**	**(2)**
ΔSale	0.268***	0.268***
	(24.99)	(25.00)
DOI	-0.000***	-0.000***
	(-3.49)	(-3.50)
ΔRM	-1.989***	-1.991***
	(-6.36)	(-16.37)
DOI x ΔRM	-0.001***	-0.001***
	(-16.62)	(-16.62)
MB	0.000	0.000
	(0.09)	(0.09)
ΔPPE	0.304***	0.304***
	(21.17)	(21.17)
ΔGDP	-0.000	-0.000
	(0.86)	(-0.86)
Annual Volatility	-0.000	
	(-1.51)	
Quarterly Volatility		-0.000
		(-1.59)
Observations	18411	18411
Adjusted R^2	0.112	0.112

Table 4 (Continued)

Panel C: Moderating effect of SOP and FG

	$\Delta SALE_{t+1}$	
Independent variables	**(1)**	**(2)**
ΔSale	0.255***	0.255***
	(21.96)	(21.97)
SOP	-0.000	-0.000
	(-0.43)	(-0.45)
ΔFG	-2.287***	-2.287***
	(-20.15)	(-20.15)
SOP x ΔFG	0.019***	0.019***
	(3.05)	(3.06)
MB	0.032***	0.033***
	(4.94)	(4.95)
ΔPPE	0.129***	0.129***
	(9.45)	(9.45)
ΔGDP	0.000***	0.000***
	(12.7)	(12.7)
Annual Volatility	-0.000	
	(-1.57)	
Quarterly Volatility		-0.000
		(-1.60)
Observations	18235	18235
Adjusted R^2	0.108	0.108

Table 4 (Continued)

Panel D: Moderating effect of SOP and RM

	$\Delta SALE_{t+1}$	
Independent variables	**(1)**	**(2)**
ΔSale	0.205***	0.205***
	(19.15)	(19.15)
SOP	-1.977***	-1.977***
	(-15.63)	(-15.63)
ΔRM	-0.000	-0.000
	(-0.50)	(-0.50)
SOP x ΔRM	-0.019**	-0.019**
	(-2.50)	(-2.50)
MB	0.013*	0.013*
	(1.93)	(1.93)
ΔPPE	0.270***	0.270***
	(18.47)	(18.47)
ΔGDP	0.000***	0.000***
	(12.06)	(12.06)
Annual Volatility	-0.000	
	(-1.38)	
Quarterly Volatility		-0.000
		(-1.38)
Observations	18182	18182
Adjusted R^2	0.120	0.120

Table 5 reports the estimation results of discrete components of inventory and operational slack on future performance using OLS regression, where all t-statistics results are presented in the paranthesis. *, **, *** Denote 10 percent, 5 percent, and 1 percent, respectively.

국문 초록

재고와 유휴 자원이 실적에 미치는 영향

미국 제조업 회사를 대상으로 개별 재고량이 회사의 미래 실적에 미치는 영향과 더 나아가 유휴 자원이 있는 상황에서 개별 재고량이 미래 실적에 어떠한 영향을 가지는지 상관 관계를 분석하고자 한다. 1972년부터 1999년까지 미국 제조업 회사들의 자료를 가지고 최소제곱법을 활용하여 실증분석한 결과 원자재와 완제품 각각 미래의 실적에 음(−)의 관계를 가지고 있는 것으로 나타났다. 유휴 자원을 실증분석하기 위해 재고자산회전율(DOI)과 고정자산회전율(SOP)을 이용하였다. 개별 재고량과 회전율 사이에는 양(+), 음(−)의 결과가 공존한다. 원자재와 완제품의 DOI는 미래 실적에 음(−)의 관계를 가지고 원자재와 SOP는 음(−)의 결과를 완제품과 SOP는 양(+)의 관계를 가지고 있는 것으로 나타났다.

주요어: 유휴 자원; 완제품; 원자재; 실적

학번: 2019-26497