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The Effect of Inventory Flexibility on Financial Performance: Moderating Role of Firm Size and Growth

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This study aims to explore how flexible inventory management affects financial performance from the perspective of quick adjustments of inventory deviations, in which firm growth and firm size are moderators. Using the empirical data collected from 1953 listed manufacturing enterprises in China from 2005 to 2021, this research employs the moderation model combined with the three-way interaction analysis to test hypotheses. The results reveal that the relationship between inventory flexibility and financial performance is positive, while firm growth weakens this relationship. Furthermore, firm size reduces the negative moderating effect of firm growth on the relationship between inventory flexibility and financial performance. This paper contributes to a better understanding of the role of quick adjustments in flexible inventory management. From a developing country perspective, this study identifies the important relationships between inventory flexibility, firm growth, firm size and financial performance. The findings will be of interest to both emerging and other developing countries.

Keywords: *Inventory Flexibility; Financial Performance; Firm Growth; Firm Size; Manufacturing Firms.*

Introduction

The dominant theme of the empirical literature on the financial benefits of inventory management in recent years has been that all deviations from optimal inventory levels are penalized by financial performance (Udenio *et al.,* 2018). For example, research on lean inventory management has shown that there is an optimal level of inventory leanness that enjoys the best financial performance (Eroglu & Hofer, 2011). Research on responsive inventory management, such as flexible or agile, provides more direct evidence for this. That is, reducing inventory deviation is conducive to improving financial performance (Song & Song, 2009; Shockley & Turner, 2015; Udenio *et al.,* 2018). As an important responsive inventory management strategy, flexible inventory management allows manufacturing enterprises to avoid stock-out when demand rises and reduce inventory waste when demand falls, thereby reducing inventory deviation caused by the mismatch between inventory and demand. This study extends the scope of flexible inventory management to the adjustment speed of inventory deviation in a broad sense, and is no longer limited to reducing inventory deviation in a narrow sense. It can be seen that, as an indicator of flexible inventory management, inventory flexibility can effectively capture quick adjustments in a broad sense, that is, the reduction of inventory deviations in the short term.

Early research on inventory flexibility provides preliminary empirical evidence of its positive impact on financial performance (Song & Song, 2009). Consistent with current research on inventory management, they only focus on the impact of adjustment magnitudes for inventory deviations on financial performance. However, in order to improve service quality and operational efficiency, managers pay more attention to quickly adjusting inventory deviations in inventory management practices. To this end, they posed a new question, namely, whether quick adjustments to inventory deviations can lead to improved financial performance. Concretely, quickly adjusting inventory deviations is a double-edged sword. On the one hand, it enables manufacturing enterprises to respond to changes in demand in a timely manner, thereby improving production stability and cash flow adequacy. On the other hand, it imposes additional adjustment costs on manufacturing enterprises, thus increasing capital costs and financial risk, especially during periods of high growth caused by rising demand (Eckstein *et al.,* 2015; Elsayed & Wahba, 2016). Although quick adjustments are considered important in inventory management (Gligor *et al.,* 2015; Dubey *et al.,* 2018), empirical evidence on the financial benefits of quick adjustments to inventory deviations remains nascent. Against this backdrop, focusing on the impact of inventory flexibility in a broad sense on financial performance, we endeavour to fill the above-mentioned gap by addressing our first research question:

RQ1: How does inventory flexibility affect the financial performance of manufacturing enterprises from the perspective of quick adjustments of inventory deviations?

Unlike lean inventory management, which pursues continuous inventory reduction, flexible inventory management emphasizes making corresponding inventory changes according to changes in demand. Nonetheless, the two inventory management strategies do not exactly conflict. While taking opposite inventory decisions during periods of rising demand, they both make decisions to reduce inventories during periods of falling demand. Generally speaking, manufacturing enterprises experience lower firm growth during periods of falling demand. At this point, manufacturers no longer rely on expanding sales to maintain profitability, but instead focus on operational management and cost savings (Elsayed & Wahba, 2016). Thus, similar to lean inventory management, flexible inventory management may allow low-growth manufacturing enterprises to enjoy a better financial performance. Conversely, flexible inventory management enables high-growth manufacturing enterprises to quickly increase inventory to avoid stock-outs and improve service quality. This not only increases additional capital costs, but also puts forward higher requirements on the resource endowment of manufacturing enterprises. Flexible inventory management is difficult to achieve effectively for small manufacturing enterprises characterized by high capital costs and large financing constraints. It can be seen that when exploring the financial benefits of flexible inventory management, firm growth and size are important conditional factors. Therefore, examining the impact of inventory flexibility on financial performance under different combinations of firm growth and size can help improve the accuracy of inventory decisions. Subsequently, we establish the following research question:

RQ2: How do firm growth and size affect the efficacy of flexibility inventory management on financial performance?

Addressing the two research questions posed above can provide new insights that advance flexible inventory management research. This study builds on three prior studies in inventory responsiveness and flexibility measures: Rumyantsev and Netessine (2007) explored the impact of inventory responsiveness on financial performance; Song & Song (2009) examined the impact of internal and external inventory flexibility on financial performance; and Gu et al. (2018) proposed a quantitative measure of operational flexibility. We contribute to the literature on flexible inventory management and financial performance in three ways. First, this study proposes an alternative measure of inventory flexibility based on secondary data, which can capture quick adjustments of inventory deviations by calculating the adjustment speed. The previous inventory flexibility index is calculated by factor analysis based on survey data (Song & Song, 2009), which not only cannot effectively capture quick adjustments of inventory deviations, but also cannot avoid subjectivity and possible common method bias. Second, this study examines the impact of inventory flexibility in a broad sense on financial performance from the perspective of quick adjustments of inventory deviations. Extant studies pay more attention to the impact of the adjustment magnitude of inventory deviation on financial performance, ignoring the impact of its adjustment speed. Drawing on the quarterly financial data with 1953 listed manufacturing enterprises from 2005 to 2021, we find that increasing the adjustment speed of inventory deviations can improve financial performance, which contributes to a better understanding of the role of quick adjustments in flexible inventory management. Finally, this study extends flexible inventory management research by investigating how firm size moderates the impact of firm growth on the relationship between inventory flexibility and financial performance. We argue that firm growth has a significant influence on the relationship between inventory flexibility and financial performance for manufacturing enterprises in different life cycles. Just as important, resource endowments support the effectiveness of flexible inventory management at different growth stages. Based on the moderating effects and three-way interaction analysis, the results show that although the financial benefits of flexible inventory management are negatively moderated by firm growth, manufacturing enterprises of different sizes can still adopt corresponding inventory management strategies to improve financial performance.

