QUALITY PAPER

The effect of inventory performance on product quality

The mediating effect of financial performance

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Abstract

Purpose – The purpose of this paper is to empirically investigate the relationship among inventory performance, financial performance (FP) and product quality.
Design/methodology/approach – The empirical analysis is based on two-stage least squares analysis of detailed firm-transaction data from Chinese manufacturing export firms for the period between 2001 and 2013.
Findings – Results show that inventory performance has a positive impact on product quality while using inventory efficiency, inventory productivity and inventory leanness to measure inventory performance. Furthermore, the effect of inventory performance on product quality is found to be partially mediated by FP.
Practical implications – The research provides mangers evidence of the benefits of inventory performance as an antecedent of product quality. Managers without sufficient liquidity or cost advantage to get better FP can achieve product quality improvement through enhancing inventory management performance.
Originality/value – This study first empirically investigates the relationship between inventory performance and product quality, and examines the mediating effect of FP on this relationship.

Keywords Product quality, Mediating effect

Paper type Research paper

1. Introduction

Product quality, as one of the core contents of corporations' competitive strategy, is typically associated with operations management. Meanwhile, inventory management is of increasing importance to operations management (Sharma, 2010). It is well known that inventory management is often considered as an effective means of releasing deposit capital caused by excess inventory and enhancing competitiveness (Sharma, 2011; Hameri and Weiss, 2017). Therefore, an increasing number of manufacturing firms have embraced various inventory management practices to reduce inventory and improve cost structure (Sharma, 2013; Isaksson and Seifert, 2014). With the increasing attention on inventory management for manufacturing firms, the need for product quality improvement is also surging. Hence, the relationship between inventory performance and product quality are of great significance in the context of modern production and operations management.

However, the exact mechanism by which inventory performance affects product quality remains unclear. The increased inventory performance strives to prevent quality deterioration and identifies problems in production process (Koumanakos, 2008; Steven and Britto, 2016), thereby improving product quality eventually. This can provide a theoretical base for investigating the direct effect of inventory performance on product quality. Unlike direct effect from the perspective of inventory management, the indirect effect mediated by financial performance (FP) should be of serious consideration.

Therefore, the purpose of this paper is to add to our understanding of inventory management by exploring the relationship between inventory performance and product quality, with a focus on the mediating role of FP. Results of this research are critical to the field of operations management and of high practical relevance. However, empirical evidence remains scarce.

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In addition, this paper contributes to the fast-growing literature that formally examines the relationship between inventory performance and product quality. Specifically, previous studies mainly focus on inventory control models with relaxing perfect quality assumption, indicating that this assumption is not true in practice (Alamri *et al.*, 2016). To our knowledge, this is the first study to empirically investigate the impact of inventory performance on product quality. Furthermore, to better evaluate inventory performance, we use the following three different indicators to form a comprehensive analysis: inventory efficiency (IE), inventory productivity (IP), and inventory leanness (IL).

This paper also contributes to the literature on FP, by showing its mediating role on the relationship between inventory performance and product quality. Concretely, we examine the mediating role of FP as previous studies suggest that inventory performance is correlated with FP (Modi and Mishra, 2011), and FP is closely related to product quality (Raithel and Schwaiger, 2015; Peters *et al.*, 2017). Efforts to enhance FP, in turn, server to improve product quality due to increased inventory performance.

The data used in empirical analysis come from a large set of manufacturing export firms in China over the period from 2001 to 2013. Empirical results provide detailed insights into the linkages among inventory performance, FP and product quality, thereby contributing to theory of inventory management. Furthermore, to minimize endogenous problems caused by reverse causality or omitted variables, we apply the instrumental variable (IV) method and employ the two-stage least squares (2SLS) estimator to make empirical analysis.

The rest of the paper is organized as follows. The relevant literature is reviewed and hypotheses are proposed in Section 2. Then Section 3 discusses the data and measurement issues. In Section 4, we present the 2SLS/IV estimation results to test our hypotheses. Finally in Section 5, we discuss our findings, research and managerial implications along with limitations and future research opportunities.

2. Literature review and hypothesis development

2.1 Inventory performance

Globally, inventory performance has become an important criterion of measuring operations management (Capkun *et al.*, 2009). Enhanced inventory performance contributes to eliminate waste in excess inventory and smooth production process (Koumanakos, 2008). Hence, inventory management is often used as a useful tool to improve firm performance (Fullerton *et al.*, 2003; Swamidass, 2007; Koumanakos, 2008; Steven and Britto, 2016). Concretely, the positive effects of inventory performance on firm performance mainly focus on return on assets (ROA) (Eroglu and Hofer, 2011; Sahari *et al.*, 2012), return on investment (ROI) (Fullerton *et al.*, 2003; Cannon, 2008), gross margin (Kolias *et al.*, 2011), net operating margin (Koumanakos, 2008), labor productivity (LP) (Lieberman and Demeester, 1999), return on sales (ROS) (Fullerton *et al.*, 2003), earnings before interests and taxes (EBIT) (Isaksson and Seifert, 2014), and stock performance (Chen *et al.*, 2005). Most of these factors are indications of FP.

In line with recent literature (Alan *et al.*, 2014; Shockley and Turner, 2015) and following the original idea of Eroglu and Hofer (2011), there are three major inventory measurement methodologies: absolute measures including average inventory levels and maximum inventory levels (Shockley and Turner, 2015); standardized measures referring to inventory turnover and its variants, such as days of inventory (Koumanakos, 2008), inventory scaled by sales (Capkun *et al.*, 2009), gross margin return on inventory (Alan *et al.*, 2014; Shockley and Turner, 2015), and sales-to-inventory ratio (Mishra *et al.*, 2013); and complex measures, such as empirical leanness indicator (ELI) (Eroglu and Hofer, 2011) and adjust inventory turnover (Alan *et al.*, 2014), estimated by regression analysis.