The remainder of this study is organized as follows. We first present the literature review and then formulate hypotheses development. Subsequently, we describe our methodology for examining research questions. Finally, we display our results and discuss theoretical and managerial implications as well as future research.

Literature Review

Inventory Flexibility

Inventory flexibility is defined as the ability to effectively and quickly adjust inventory in response to customer demand (Song & Song, 2009). It can take the form of increasing inventory to avoid stock-out when demand rises, and reducing inventory to save costs when demand falls. A narrow definition of inventory flexibility focuses on reducing inventory deviation. Broadly speaking, inventory flexibility refers to quick adjustments to inventory deviations, similar to inventory agility.

As far as the definition of inventory flexibility is concerned, it has similarities and differences with other responsive inventory management indicators, such as inventory responsiveness, inventory stickiness, and inventory agility. From a responsiveness perspective, inventory flexibility includes inventory responsiveness. As argued by Rumyantsev and Netessine (2007), inventory responsiveness can be used as a proxy for flexibility. They defined inventory responsiveness as the degree to which changes in inventory match changes in demand. Furthermore, they argued that a firm with a perfect demand forecast will have zero inventory responsiveness, at which point changes in sales revenue will match well with changes in inventory. In contrast, sticky inventory management is seen as under-responsive. Kroes and Manikas (2018) defined sticky inventory management as a behavior in which the magnitude of change in inventory in proportion to a change in revenue is smaller during periods when revenue decreases compared to the change in inventory when revenue increases. That is, inventory stickiness can be viewed as a mismatch between changes in inventory and changes in sales revenue. Clearly, inventory flexibility and inventory stickiness are opposites during periods of

declining sales revenue. Regarding inventory agility, related research regards flexibility as a dimension of agility from the perspective of supply chain management (Gligor *et al.,* 2013). But when it comes to inventory management, both inventory flexibility and inventory agility involve responsiveness and quick adjustments. For example, Udenio et al. (2018) defined inventory agility narrowly as a response to demand shocks. Broadly speaking, however, inventory agility was defined as the extent to which a firm quickly adjusts its relative inventory levels to meet changing demand realities (Gligor *et al.,* 2013; Udenio *et al.,* 2018).

Additionally, the differences in indicator measures provide guidance for understanding the relationship between inventory flexibility and other responsive inventory management indicators. The measurement of responsive inventory management indicators in empirical research can be classified into two groups: one is to use factor analysis or complex models to combine multiple sub-indicators into a comprehensive indicator, mainly based on survey data (Song & Song, 2009; Gligor *et al.,* 2013). Due to its subjectivity and possible common method bias, this measure is not well suitable for widespread use by managers (Eroglu & Hofer, 2011). The other is to directly calculate indicators based on secondary data (Rumyantsev & Netessine, 2007; Shockley & Turner, 2015; Kroes & Manikas, 2018; Udenio *et al.,* 2018). Therefore, we mainly focus on the latter research. Concretely, inventory responsiveness is measured as the difference between the percentage change in inventory levels and the percentage change in sale revenue or cost of goods sold (COGS) (Shockley & Turner, 2015). That is, the larger the absolute value of the difference, the worse the responsiveness. Similarly, inventory stickiness is measured by the ratio of a firm's current versus prior inventory divided by the ratio of its current versus prior sales revenue (Kroes & Manikas, 2018). It is not hard to find that both inventory responsiveness and inventory stickiness are the difference between inventory changes and sales revenue changes. In other words, both view changes in sales revenue (i.e., a proxy for changes in demand) as the optimal level for changes in inventories. That is, the larger the difference, the more the inventory deviates from the optimal level, resulting in higher inventory stickiness and poorer inventory responsiveness. Moreover, inventory agility is measured by the maximum integral positive error (IPE) of inventory in the sample minus the firm's normalized IPE of inventory (Udenio *et al.,* 2018). It should be pointed out that inventory agility takes the expected demand change as the optimal level of inventory change. Although they measure inventory agility in a narrow sense, the extent to which inventory deviates from optimal levels (i.e., the normalized IPE of inventory) is not limited to the relative value of two adjacent periods, but to a maximum value over a longer period. This is especially important for inventory management indicators based on quarterly data, as the seasonal effect of inventory can affect the inventory deviation in adjacent quarters. This method is similar to that used to measure operational flexibility in Gu et al. (2018), where the difference between the maximum and minimum values over a period of time is used to capture the adjustment magnitude.

To sum up, the responsive inventory management indicators in empirical studies based on secondary data all measure responsiveness by the degree of inventory deviation from the optimal level. The greater the inventory deviation, the worse the responsiveness. However, the current measurement of responsive management indicators mainly focuses on the adjustment magnitude of inventory deviation, and fails to effectively calculate its adjustment speed. Therefore, these indicators are difficult to capture quick adjustments of inventory deviation, so they cannot effectively measure inventory flexibility in a broad sense.

Inventory Management and Financial Performance

Empirical studies of the link between inventory management and financial performance have concentrated on assessing whether inventory reduction or inventory responsiveness leads to higher financial performance. Therefore, there are two main streams of research on the relationship between inventory management and financial performance.

One stream discusses the impact of inventory reduction on financial performance. According to lean production principles, inventory is a waste and should be eliminated. Most studies are primarily based on the inventory-to-sales ratio or inventory turnover, showing that reducing inventory is believed to result in cost savings and thus improved financial performance (Shockley & Turner, 2015; Golas & Bieniasz, 2015; Steinker *et al.,* 2016). However, Obermaier and Donhauser (2012) pointed out that the lowest inventory leads to the worst performance, indicating that moving toward to zero-inventory case is not always recommended. In response to the above mixed results, some studies have explained them from the perspective of optimal inventory levels. There may be a trade-off between inventory reduction and financial performance, indicating that optimal inventory levels exist. This might be because the increased shipping costs, compensation for customers, and lost sales due to inventory underage outweigh the savings from the reduced inventory. According to this reasoning, the relationship between inventory reduction and financial performance may be nonlinear. Research based on inventory leanness provides a wealth of empirical evidence for this (Eroglu & Hofer, 2011; Isaksson & Seifert, 2014). They confirmed an inverted U-shaped relationship between inventory leanness and financial performance, suggesting that there is an optimal inventory level that leads to the best financial performance.

A second stream analyses the link between inventory responsiveness and financial performance. Responsive inventory management emphasizes the close matching of changes between inventory and sales. In general, the change in sales is considered the optimal level for the change in inventory. It is argued that inventory growth or declines faster relative to sales is associated with lower profitability (Rumyantsev & Netessine, 2007; Steinker & Hoberg, 2013). Over-responsiveness (i.e., inventory changes greater than sales changes) or under-responsiveness (i.e., inventory changes less than sales changes) in inventory management can negatively impact financial performance (Shockley & Turner, 2015). Similar evidence is also provided by findings on the negative relationship between

inventory stickiness and financial performance (Kroes & Manikas, 2018). Sticky inventory management can be viewed as under-responsive inventory during periods of declining sales. Research on inventory agility provides more empirical evidence for this, with Udenio et al. (2018) confirming a positive relationship between inventory agility and financial performance. They argued that both inventory underage and overage are associated with lower financial performance.

Taken together, whether it is inventory reduction or inventory responsiveness, relevant empirical research shows that the adjustment magnitude of inventory deviation is closely related to financial performance. Specifically, however, that current inventory management research focuses on the negative relationship between inventory deviations and financial performance, ignoring the impact of the adjustment speed for such inventory deviations on financial performance. Especially when it comes to responsive inventory management, although the definition of inventory agility emphasizes adjustment time, empirical research still focuses on the impact of the adjustment magnitude of inventory deviations on financial performance (Udenio *et al.,* 2018). Early research on inventory flexibility based on survey data provides preliminary evidence of its impact on financial performance. As Song and Song (2009) stated, inventory flexibility has a positive impact on financial performance. However, they do not address the impact of quick adjustments to inventory deviations on financial performance.

Hypothesis Development

Relationship between Inventory Flexibility and Financial Performance

According to the definition, inventory flexibility is the ability to make quick adjustments to inventory deviations, so it depends not only on how much, but how quickly. In other words, speeding up the adjustment speed is equivalent to increasing the adjustment magnitude per unit time, which means reducing inventory deviation to a greater extent. Extant research provides ample empirical evidence for the relationship between inventory deviation reduction and improved financial performance (Eroglu & Hofer, 2011; Udenio et al., 2018).

In terms of responsiveness, flexible inventory management can reduce inventory deviations caused by mismatches between inventory and demand. Concretely, as argued by Rumyantsev and Netessine (2007), during periods of falling demand, inventory overage due to insufficient inventory reduction increases capital costs, warehousing costs, scrapping costs, and discount losses. Conversely, an excessive drop in inventory or a failure to increase inventory accordingly during periods of rising demand can lead to inventory underage. Inventory underage triggers additional labor and logistics costs, as well as reduced customer satisfaction and future business. In addition, timely reduction of excess inventory is conducive to increasing cash flow, which is crucial to venture survival (Zhu *et al.,* 2021). Similarly, replenishing inventory in a timely manner not only enhances production stability, but also helps seize various fleeting sales opportunities (Azadegan *et al.,* 2013). In this vein, flexible inventory management can reduce the risk of inventory overage or inventory underage and then exert a positive impact on financial performance.

However, quickly adjusting for inventory deviations may negatively impact financial performance by incurring additional adjustment costs for manufacturers. For example, when demand rises, quickly replenishing inventory in the short term will not only increase communication and transaction costs with suppliers, but also cause additional logistics and capital costs. Likewise, managers must discount inventories during periods of falling demand, thus reducing financial performance. Therefore, the net effect of inventory flexibility on financial performance depends on whether the benefits of quickly adjusting inventory deviations can compensate for the additional adjustment costs incurred. Consequently, we predict the following:

Hypothesis 1a: Inventory flexibility is positively associated with financial performance.

Hypothesis 1b: Inventory flexibility is negatively associated with financial performance.

The Moderating Effect of Firm Growth

Firm growth refers to the continuous expansion of firm size under the premise of maintaining operations. In general, firm growth is used as a control variable in studies of the impact of inventory management on financial performance, but its impact on financial performance is mixed (Eroglu & Hofer, 2014; Shockley & Turner, 2015). To this end, we analyze whether firm growth moderates the relationship between inventory flexibility and financial performance. Firm growth is usually related to the life cycle stage. For example, the rapid growth stage can act as a proxy for high firm growth. According to the life cycle theory, compared with the rapid growth stage, the firm growth in the introduction stage, mature stage, and decline stage are lower.

According to the growth theory, manufacturing enterprises in the rapid growth stage are sales-oriented and vulnerable to problems of undercapitalization (Elsayed & Wahba, 2016). This is because manufacturing enterprises maintain production stability and product availability at the expense of excess inventory in view of strong market demand during the rapid growth stage. Based on this view, high firm growth may weaken the impact of inventory flexibility on financial performance. As manufacturing enterprises with flexible inventory management strategies will rapidly build up inventories in response to high firm growth, inventory flexibility under high firm growth exacerbates the undercapitalization dilemma. Hence, manufacturing enterprises have to seek higher-cost financing, hurting their profitability. Meanwhile, inventory adjustments due to high growth may have far exceeded safety stock levels. Excess inventory not only increases additional capital and warehousing costs, but can worsen financial conditions by taking up too much cash flow (Zhu *et al.,* 2021), thereby losing competitive advantage and reducing profitability. In contrast, for low-growth enterprises, sales growth is slow and even negative. Inventory adjustments are lower, making it easier to achieve flexible inventory management at a low cost. In addition, low-growth enterprises are more sensitive to cost

changes (Elsayed & Wahba, 2016). Cost savings through quick inventory adjustments are more critical to improving financial performance in a low-growth scenario than sales expansion is decisive for financial performance in a high-growth scenario. Therefore, flexible inventory management exerts a greater impact on financial performance for manufacturing enterprises with low firm growth.