2.2 Product quality

According to International Organization for Standardization, product quality is defined as the ability to satisfy the customer and market (Lakhal and Pasin, 2008), which is often separated into eight dimensions, consisting of performance, features, reliability, conformance, durability, serviceability, aesthetics and perceived quality. Enterprises with higher product quality are more likely to capture superior customer value, thus improving their own competitiveness (Kafetzopoulos *et al.*, 2015; Prakash *et al.*, 2017).

Generally, product quality consists of tangible quality (performance, durability, size, etc.) and intangible quality (aesthetics, serviceability, perceived quality, etc.). Tangible quality is typically used to evaluate the physical attributes, capturing the production process control capability (Agus and Hajinoor, 2012). Some metrics are employed to measure tangible quality, such as defective items (Das *et al.*, 2011; Chuang *et al.*, 2013), first time yield, scrap cost (Maiga *et al.*, 2015) and the number of recalls (Steven and Britto, 2016). Intangible quality mainly refers to corporate reputation and service quality, such as serviceability and perceived quality (Llusar and Zornoza, 2000; Ojasalo, 2006). It is worth mentioning that perceived quality is considered as consumers' overall assessment of the product (or service) based on past performance (Madu and Madu, 2002). As the intangible quality is unobserved, how to capture the intangible quality becomes the main barrier to measure product quality. To address this issue, some researchers employ the unit value as the proxy of product quality based on the vertical-market assumption (Schott, 2004). However, unit value not only captures product quality, but also refers to cost fluctuations and demand shocks. Hence, unit value is not suitable for measuring product quality (Kugler and Verhoogen, 2012). Taking this issue into consideration, Hallak and Sivadasan (2013) proposed to comprehensively measure the product quality by constructing a utility function.

2.3 Inventory performance and product quality

Inventory performance is perceived as one of the major indexes to reflect operations management, which minimizes waste and promotes operational strength (Lawson, 2001). Generally, enhanced inventory performance is expected to bring increased FP (Sahari *et al.*, 2012), and then drives enterprises to improve product quality (Aw *et al.*, 2008; Peters *et al.*, 2017). This description of FP clearly indicates a mediating factor between inventory performance and product quality. Therefore, inventory performance may not only have direct effect on product quality, but also have indirect effect on product quality, mediated by FP.

In line with the proposed research model, relevant studies are grouped into three streams as shown in Figure 1. The first stream reviews studies linking inventory performance and product quality, and explores the direct effect of inventory performance on product quality. The second stream consists of empirical studies, referring to the relationship between inventory performance and FP. The third stream focuses on the analysis of the relationship between FP and product quality.

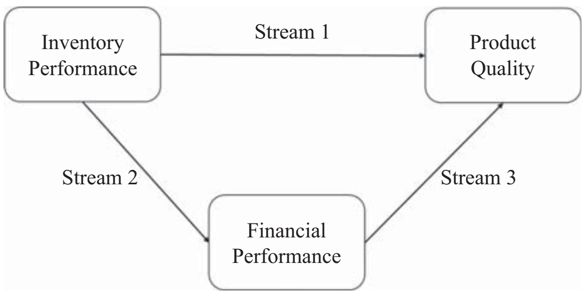

Figure 1.
Research streams on inventory performance and product quality

2.3.1 Relationship between inventory performance and product quality. The first stream explores the relationship between inventory performance and product quality. Previous researches mainly focus on inventory control models with relaxing the perfect quality assumption theoretically (Alamri *et al.*, 2016). Concretely, the classical economic ordering quantity (EOQ) model is typically used to analyze the inventory control issue, which assumes that all inventories comfort to quality characteristics (Fauza *et al.*, 2016). But that is not true for most production process. In recent years, the EOQ model has been developed by relaxing the perfect quality assumption. Konstantaras *et al.* (2012) develop an EOQ model with imperfect quality items and shortages. They propose that products with imperfect quality in each lot may be reduced as a result of learning by the manual screening. In addition, Chuang *et al.* (2013) extend EOQ model with imperfect quality and an investment function as a logarithmic function to improve quality. They establish an iterative algorithm to obtain the optimal ordering to maximize the supply chain profit.

As argued by Lawson (2001), excess inventory consumes physical space and increases operating cost, thereby worsening operations performance. Inventory management is touted as a useful tool to eliminate waste in excess inventory, and smooth production process. It is believed that enhancing inventory performance could be beneficial for improving product quality. This opinion can be explained from the following aspects.

First, enhanced inventory performance helps to avoid product quality deterioration. Poor inventory performance may cause deterioration of product quality, such as damage, spoilage and loss (Koumanakos, 2008; Steven and Britto, 2016). Early studies on inventories assumed that products carried from one period over to the next were the perfect alternatives to newly purchased ones (Wang and Li, 2012; Alamri *et al.*, 2016). However, in practice, when inventories are carried, product quality is subject to deterioration over time (Fauza *et al.*, 2016). For various reasons, consumers tend to be little interested in inventoried products, especially for perishable products, whose products are not as fresh as new ones.

Second, enhanced inventory performance helps to identify problems in production process. Poor inventory performance reduces information visibility and covers up problems in the operational management, such as equipment failure, quality defect, rework and haphazard scheduling (Modi and Mishra, 2011; Steven and Britto, 2016). Therefore, it is hard for managers to identify quality problems in the production process unless the inventory performance is improved. Although the orders are completed on time, sloppy management and contempt for procedures have resulted in huge cost and poor product quality (Koumanakos, 2008). Inventory management will enable managers to be more concerned with quality problems, and smooth the production process so as to reduce the defect rate, resulting in product quality improvement. In sum, we propose the following hypothesis:

H1. Inventory performance is positively associated with product quality.

2.3.2 The mediating role of FP. FP involves multiple blocks of financial capabilities, which matters for development strategy (Fresard, 2010; Martínez-Ferrero and Frías-Aceituno, 2015). Previous literature argued that better FP facilitates the investment in marketing and innovation activities that can enhance competitive advantage (Roberts and Dowling, 2002; Pavic *et al.*, 2007). FP indicators usually refer to stock-returns, Tobin's *Q*, ROA, ROS and gross margin (Fullerton *et al.*, 2003; Cannon, 2008; Capkun *et al.*, 2009). Most of studies related to FP in management literature focus on corporate social performance (Simpson and Kohers, 2002), product market behavior (Fresard, 2010), resource efficiency (Modi and Mishra, 2011), supply chain integration (Yu *et al.*, 2013) and quality management (O'Neill *et al.*, 2016). In terms of product quality, enhanced FP drives companies to improve product quality (Roberts and Dowling, 2002; Peters *et al.*, 2017).

The second stream of research investigates the link between inventory performance and FP. Usually, inventory management helps release cash flows through eliminating waste in inventory (Hameri and Weiss, 2017), and then brings FP improvement. On the other hand, enhanced inventory performance typically can promote a high-level supply chain coordination (Barnesschuster *et al.*, 2002), which often leads to better FP (Modi and Mishra, 2011). Motivated by the wave of inventory management improvement concepts, there are increasing amount of academic researches attempting to empirically document the relationship between inventory performance and FP (Obermaier, 2012). Most of studies use profitability metrics as proxy variables of FP. However, results of the impact of inventory performance on FP are mixed. Generally, it is believed that firms with high inventory performance, measured by total inventory-to-sales ratio, enjoy better FP (Swamidass, 2007). Deloof (2003) argues that inventory turnover measured by the number of days of inventories is positively associated with gross operating income for Belgian firms. Meanwhile, Fullerton *et al.* (2003) investigate the impacts of inventory turnover on cash flow margin, ROS, and ROA, suggesting that enhanced inventory performance is positively associated with FP. Similarly, Capkun *et al.* (2009) examine the relationship between the discrete components of inventory and FP, suggesting that total inventory levels, as well as raw materials, work in-process inventory, and finished goods, have positive effects on FP (gross profit, EBIT). Furthermore, Shockley and Turner (2015) document positive impacts of IE, IP and inventory responsiveness on ROA and ROS. However, the impacts of inventory performance measured by IL or inventory turnover on FP may be non-liner (Eroglu and Hofer, 2011; Isaksson and Seifert, 2014). Besides, Cannon (2008) finds no significant relationship between inventory turnover and FP measured by market value added, ROA, ROI and Tobin's *Q*. As mentioned above, the inventory performance indicators are different, so the mixed result may, at least in part, be caused by measurement issues (Cannon, 2008; Eroglu and Hofer, 2011). To address this issue, we investigate the relationship between inventory performance and product quality by using three different inventory performance indicators: IE, IP and IL.

The third stream of research focuses on the relationship between FP and product quality. It is believed that FP provides financial security for product quality improvement (Aw *et al.*, 2008; Peters *et al.*, 2017). The positive effect of FP on product quality could be explained from the following aspects.

First, firms with good FP pay more attention to innovative activities (Peters *et al.*, 2017) and then achieve product quality improvement. Consumers are more willing to pay for innovative products that are generally considered to be of high perceived quality, but that comes at a cost, namely research and development (R&D) investment (Karjalainen, 2008). Financial resource plays a crucial role in the firm's investment decision, which affects the ability to support the R&D outlays (Li, 2007). Firms with good FP are more likely to invest in R&D (Peters *et al.*, 2017). And R&D investment is closely related to product quality. Prajogo and Sohal (2006) examines the impact of R&D investment on product quality, showing positive relationship between R&D and product quality. Similar result is also provided by Aw *et al.* (2008).

Second, firms with good FP usually enjoy high reputation, and obtain high perceived quality (Raithel and Schwaiger, 2015). FP is always deemed as the signals of firm's overall performance (Roberts and Dowling, 2002). It is believed that the FP is closely related to credit rating, which does much to build up a firm's reputation (Lange *et al.*, 2011). Meanwhile, FP is also the basis for enterprises to enhance their reputation (Leiva *et al.*, 2014), such as advertising investment, which contributes to build brand effect and increase visibility (Demont *et al.*, 2013). Moreover, good reputation typically represents high perceived product quality, and thus positively affects customer behaviors in terms of satisfaction, loyalty or willingness to pay (Raithel and Schwaiger, 2015).

Lastly, firms with good FP tend to use high-quality intermediate inputs (Hallak and Schott, 2011; Kugler and Verhoogen, 2012), which are essential for product quality improvement. Recently managers are beginning to realize the importance of high-quality intermediate inputs to improve product quality (Kugler and Verhoogen, 2012), which is associated with improved FP. As argued by Brox and Fader (2002) and Hallak and Schott (2011), high-quality intermediate inputs can enhance product performance and reduce product defects, thereby improving product quality. In summary, the following hypothesis is proposed:

H2. FP mediates the relationship between inventory performance and product quality.

3. Data and variable description

3.1 Data resource

This study draws on three main sources of data, firm-level, transaction-level and macro-level. First, the firm-level data comes from the Chinese Annual Survey of Industrial Firms (CASIF) database, maintained by National Bureau of Statistics of China, consisting of all state-owned firms and some non-state-owned firms whose annual sales are more than $700,000. The CASIF database provides detailed information about production activities, financial measures, industry and other basic characteristics. It covers more than 200 thousand firms each year, accounting for around 95 percent of total Chinese industrial output (Upward *et al.*, 2013). Second, the transaction-level data comes from Chinese Customs Trade Statistics (CCTS) database from the General Administration of Customs of China, containing information about all merchandise transaction passing through Chinese customs such as quantity of goods, custom codes, destination country and value of goods. Due to the inconsistent enterprise registration codes in the CASIF database and CCTS database, two databases are merged on basis of the enterprises name, year and contact information by following the study of Yu (2015). Finally, the macro-level data comes from World Bank Indicators (WDI) database which is compiled and maintained by World Bank. The WDI database mainly provides national characteristic variables, including GDP and per capita income of destination country.