In summarizing, in situations with high firm growth, flexible inventory management exposes manufacturing enterprises to higher financing and adjustment costs, weakening the effectiveness of inventory flexibility in impacting financial performance. Accordingly, we propose the following hypothesis:

Hypothesis 2: Firm growth has a negative impact on the relationship between inventory flexibility and financial performance.

The Moderating Role of Firm Size

The resource-based review (RBV) highlights that firm size is directly related to the power of resource endowments (Uhlaner *et al.,* 2013). In general, large enterprises enjoy higher degrees of resource bases, scale and scope economies, and formalization levels. However, large enterprises suffer from more complex forms of communication, as well as greater organizational inertia and bureaucracy, making them take longer to respond to changing conditions (Raguseo *et al.,* 2020). While firm growth examines the cost impact of flexible inventory management at different scales of expansion, the impact may vary across manufacturing enterprises of different sizes. The difference in resource endowment makes the firm size determine the strategy of flexible inventory management adopted by manufacturing enterprises in various growth situations. As a result, managers can subjectively decide their strategies for flexible inventory management to achieve better financial performance in combination with firm size and firm growth.

Generally speaking, large enterprises enjoy better credit ratings and lower financing costs than small enterprises (Gonzalez & Gonzalez, 2012). Then, in the case of high growth, manufacturing enterprises have to increase inventory to ensure production stability and service quality. In this way, flexible inventory management exposes small enterprises to higher financing costs and operating risks, reducing their competitive advantage and profitability. Conversely, economies of scale give large enterprises lower production costs and greater bargaining power with suppliers (Chopra & Sodhi, 2014). Meanwhile, large enterprises can take advantage of the demand pool effect to achieve a higher quality of service with lower inventory (Chuang *et al.,* 2019). Thus, for large enterprises, the negative impact of firm growth on the relationship between inventory flexibility and financial performance is reduced.

In the low-growth scenario, while large enterprises enjoy lower costs and higher financial performance, this is not the case in terms of the impact of inventory flexibility on financial performance. This is because the costs of large enterprises do not change much under low growth relative to high growth. However, small enterprises usually enjoy a high level of organizational flexibility (Bartz & Winkler, 2016), making them more compatible with flexible inventory management. Especially considering that small enterprises are more vulnerable to financing constraints, reducing inventory is an important way for them to obtain funds (Steinker *et al.,* 2016). As a result, small enterprises benefit more from inventory flexibility than small enterprises in a low-growth scenario. Therefore, on the basis of the preceding rationale, we hypothesize the following:

Hypothesis 3: Firm size reduces the negative moderating effect of firm growth on the relationship between inventory flexibility and financial performance.

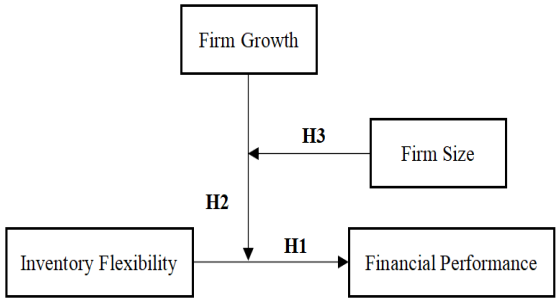

Figure 1. Summarizes Our Conceptual Model and Associated Hypotheses

Methodology

Data Resource

To test our conceptual model, we use quarterly financial data for Chinese listed manufacturing enterprises over the period from 2005 to 2021. All data are obtained from the China Stock Market and Accounting Research database, which provided basic financial information of all Chinese listed firms. Following the standard sample screening procedures, we first drop samples which are special treatment firms and particular transfer firms. Second, samples with missing values of main variables are removed. Finally, we winsorize all variables at the 1 % and 99 % tails of the distributions. The resulting data set contains 16117 firm-year observations of 1953 firms. In addition, the maximum variance inflation factor score for the variables is 1.18, well below the 10 cutoffs, so multicollinearity is not a concern in our model.

Variable Measurement

The measurement of all variables is now described. Concretely, the dependent variable is financial performance, and the main independent variable is inventory flexibility. The moderating variables are firm growth and firm size. In addition, three control variables are included. Table 1 gives the mean, standard deviations, and correlations of the main variables used in the analysis.

Financial performance. Various financial performance measures, such as return on assets (ROA), return on sales (ROS), or market-based measures like stock returns and Tobin's Q, have been used in empirical studies examining the relationship between inventory management and financial performance (Eroglu & Hofer, 2014). In this study, ROA was used to capture financial performance in line with previous research (Eroglu & Hofer, 2011; Shockley & Turner, 2015).

Inventory flexibility. The measure of a firm's inventory flexibility, namely, the Inventory Flexibility

Indicator (IFI) is proposed, which can capture quick adjustments of inventory deviations by calculating the adjustment speed. Following the methodology in Rumyantsev and Netessine (2007), Gu et al. (2018) and Udenio et al. (2018), the calculation of IFI is as follows:

$$D_{i,q} = \left| \frac{Inv_q - Inv_{q-1}}{Inv_{q-1}} - \frac{COGS_q - COGS_{q-1}}{COGS_{q-1}} \right| \quad (1)$$

$$D_{i,max} = \max(D_{i,q-8} \cdots D_{i,q-1}), \max \in [q-8, q-1] \quad (2)$$

$$D_{i,min} = \min(D_{i,q} \cdots D_{i,q+3}), \min \in [q, q+3] \quad (3)$$

$$IFI_{i,t} = \frac{(D_{i,max} - D_{i,min}) / Avg(D_{i,max} \cdots D_{i,min})}{T_i(max \sim min)} \quad (4)$$

In the formula, i denotes firm, t denotes year, and q denotes quarter. $D_{i,q}$ is the inventory deviation at the quarterly level, measured by the absolute value of the difference between the quarterly growth rate of inventory and the quarterly growth rate of COGS. $D_{i,max}$ is the maximum value of inventory deviation in the previous two years. $D_{i,min}$ is the minimum value of inventory deviation for the current year.