In line with Upward *et al.* (2013) and Isaksson and Seifert (2014), we therefore limit our study to firms with more than $50 export value and $1 inventory or sales. In addition, economically insignificant values are removed such as observations whose total assets are lower than the liquid assets, total fixed assets or the net value of the fixed assets.

3.2 Main variables

3.2.1 Product quality estimates. In principle, an ideal measure of product quality should capture various attributes, especially the perceived value obtained from consumers. However, the ordinary measurement of product quality is difficult to capture the intangible attributes related to consumer satisfaction. Then, we resort to construct the utility function of consumers to capture consumer preferences for quality following the methodology in Hallak and Schott (2011) and Manova *et al.* (2015). The utility function of consumers is as follows:

$$U = \left[\sum_{h} (q_h d_h)^{(\theta-1)/\theta}\right]^{\theta/(\theta-1)}, \theta \in (0,1) \tag{1}$$

where q_h represents the quality of product h, and θ represents the elasticity of substitution of different products. Then, the price index $P = \sum_h p_h^{1-\theta} q_h^{\theta-1}$, and the demand of product h in year t could be defined as $d_h = p_h^{-\varepsilon} q_h^{\varepsilon-1}(E/P)$, where p_h is the price of product h, and E is the consumer spending. In order to fully reflect the product quality of goods in the global markets as much as possible, we use the four-dimensional data (firm × year × destination country × product) from CCTS database to measure the product quality. As in Hallak and Schott (2011) and Shi (2013), we specify the following empirical version of the demand function for each 6-digit HS product as follows:

$$d_{imt} = p_{imt}^{-\theta} q_{imt}^{\theta-1} \frac{E_{mt}}{P_{mt}} \tag{2}$$

The high dimensionality of the data set employed here requires some definitions. Hereafter, index i will identify a firm, m a destination country, t a year, and h a product. Then we take log of Equation (2), and obtain the econometric model as follows:

$$\ln d_{imt} = v_{mt} - \theta \ln p_{imt} + \varepsilon_{imt} \tag{3}$$

Where $v_{mt} = \ln E_{mt} - \ln P_{mt}$ is a two-dimensional binary variable (destination country × year), which not only controls the factors changing with destination country or factors changing with time, but simultaneously reins the factor changing with destination and time all together. $\varepsilon_{imt} = (\theta-1) \ln q_{imt}$ is the error term that captures the information of product quality. Note that the Equation (3) will be estimated for each 6-digit HS product, respectively. Then the product quality could be defined as follows:

$$q_{imt} = \ln \widehat{q}_{imt} = \frac{\widehat{\varepsilon}_{imt}}{\theta-1} = \frac{\ln d_{imt} - \ln \widehat{d}_{imt}}{\theta-1} \tag{4}$$

Next, we standardize the product quality, and obtain the standardized product quality as follows:

$$sq_{imt} = \frac{(q_{imt} - \min q_{imt})}{(\max q_{imt} - \min q_{imt})} \tag{5}$$

where the max q_{imt} and min q_{imt} are the maximum value and minimum value of product quality, respectively. The sq_{imt} is the standardized product quality with a value from 0 through 1 at four dimension level (firm × year × destination country × product).

3.2.2 Inventory performance indicators. According to the studies of Eroglu and Hofer (2011), Modi and Mishra (2011) and Alan *et al.* (2014), three inventory performance indicators are used to measure inventory performance. Concretely, IE is typically used to evaluate the inventory performance and is calculated as sales divided by average inventory, which is standardized at two-digit industry level. Note that the average inventory is calculated by the arithmetic average of inventory levels at the end of the year $t-1$ and t. The higher the value of the IE, the better the inventory performance. The second inventory performance indicator is IP. Inventory turnover is used as the proxy of IP, and is calculated as the cost of goods sold divided by average inventory, indicating that the higher IP represents the better inventory performance. The IP mainly measures the profit-productivity of the inventory sold (Shockley and Turner, 2015). The last one is IL, which is measured by the ELI. ELI has the advantage of capturing the industry-specific inventory characteristics and economies of scale in inventories as well as presenting a good measure of the IL of a firm. In calculating the ELI, the natural logarithm of average inventories are regressed on the natural logarithm of sales for each industry j at two-digit industry level and year t, and the estimation is as follows:

$$\ln(\text{inventory}_{ijt}) = \alpha_{jt} + \beta_{jt} \ln(\text{sale}_{ijt}) + \mu_{ijt} \tag{6}$$

To obtain the ELI for each firm i in year t, we studentize the residuals (u) and multiply them by -1 so that positive ELI values correspond to better inventory performance.

3.2.3 Financial performance. Mirroring Capkun *et al.* (2009), we employ the EBIT to sales ratio (EBITS) to measure the FP. Therefore, the higher the value of the index, the better the FP. Since EBIT represents the profitability of the business after deducting all operations expense, it can better capture the operational success owing to the advantage in being not sensitive to firm size (Isaksson and Seifert, 2014).

3.3 Control variables

In some specifications, with the view to both improving the estimation accuracy and checking for the robustness of our core results, we identify the following variables that are likely to influence product quality. The destination country characteristics and firm-level variables are used as control variables in the empirical model. Previous literature has shown the importance of controlling the market size and the consumption ability of destination country (Hallak and Schott, 2011). Therefore, the logarithm of GDP of destination country (GDP) used as the proxy for market size and income per capita of destination country (INCOME) used as the proxy for consumption ability are included into the model (Fajgelbaum *et al.*, 2011). It has been shown that consumer preferences for quality vary according to per capita income. In particular, consumers in more effluent countries prefer higher quality goods (Hallak, 2006; Feenstra and Romalis, 2012). As further controls, some firm-level characteristic variables are incorporated into the model. Following the studies of Chen and Juvenal (2016), LP measured by gross industrial output over employees, firm size (SIZE) measured by sales entered in logs and R&D intensity (RD) measured by total R&D investment over employees are incorporated into the model as controls. Concretely, enterprises with high LP usually enjoy cost advantages and low rejection rate, and thus have impacts on product quality (Crinò and Ogliari, 2017). As argued by Kugler and Verhoogen (2012), larger enterprises charge more for their outputs and material inputs, and can convert high-quality inputs into high-quality products. It is believed that R&D investment is conducive to establishment of competitive advantage, thereby enhancing product quality (Johansson and Lööf, 2008). In addition, we have incorporated industry, destination country and year fixed effects into the model to absorb unobserved industry and destination country characteristics, and to control for shocks that are common to all the destination countries in our samples, respectively.

3.4 Descriptive statistics

Our empirical analysis focuses solely on product quality of exporting manufacturing firms for which measurements of product quality, inventory performance and other firm-level controls are available. We obtain a baseline estimating data set comprising 1,187 firms over the period from 2001 to 2013, covering 174 destination countries, 30 industries and 3,817 6-digit HS products. Table I contains descriptive statistics and correlations for the data collected. Even though 1 percent of outliers are winsorized, there is still a considerable range in many of variables such as IP. The average of product quality is 0.52, with a standard deviation of 0.13 and a maximum of 1. Moreover, a further control of the interrelation between our variables reveals no high correlations (except among the IE, IP and IL but they are analyzed respectively). The only relatively high correlation is found between the logarithm of sales and the gross industrial output over employees (0.61), indicating a positive relationship between firm size and LP.

4. Empirical analysis and results

In this section, we employ the 2SLS/IV estimator to investigate the direct effect of inventory performance on product quality and test the mediating effects of FP on the relationship

Table I. Descriptive statistics and correlations

	1	2	3	4	5	6	7	8	9	10
1. Product quality	1.000									
2. Financial performance	0.024*	1.000								
3. Inventory efficiency	−0.041*	0.064*	1.000							
4. Inventory productivity	−0.005*	0.022*	0.780*	1.000						
5. Inventory leanness	−0.015*	−0.048*	0.262*	0.323*	1.000					
6. GDP	0.055*	−0.002	−0.019*	0.003	0.011*	1.000				
7. Income per capita	0.047*	−0.049*	−0.051*	−0.013*	0.023*	−0.038*	1.000			
8. Labor productivity	0.016*	0.145*	0.203*	0.133*	−0.052*	0.008*	−0.088*	1.000		
9. R&D intensity	−0.015*	0.057*	0.026*	0.026*	0.036*	−0.026*	−0.022*	0.057*	1.000	
10. Firm size	0.004*	0.210*	0.101*	0.038*	−0.206*	−0.025*	−0.112*	0.613*	0.076*	1.000
Mean	0.517	0.044	−0.086	10.606	−0.260	29.358	2.172	0. 0628	0.001	12.448
SD	0.129	0.070	0.568	15.743	0.461	3.004	1.546	0.112	0.005	1.627
Minimum	0.000	−1.266	−0.873	0.328	−4.031	22.735	0.031	0. 0026	0.000	9.049
Maximum	1.000	1.206	5.106	176.565	2.082	36.795	7.062	1.039	0.054	18.832
Observations	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960

Note: $*p < 0.01$

between inventory performance and product quality. Furthermore, we check whether the findings are robust with full consideration of alternative measurement of inventory performance, FP and firm size.

4.1 Models

In order to better understand the relationship among inventory performance, FP and product quality, we employ a three-model system to test the proposed hypotheses regarding direct effect and mediating effect. The direct effect refers to the causal effect of inventory performance on product quality. The mediating effect mainly tests the role of FP in facilitating the process through which inventory performance affects product quality. Following the methodology in Baron and Kenny (1986) and Wang *et al.* (2016), the three-model system is as follows:

$$\text{Model 1: } \mathrm{QUALITY}_{ihmt} = \alpha_0 + \alpha_1 \mathrm{INVENTORY}_{it} + \alpha_2 \mathrm{CONTROLS} + \sum \alpha_j I_j + \sum \alpha_m D_m + \sum \alpha_t Y_t + \varepsilon \quad (7)$$

$$\text{Model 2: } \mathrm{FP}_{it} = \beta_0 + \beta_1 \mathrm{INVENTORY}_{it} + \beta_2 \mathrm{CONTROLS} + \sum \beta_j I_j + \sum \beta_m D_m + \sum \beta_t Y_t + \varepsilon \quad (8)$$

$$\text{Model 3: } \mathrm{QUALITY}_{ihmt} = \gamma_0 + \gamma_1 \mathrm{INVENTORY}_{it} + \gamma_2 \mathrm{FP}_{it} + \gamma_3 \mathrm{CONTROLS} + \sum \gamma_j I_j + \sum \gamma_m D_m + \sum \gamma_t Y_t + \varepsilon \quad (9)$$

The high dimensionality of the data set employed here requires some definitions. Hereafter, index i will identify a firm, h a 6-digit HS product, d a destination country, t a year, and j an industry. Where QUALITY is the product quality at four dimensional level; INVENTORY represents inventory performance including IL, IE and IP; FP indicates the FP. CONTROLS denote the control variables mentioned in section 3.3. In addition, industry (I), destination country (D) and year (Y) fixed effects are controlled for. Note that, in line with recent literature (Cai and Yang, 2014) and following the original idea of Aiken and West (1991), the main variables such as product quality, inventory performance and FP are mean-centered to minimize multicollinearity in empirical models. The variance inflated factor (VIF) score for each variable in all the models are provided. We find that the VIF score are all lower than 1.75, suggesting that multi-collinearity is unlikely to pose a threat to the analysis.

Concretely, we first test the direct effects of inventory performance on product quality without considering FP in Model (1). Then we investigate the effects of inventory performance on FP in Model (2). The third step is to explore the effects of inventory performance and FP on product quality in Model (3). All these three models are applied to examine the mediating effects of FP on the relationship between inventory performance and product quality.