To better explain IFI, Figure 2 is supplemented. The horizontal axis in the figure represents time, and the vertical axis represents inventory deviation. In Figure 2, the maximum inventory deviation in a certain period occurs at q-6. The minimum inventory deviation occurs at q+2, then the min is equal to q+2. $D_{i,max}$-$D_{i,min}$ is the maximum adjustment magnitude of inventory deviation in a certain period. Then, we weigh the adjustment magnitude of inventory deviation. With a weight of $Avg(D_{i,max} \cdots D_{i,min})$, it represents the average of inventory deviations from $D_{i,max}$ to $D_{i,min}$. In Figure 2, this weight is the average of inventory deviations from q-6 to q+2. Hence, we use $(D_{i,max}$-$D_{i,min})/Avg(D_{i,max} \cdots D_{i,min})$ to capture the weighted adjustment magnitude of inventory deviation. The larger the value, the greater the adjustment magnitude. $T_i(max \sim min)$ is the adjustment time for inventory deviation from $D_{i,max}$ to $D_{i,min}$, which is the period from max to min. In Figure 2, the adjustment time is 8 quarters. Therefore, IFI measures the adjustment magnitude of inventory deviation per unit time. The larger the value, the greater the inventory flexibility.

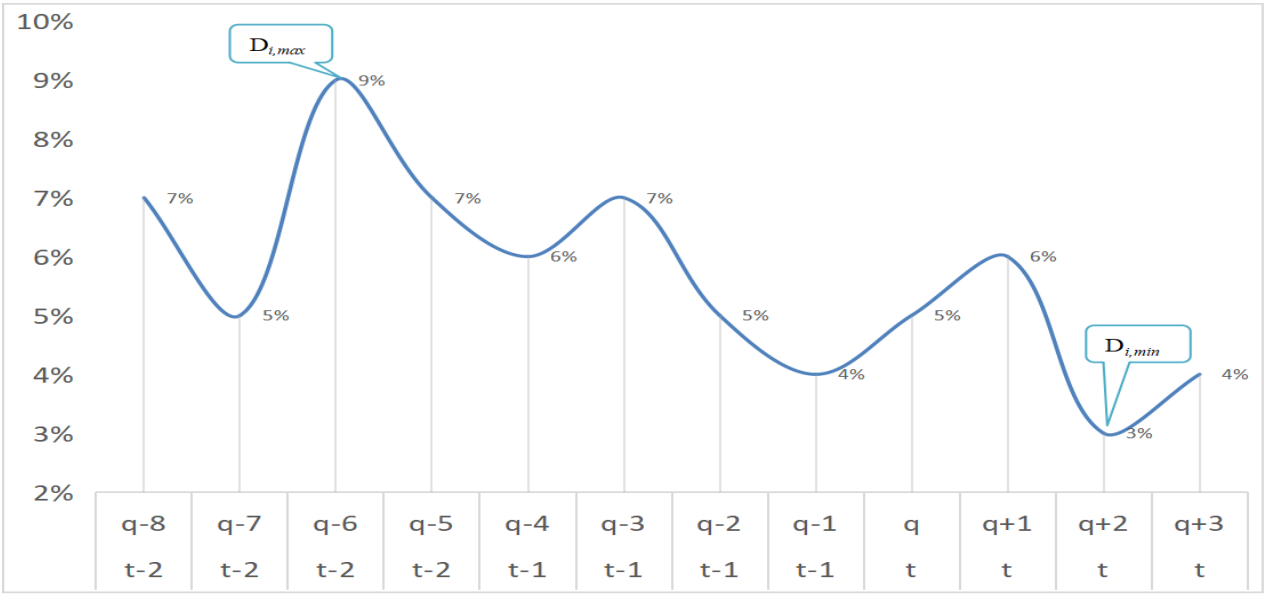

Figure 2. An Illustration of Inventory Flexibility

Moderating variables. Two firm-level moderators are used in our study: firm growth and firm size. Concretely, consistent with previous studies (Coad *et al.,* 2016), firm growth was measured by the difference between the logarithm of sales revenue in year t and the logarithm of sales revenue in year t-1. The larger the value, the higher the firm growth. Existing studies on the measurement of firm size mainly include three proxies: sales revenue, number of employees, and total assets. In line with Bendig et al. (2018), the logarithm of total assets was used as a proxy for firm size.

Control variables. In order to improve the robustness and generalizability, three additional firm-level factors that may affect financial performance were identified through an examination of prior related studies (Eroglu & Hofer, 2011; Isaksson & Seifert, 2014). As leverage has been proven to be closely related to financial performance, we utilize the ratio of total liabilities to total assets as a control variable. To control for the differences in the utilization of resources that might be related to financial performance, the capital intensity measured as the ratio of total assets to sales revenue is introduced into our models (Udenio *et al.,* 2018). Moreover, as recommended by Elsayed and Wahba (2016), we introduce the logarithmic of firm age into our model. As further controls, the year-fixed effects and firm-fixed effects are introduced into the model.

Table 1

Summary Statistics and Correlations

	Variables	1	2	3	4	5	6	7
1	Financial Performance	1.0000						
2	Inventory Flexibility	-0.0027	1.0000					
3	Leverage	-0.3546*	0.0241*	1.0000				
4	Capital Intensity	-0.2224*	0.0714*	-0.1158*	1.0000			
5	Firm Age	0.0038	0.0164	-0.0170	0.0296*	1.0000		
6	Firm Growth	0.2451*	0.0288*	0.0415*	-0.1493*	-0.0501*	1.0000	
7	Firm Size	0.1145*	-0.0002	0.3050*	-0.0660*	0.2164*	0.0959*	1.0000
	Mean	0.0319	0.4016	0.4618	1.9740	2.8469	0.1157	22.1568
	Standard deviation	0.0526	0.2618	0.1889	1.2886	0.3426	0.3421	1.2295

*[N=16117; * p<0.01]*

Model Specification

In order to examine the relationships among inventory flexibility, firm growth, firm size, and financial performance, three models were employed to test the above hypotheses. Concretely, the first model is used to test the direct effect of inventory flexibility on financial performance (Model 1). The second model is used to test the moderating effect of firm growth on the relationship between inventory flexibility and financial performance (Model 2). The third model is used to test the role of firm size in moderating the moderation effect of firm growth (Model 3).