4.2 Correcting for endogenous problems

A concern while evaluating the impact of inventory performance on product quality is the endogenous nature of inventory performance. The sources of endogenous problems may come from reverse causality (simultaneity) or omitted variables (Woolridge, 2002). For example, inventory performance may be influenced by some omitted variables which also impact product quality thus leading to endogenous problems. On the other hand, enhanced inventory performance may improve product quality, the opposite may also be true. Firms with high product quality may experience good inventory performance. To minimize endogenous problems, we adopt the 2SLS/IV estimator to investigate the direct and indirect effects of inventory performance on product quality (Bai *et al.*, 2016).

Following the studies of Baum *et al.* (2003) and Wouterse (2016), the IV must satisfy two requirements: it must be associated with the endogenous variable and uncorrelated with the error term. More specifically, we regard the distance between firm and its nearest major port as the IV. The reasons are as follows: first, according to "Review of Maritime Transport 2015" reported by United Nations Conference on Trade and Development, maritime transport has always been the main route for exporting products and obtaining raw materials and intermediates. Export firms close to coastline may be more likely to get raw materials and export product from the transport cost saving perspective, thus enjoying better inventory performance. Second, the distance between firm and its nearest port would not directly influence the product quality (Frankel and Romer, 1999). In order to verify the validity of the IV, we report the Kleibergen-Paap rk LM statistic and Kleibergen-Paap rk Wald F statistic to test the underidentification and weak instruments, respectively (Wouterse, 2016).

4.3 Direct effects of inventory performance on product quality

Table II includes estimation results for Model (1) to (3) with three inventory performance indicators used as the independent variables, respectively. The column (1) to (3) of Table II show the direct effects of IE, IP and IL on product quality using 2SLS/IV estimator for Model (1). Concretely, we find that the coefficient of IE is positive and significant at 1 percent level, indicating that the IE could matter for product quality positively. Similarly, the coefficients of IP and IL are positive and significant, suggesting that the increased IP and IL are associated with the significant product quality improvement. As expected, the overall results do not exhibit a substantial change. We interpret these results as preliminary evidence that increased inventory performance can improve product quality significantly, supporting *H1*.

4.4 Testing the mediating role of FP

To test the mediating role of FP, we apply three-model system as well as significant tests for the indirect effect (Baron and Kenny, 1986; Wang *et al.*, 2016). As shown in column (1) to (3) of Table II, inventory performance has a positive and significant direct effect on product quality without controlling mediating variable FP. Next, the 2SLS/IV estimation results for Model (2) are provided in column (4) to (6) in Table II. The coefficients of inventory performance indicators are all positive and significant at 1 percent level, suggesting that inventory performance has a positive and significant effect on FP. The column (7) to (9) in Table II shows the 2SLS/IV estimation results for Model (3). When the mediator, FP, is incorporated into the regression analysis, the magnitude of the coefficients of inventory performance are all reduced. All these results indicate that FP partially mediates the relationship between inventory performance and product quality, in support of *H2*.

Furthermore, we find that results of the Kleibergen-Paap rk LM statistic are all significant at 1 percent level, rejecting the null hypothesis that the IV is under-identification. Meanwhile, results of Kleibergen-Paap rk Wald F statistic confirm that our IV is appropriate at 10 percent maximal IV size. These results indicate that our model is well specified and adequately defined (Wouterse, 2016).

4.5 Robustness checks

In this section, we further perform several robustness checks to verify whether our results change while accounting for alternative measurements of inventory performance indicators, FP, and firm size.

Table II.
Baseline results for the direct and indirect effects

	Product quality			Financial performance			Product quality		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Financial performance							0.0483***	0.0513***	0.0570***
							(13.0266)	(15.7683)	(18.7911)
Inventory efficiency	0.0233***			0.0989***			0.0185***		
	(4.2556)			(23.9773)			(3.2629)		
Inventory productivity		0.0008***			0.0035***			0.0006***	
		(4.2570)			(23.5160)			(3.2645)	
Inventory leanness			0.0586***			0.2488***			0.0445***
			(4.1612)			(14.7896)			(3.2242)
GDP(Log)	0.0049***	0.0043***	0.0043***	0.0103***	0.0081***	0.0079***	0.0044***	0.0039***	0.0038***
	(5.0229)	(4.6448)	(4.5077)	(15.6172)	(12.8832)	(8.5785)	(4.4823)	(4.1972)	(4.0752)
Income per capita	0.0005	0.0006	0.0010*	0.0012***	0.0016***	0.0034***	0.0004	0.0005	0.0008
	(0.9360)	(1.1375)	(1.8695)	(3.2317)	(4.3780)	(6.1007)	(0.8300)	(0.9814)	(1.5300)
Labor productivity	0.0180***	0.0214***	0.0114*	−0.0844***	−0.0700***	−0.1125***	0.0221***	0.0250***	0.0178***
	(3.6013)	(5.0227)	(1.7289)	(−22.2973)	(−22.7052)	(−15.0533)	(4.2867)	(5.7749)	(2.7583)
R&D intensity	−0.2199***	−0.2825***	−0.3883***	0.1233***	−0.1424***	−0.5913***	−0.2259***	−0.2752***	−0.3546***
	(−5.9019)	(−6.4832)	(−6.1685)	(5.4527)	(−4.7803)	(−8.2572)	(−6.1026)	(−6.3373)	(−5.7473)
Firm size(Log)	0.0005***	0.0005***	0.0048***	0.0120***	0.0121***	0.0303***	−0.0001	−0.0001	0.0031***
	(2.6585)	(2.7032)	(4.2009)	(101.6786)	(102.4766)	(22.6643)	(−0.5719)	(−0.7336)	(2.7504)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960
Kleibergen-Paap rk LM	2,147.29***	2,071.31***	375.16***	2,116.94***	2,052.93***	373.71***	1,988.43***	1,984.39***	390.08***
Kleibergen-Paap rk Wald F	1,556.165	1,517.763	358.173	1,530.816	1,501.971	356.731	1,451.956	1,460.599	372.637
Stock-Yogo critical values									
10% maximal IV size	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38
15% maximal IV size	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96
20% maximal IV size	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66

Notes: R^2 is not reported in the context of 2SLS/IV since it has little statistical meaning. t-statistics in parentheses, Results of the Kleibergen-Paap rk LM statistic and the Kleibergen-Paap rk Wald F statistic indicate that the 2SLS/IV estimator is well specified and adequately defined. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

First, we estimate the model with three alternative indicators of inventory performance to minimize concerns that our results are susceptible to different measurements of inventory performance. To reduce the effect of the relative differences among different four-digit industries under the same two-digit industry level, we classify the new ELI estimated at four-digit industry level as the alternative measure of IL. Furthermore, following the studies of Chen *et al.* (2005) and Shockley and Turner (2015), we employ the ratio of average inventory to cost of goods sold, which is the inverse of inventory turnover, to measure IE. Note that the smaller the value of the IE, the better the inventory performance. We also use the gross margin return on average inventory to replace inventory turnover to represent the IP, where the higher IP represents the better inventory performance. The 2SLS/IV estimation results of three alternative indicators of inventory performance are reported in Table III, respectively. The coefficient and significant of IE, IP and IL remain broadly same as before.

Second, we examine whether our results are robust to variations in the proxy variable of FP while being used as mediator. In line with recent literature (Eroglu and Hofer, 2011), we employ the ROS as the alternative FP variable. ROS can be used to measure the profitability, and is calculated as net income divided by net sales. Similar 2SLS/IV estimation results hold if we employ ROS as FP, and are shown in Table IV.

Finally, we introduce alternative indicators of firm size to test whether proxy variable for firm size unduly influence the regression results. In addition to total sales, we test whether inclusion of total asset as proxy variable of firm size changes the results (Manikas and Patel, 2016). Again, we obtain 2SLS/IV estimation results that do not change significantly (shown in Table V).

According to the results of robustness checks, we find robust evidences that increased inventory performance can improve product quality significantly, and the FP mediates the relationship between inventory performance and product quality significantly.

5. Discussion and conclusions

In conclusion, this paper provides a more complete picture of inventory performance-FP-product quality triangle. This research adds to the theory of inventory management by focusing and exploring the mediating role of FP in deriving the product quality improvement, which is commonly associated with inventory management. As such, this study confirms the importance of inventory management with the broader realm of operations management.

5.1 Main findings

In this paper, we investigate the relationship among inventory performance, FP and product quality based on a sample of manufacturing export firms between 2001 and 2013 in China. Utilizing the distance between firms and its nearest major port as IV, we apply 2SLS/IV estimator to correct for endogeneity. Furthermore, the three-model system is used to explore the impact of inventory performance on product quality and test the mediating role of FP on the relationship between inventory performance and product quality.

The first major finding of this research is that there are positive effects of inventory performance on product quality. This suggests that the enhanced inventory performance can bring product quality improvement. Concretely, we employ IE, IP and IL as proxies of inventory performance to better understand the role of inventory management. The coefficients of three inventory performance indicators are all positive and significant at 1 percent, in support of *H1*. This set of results indicates affirmatively that inventory performance has a pervasive direct effect on product quality. The hypotheses tested provide empirical evidence and respond to the request for more research on the topic linking inventory management and product quality (Steven and Britto, 2016).

Second, perhaps more major, finding is that FP is found to able to mediate the relationship between inventory performance and product quality. The mediating effect is presented by the effect of inventory performance on FP and the effect of FP on product quality. All three

Table III.
Robustness check results of alternative inventory performance indicators

	Product quality			Financial performance			Product quality		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Financial performance							0.0485***	0.0458***	0.0574***
							(13.1777)	(10.8423)	(18.7750)
Inventory efficiency	−0.0777***			−0.3297***			−0.0617***		
	(−4.2511)			(−21.9724)			(−3.2616)		
Inventory productivity		0.0007***			0.0029***			0.0005***	
		(4.2581)			(24.3030)			(3.2641)	
Inventory leanness			0.0646***			0.2741***			0.0489***
			(4.1566)			(14.5385)			(3.2226)
GDP(Log)	0.0038***	0.0042***	0.0042***	0.0060***	0.0075***	0.0075***	0.0035***	0.0038***	0.0038***
	(4.1714)	(4.5250)	(4.4338)	(9.3072)	(12.4392)	(8.1002)	(3.8599)	(4.1424)	(4.0186)
Income per capita	0.0009*	0.0006	0.0011*	0.0028***	0.0015***	0.0035***	0.0008	0.0005	0.0009
	(1.6693)	(1.0892)	(1.9146)	(7.0053)	(4.2063)	(6.1841)	(1.4118)	(0.9594)	(1.5624)
Labor productivity	0.0325***	0.0203***	0.0076	−0.0230***	−0.0747***	−0.1286***	0.0336***	0.0237***	0.0150**
	(14.2512)	(4.5192)	(1.0166)	(−15.0488)	(−23.5332)	(−14.7708)	(14.6032)	(5.0676)	(2.0550)
R&D intensity	−0.1865***	−0.2875***	−0.3883***	0.2652***	−0.1634***	−0.5910***	−0.1993***	−0.2800***	−0.3543***
	(−5.1710)	(−6.4950)	(−6.1606)	(8.4432)	(−5.4907)	(−8.1069)	(−5.5685)	(−6.3186)	(−5.7458)
Firm size(Log)	−0.0023***	0.0006***	0.0058***	0.0001	0.0124***	0.0345***	−0.0024***	−0.0000	0.0038***
	(−3.9647)	(2.9864)	(4.1948)	(0.1831)	(100.4491)	(20.9341)	(−3.9851)	(−0.0209)	(2.8332)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960
Kleibergen-Paap rk LM	1,425.02***	2,289.12***	359.57***	1,421.72***	2,271.58***	358.38***	1,305.06***	2,065.22***	376.17***
Kleibergen-Paap rk Wald F	1,046.648	1,628.93	343.468	1,044.017	1,614.005	342.302	969.851	1,484.615	359.518
Stock-Yogo critical values									
10% maximal IV size	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38
15% maximal IV size	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96
20% maximal IV size	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66