Model 1:

$$FP=\alpha_0+\alpha_1 IF+\alpha_2 FG+\alpha_3 FS+\alpha_4 Controls+\varepsilon \quad (5)$$

Model 2:

$$FP=\beta_0+\beta_1 IF+\beta_2 FG+\beta_3 FS+\beta_4 IF\times FG+\beta_5 Controls+\varepsilon \quad (6)$$

Model 3:

$$FP=\gamma_0+\gamma_1 IF+\gamma_2 FG+\gamma_3 FS+\gamma_4 IF\times FG+\gamma_5 IF\times FS+\gamma_6 FG\times FS+\gamma_7 IF\times FG\times FS+\gamma_8 Controls+\varepsilon \quad (7)$$

Where *FP* denotes financial performance, *IF* denotes inventory flexibility, *FG* denotes firm growth, *FS* denotes firm size, and Controls contains control variables (leverage, capital intensity, and firm age), year-fixed effects, and firm-fixed effects.

Results

Testing Direct Effects and Moderating Effects

Table 2 provides the results of the three models used to test the above hypotheses. These models control for leverage, capital intensity, and firm age, as well as year-fixed effects and firm-fixed effects. Concretely, we first examine the relationship between inventory flexibility and financial performance in Model 1, and find that the coefficient of inventory flexibility is positive and significant (β=0.0051; $p<0.01$). The results show that manufacturing enterprises with higher inventory flexibility can enjoy a better financial performance, supporting Hypothesis 1a and rejecting Hypothesis 1b.

Next, we hypothesized in Hypothesis 2 that firm growth negatively moderates the relationship between inventory flexibility and financial performance. Model 2 tests the moderating effect of firm growth. Results in Model 2 show that the interaction term between inventory flexibility and firm growth (two-way interaction) is negative and significant (β=-0.0114; $p<0.01$). Thus, Hypothesis 2 is supported.

With Hypothesis 3, we proposed that firm size reduces the negative moderating effect of firm growth on the relationship between inventory flexibility and financial performance. Model 3 reveals the effect of firm size by adding the three-way interaction among inventory flexibility, firm growth, and firm size. Results in Model 3 show that firm size positively (β=0.0065; $p<0.01$) moderates the negative interactive effect of inventory flexibility and firm growth on financial performance. That is, firm size, in a way, reduces the negative influence of firm growth on the relationship between inventory flexibility and financial performance. Accordingly, Hypothesis 3 is supported.

Following Dawson and Richter (2006), Fig. 3 show the effect of inventory flexibility on financial performance in four scenarios pertinent to high and low levels of firm growth, and high and low levels of firm size. Meanwhile, by calculating the slopes under these four scenarios, we find that Lines 1 to 4 have slopes of 0.0025, -0.0034, 0.0057, and 0.0107, respectively. Although manufacturing enterprises with high firm growth (Lines 1 and 2) enjoy better financial performance than those with low firm growth (Lines 3 and 4), the magnitude to which the former's inventory flexibility affects financial performance is lower than that of the latter. Moreover, we find that in terms of the positive effect of inventory flexibility on financial performance, large enterprises have a greater impact than small enterprises under the high growth scenario, whereas small enterprises have a greater impact than large enterprises under the low growth scenario. These results provide extra evidence to support Hypotheses 2 and 3.

Table 2

Results of Direct and Moderated Regression Analysis

Variables		(1) Model 1	(2) Model 2	(3) Model 3
Controls				
Leverage		-0.1261***	-0.1303***	-0.1367***
		(0.0031)	(0.0030)	(0.0030)
Capital Intensity		-0.0109***	-0.0081***	-0.0087***
		(0.0004)	(0.0004)	(0.0004)
Firm Age		-0.0103*	-0.0061	-0.0098*
		(0.0057)	(0.0055)	(0.0055)
Predictors				
Inventory Flexibility (IF)	**H1**	0.0051***	0.0066***	0.0186
		(0.0013)	(0.0013)	(0.0229)
Firm Growth (FG)			0.0355***	0.1399***
			(0.0016)	(0.0245)
IF×FG	**H2**		-0.0114***	-0.1567***
			(0.0027)	(0.0448)
Firm Size (FS)				0.0076***
				(0.0009)
IF×FS				-0.0006
				(0.0010)
FG×FS				-0.0048***
				(0.0011)
IF×FG×FS	**H3**			0.0065***
				(0.0020)
Year fixed effects		Yes	Yes	Yes
Firm fixed effects		Yes	Yes	Yes
Observations		16117	16117	16117
R-squared		0.5158	0.5468	0.5501

*[Standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01]*

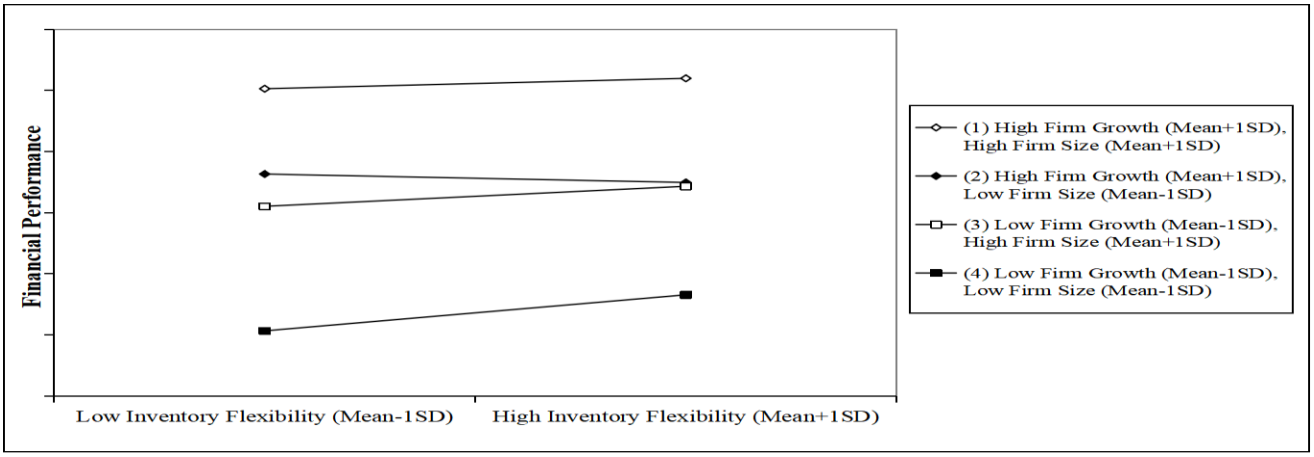

Figure 3. Effects of Three-Way Interaction of Firm Growth and Firm Size on the Relationship between Inventory Flexibility and Financial Performance

Robustness Checks

To strengthen and support our hypotheses, we conduct three separate robustness checks. Specifically, we mainly repeat Models 1 to 3 of our regression analysis. The corresponding results support our previous findings and are presented in Tables 3 to 5.

First, we examine whether our results are sensitive to variations in period lengths used to measure inventory flexibility. To do this, we increase and decrease the period length by one year. For example, decreasing one year means using the length of the period from two years to one year to measure inventory flexibility. The results of decreasing one year are shown in Columns (1) to (3) of Table 3, indicating that signs and statistical significance of the main variables remain unchanged. Meanwhile, Columns (4) to (6) of Table 3 provide results of increasing one year, suggesting that the variation in period lengths does not affect the previous estimations as all coefficients remain unchanged.

As a second robustness check, we examine whether our results are robust to measures of financial performance. Concretely, in line with Isaksson and Seifert (2014), we used the ratio of earnings before interest and taxes (EBIT) to sales as the proxy for financial performance. Results in Columns (1) to (3) of Table 4 remain broadly the same as before. Furthermore, we used the return on sales (ROS) to capture financial performance. Results are reported in Columns (4) to (6) of Table 4. Concluding, the results increase our confidence in the robustness of our results.

Finally, we conduct a robustness check to control for the possible seasonal effects. Following the methodology in Steinker and Hoberg (2013), we used the seasonally adjusted inventory to calculate inventory flexibility. The results are provided in Columns (1) to (3) of Table 5. In addition, mirroring Rumyantsev and Netessine (2007), we measure co-movements of inventory and COGS to the same quarter of the previous year. Hence, the $D_{i,q}$ is as follows:

$$D_{i,q} = \left| \frac{Inv_q - Inv_{q-5}}{Inv_{q-5}} - \frac{COGS_q - COGS_{q-5}}{COGS_{q-5}} \right| \quad (8)$$

The results are provided in Columns (4) to (6) of Table 5. The corresponding results support our previous findings.

Table 3

Robustness Check Results of Alternative Inventory Flexibility Measures

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Inventory Flexibility (IF)	0.0020*	0.0027***	0.0181	0.0053***	0.0070***	-0.0015
	(0.0010)	(0.0011)	(0.0182)	(0.0015)	(0.0015)	(0.0255)
Firm Growth (FG)		0.0325***	0.1449***		0.0345***	0.1045***
		(0.0014)	(0.0222)		(0.0017)	(0.0257)
IF×FG		-0.0052**	-0.1531***		-0.0105***	-0.1035**
		(0.0023)	(0.0362)		(0.0031)	(0.0507)
Firm Size (FS)			0.0066***			0.0079***
			(0.0008)			(0.0010)
IF×FS			-0.0007			0.0003
			(0.0008)			(0.0011)
FG×FS			-0.0051***			-0.0032***
			(0.0010)			(0.0011)
IF×FG×FS			0.0066***			0.0041*
			(0.0016)			(0.0022)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17918	17918	17918	14059	14059	14059
R-squared	0.5096	0.5407	0.5436	0.5161	0.5462	0.5497

*[Standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01. Due to space limitations, the control variables are not listed one by one]*

Table 4

Robustness Check Results of Alternative Financial Performance Indicators

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Inventory Flexibility (IF)	0.0102***	0.0146***	0.0701	0.0115***	0.0152***	0.0886*
	(0.0031)	(0.0032)	(0.0549)	(0.0030)	(0.0031)	(0.0536)
Firm Growth (FG)		0.0782***	0.4327***		0.0791***	0.4611***
		(0.0038)	(0.0594)		(0.0037)	(0.0577)
IF×FG		-0.0304***	-0.3139***		-0.0270***	-0.3869***
		(0.0067)	(0.1131)		(0.0065)	(0.1075)
Firm Size (FS)			0.0285***			0.0291***
			(0.0021)			(0.0021)
IF×FS			-0.0026			-0.0034
			(0.0025)			(0.0024)
FG×FS			-0.0162***			-0.0174***
			(0.0027)			(0.0026)
IF×FG×FS			0.0128**			0.0162***
			(0.0051)			(0.0048)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16145	16145	16145	16186	16186	16186
R-squared	0.4360	0.4652	0.4745	0.4480	0.4795	0.4891

*[Standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01. Due to space limitations, the control variables are not listed one by one]*

Table 5

Robustness Check Results of Controlling for Seasonal Effects

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Inventory Flexibility (IF)	0.0047***	0.0061***	0.0379	0.0028*	0.0051***	0.0224
	(0.0015)	(0.0015)	(0.0258)	(0.0014)	(0.0014)	(0.0246)
Firm Growth (FG)		0.0332***	0.1393***		0.0400***	0.1402***
		(0.0018)	(0.0280)		(0.0017)	(0.0275)
IF×FG		-0.0080**	-0.1575***		-0.0142***	-0.1566***
		(0.0033)	(0.0510)		(0.0033)	(0.0528)
Firm Size (FS)			0.0082***			0.0057***
			(0.0010)			(0.0010)
IF×FS			-0.0015			-0.0008
			(0.0012)			(0.0011)
FG×FS			-0.0048***			-0.0045***
			(0.0012)			(0.0012)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
IF×FG×FS			0.0067***			0.0065***
			(0.0023)			(0.0024)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12166	12166	12166	12833	12833	12833
R-squared	0.5118	0.5421	0.5455	0.5008	0.5447	0.5466

*[Standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01. Due to space limitations, the control variables are not listed one by one]*

Discussion and Conclusions

This study examines whether manufacturing enterprises of different firm growth and firm sizes can achieve improved financial performance through flexible inventory management. To test our hypotheses, we conduct an empirical analysis based on the data of Chinese listed manufacturing enterprises over the period from 2005 to 2021. Summarizing the above results, all hypotheses are confirmed. Concretely, inventory flexibility is positively related to financial performance (H1a). Further, firm growth can negatively moderate the relationship between inventory flexibility and financial performance (H2). Moreover, firm size reduces the negative moderating effect of firm growth on the inventory flexibility-financial performance link (H3). This calls for a deeper understanding of flexible inventory management, which, in this study, differs from the definition described in prior studies. These findings have both theoretical and managerial implications.

Theoretical Implications

This study has theoretical implications as follows. First, our research contributes to the flexible inventory management literature by extending the definition of inventory flexibility from the perspective of quick adjustments of inventory deviations. It advances our understanding of the financial benefits of inventory flexibility by quantifying how quickly inventory deviations can be adjusted. Quick adjustments of inventory deviations are perceived as an important factor in the success of inventory management (Gligor *et al.,* 2015; Dubey *et al.,* 2018). Yet empirical evidence that responsive inventory management integrating adjustment speed and adjustment magnitude affects financial performance is scant in the literature. We find that flexible inventory management in general can positively affect the financial performance of manufacturing enterprises. This finding supports the argument that the reduction of inventory deviation can effectively improve financial performance and is consistent with several previous studies on responsive inventory management (Kroes & Manikas, 2018; Udenio *et al.,* 2018). More than that, our findings address the research gap in which the effect of quick adjustments to inventory deviations on financial performance has not been identified. This is different from inventory flexibility in the narrow sense, which focuses on the adjustment magnitude of inventory deviation, but extends the research on flexible inventory management to the level of quick adjustments of inventory deviation in a broad sense.

The second theoretical contribution of this study is the added evidence to the literature on growth theory. Our research shows that firm growth negatively moderates the positive relationship between inventory flexibility and financial performance. That is, flexible inventory management in high-growth manufacturing enterprises has less improvement in financial performance than that in low-growth manufacturing enterprises. This differs from the results of Elsayed & Wahba (2016) in which the rapid growth stage positively moderates the relationship between the inventory-to-sales ratio and financial performance. A possible explanation is that the direct effect of the inventory-to-sales ratio on financial performance in their study is negative, while the direct effect of inventory flexibility on financial performance in our study is positive. In addition, our study partially supports the view that there is a negative relationship between sticky inventory management and financial performance during periods of declining sales (Kroes & Manikas, 2018), since flexible inventory management in low-growth manufacturing enterprises yields higher financial performance.

The final theoretical contribution of this research is that the factors of growth theory and those of RBV can be connected in the sense that firm size reduces the negative moderating effect of firm growth on the relationship between inventory flexibility and financial performance. Then, we drill down to explore boundary conditions to highlight that the same levels of inventory flexibility may not yield a similar level of financial performance. Combing with Fig. 3, we find that while high-growth manufacturing enterprises and large manufacturing enterprises can enjoy a better financial performance, this is not the case in terms of the impact of inventory flexibility on financial performance. Concretely, we find that the financial benefits of inventory flexibility are greatest for small manufacturing enterprises in the low-growth scenario. However, the impact of flexible inventory management on the financial performance of small manufacturing enterprises in the high-growth scenario is negative.

Managerial Implications

This study offers some managerial implications for managers in implementing flexible inventory management. First, this study provides an inventory flexibility measure (IFI) that can effectively capture quick adjustments to inventory deviations. The IFI presents a more accurate assessment of the degree of inventory flexibility of manufacturing enterprises in a broad sense. Meanwhile, this metric is based on time series data and does not rely on complex analytical models, so it is suitable for widespread use by managers.

Second, managers of manufacturing enterprises need to be aware of the importance of quick adjustments of inventory deviations when formulating flexible inventory management strategies. As we have demonstrated, flexible inventory management is seen as beneficial to financial performance. Further, the impact of inventory flexibility on financial performance can be enhanced in the context of low growth. Thus, for low-growth manufacturing enterprises, managers should proactively employ flexible inventory management strategies centered on quickly adjusting inventory deviations to improve financial performance.

Finally, managers should understand the importance of firm size. The three-way interaction results suggest that firm size reduces the negative impact of firm growth on the relationship between inventory flexibility on financial performance. This should be the motivation for managers of large manufacturing enterprises to implement flexible inventory management. For large manufacturing enterprises, since the quick adjustments of inventory deviations can reduce the adverse impact of firm growth, managers can implement flexible inventory management without worries. However, when implementing flexible inventory management, managers of small manufacturing enterprises should be proactive in the low-growth scenario and cautious in the high-growth scenario. Collectively, these findings provide managers with precise guidelines to help them achieve better financial performance through flexible inventory management.

Limitations and Future Research

This study has several limitations, which point to directions for future research. First, our research only focuses on the financial benefits of flexible inventory management. Inventory management has been shown to deliver benefits in areas beyond financial performance, such as productivity (Zhu *et al.,* 2018), venture survival (Azadegan *et al.,* 2013), and product quality (Lin *et al.,* 2018). Future research should theorize and test whether flexible inventory management significantly affects other important performance. Second, our research tests the hypotheses based on Chinese manufacturing enterprises. Although China shares many characteristics with other emerging economies in terms of operational management, it also has certain uniqueness. More studies are necessary before generalizing these findings to other countries. Finally, in addition to the moderating effect analysis, an inquiry into the mechanism between flexible inventory management and financial performance is important. Existing research reveals the mechanism of flexible inventory management on financial performance from the perspective of inventory service flexibility (Song & Song, 2009). Some mechanisms have been proposed in our study, but we cannot rule out the existence of one or more alternative mechanisms. Future research should seek to identify the mechanism and explore the extent of its explanation.

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