Notes: R^2 is not reported in the context of 2SLS/IV since it has little statistical meaning. t-statistics in parentheses. Results of the Kleibergen-Paap rk LM statistic and the Kleibergen-Paap rk Wald F statistic indicate that the 2SLS/IV estimator is well specified and adequately defined. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$

Table IV. Robustness check results of alternative financial performance

	Financial performance (1)	(2)	(3)	Product quality (4)	(5)	(6)
Financial performance				0.0509*** (13.8382)	0.0542*** (16.6581)	0.0590*** (18.7278)
Inventory efficiency	0.1015*** (25.1947)			0.0181*** (3.2085)		
Inventory productivity		0.0036*** (24.5818)			0.0006*** (3.2105)	
Inventory leanness			0.2554*** (15.1842)			0.0436*** (3.1723)
GDP(Log)	0.0107*** (16.0512)	0.0084*** (13.2317)	0.0082*** (8.7553)	0.0043*** (4.4392)	0.0039*** (4.1576)	0.0038*** (4.0424)
Income per capita	0.0012*** (3.2230)	0.0016*** (4.3968)	0.0035*** (6.1063)	0.0004 (0.8250)	0.0005 (0.9723)	0.0008 (1.5126)
Labor productivity	−0.0851*** (−22.9565)	−0.0703*** (−23.2854)	−0.1139*** (−15.2657)	0.0223*** (4.3562)	0.0252*** (5.8600)	0.0181*** (2.8172)
R&D intensity	0.2619*** (11.8623)	−0.0108 (−0.3660)	−0.4715*** (−6.5090)	−0.2333*** (−6.3128)	−0.2819*** (−6.5109)	−0.3605*** (−5.8524)
Firm size(Log)	0.0110*** (93.9582)	0.0110*** (94.8145)	0.0298*** (22.2484)	−0.0001 (−0.4627)	−0.0001 (−0.6227)	0.0030*** (2.7374)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	546,960	546,960	546,960	546,960	546,960	546,960
Kleibergen-Paap rk LM	2,116.94***	2,052.93***	373.71***	1,994.00***	2,004.30***	391.96***
Kleibergen-Paap rk Wald *F*	1,530.816	1,501.971	356.731	1,453.69	1,473.48	374.535
Stock-Yogo critical values						
10% maximal IV size	16.38	16.38	16.38	16.38	16.38	16.38
15% maximal IV size	8.96	8.96	8.96	8.96	8.96	8.96
20% maximal IV size	6.66	6.66	6.66	6.66	6.66	6.66

Notes: R^2 is not reported in the context of 2SLS/IV since it has little statistical meaning. *t*-statistics in parentheses. As the direct effects of inventory performance on product quality are the same with the baseline results in column (1) to (3) of Table II while regarding ROS as the financial performance, we do not report the direct effects here. Results of the Kleibergen-Paap rk LM statistic and the Kleibergen-Paap rk Wald *F* statistic indicate that the 2SLS/IV estimator is well specified and adequately defined. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Table V. Robustness check results of alternative firm size

	Product quality			Financial performance			Product quality		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Financial performance							0.0395***	0.0423***	0.0504***
							(8.7638)	(10.7016)	(16.9299)
Inventory efficiency	0.0232***			0.0895***			0.0196***		
	(4.2827)			(23.1972)			(3.4411)		
Inventory productivity		0.0008***			0.0032***			0.0007***	
		(4.2884)			(23.0702)			(3.4452)	
Inventory leanness			0.0505***			0.1951***			0.0407***
			(4.2222)			(15.8005)			(3.4136)
GDP(Log)	0.0040***	0.0034***	0.0032***	0.0075***	0.0053***	0.0047***	0.0037***	0.0032***	0.0030***
	(4.2378)	(3.7054)	(3.4957)	(12.4114)	(9.0650)	(6.1379)	(3.9051)	(3.4630)	(3.2592)
Income per capita	0.0006	0.0007	0.0010*	0.0014***	0.0019***	0.0033***	0.0005	0.0006	0.0009
	(1.0539)	(1.2612)	(1.9227)	(4.0662)	(5.1976)	(6.9114)	(0.9490)	(1.1151)	(1.6256)
Labor productivity	0.0021	0.0045	0.0088*	−0.0875***	−0.0783***	−0.0617***	0.0056	0.0078	0.0119**
	(0.3113)	(0.7212)	(1.6493)	(−18.2290)	(−18.1157)	(−11.8353)	(0.7915)	(1.2182)	(2.2432)
R&D intensity	−0.2492***	−0.3132***	−0.3923***	0.0567**	−0.1907***	−0.4959***	−0.2514***	−0.3052***	−0.3673***
	(−6.4891)	(−6.8266)	(−6.4990)	(2.5073)	(−6.3959)	(−8.5389)	(−6.5827)	(−6.6326)	(−6.1386)
Firm size(Log)	0.0033***	0.0035***	0.0063***	0.0170***	0.0177***	0.0285***	0.0026***	0.0028***	0.0049***
	(7.0347)	(6.8390)	(5.3836)	(51.7022)	(49.2768)	(23.8385)	(5.0264)	(4.9534)	(4.1634)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960	546,960
Kleibergen-Paap rk LM	2,301.31***	2,479.32***	504.14***	2,286.09***	2,474.04***	504.11***	2,072.53***	2,285.26***	508.80***
Kleibergen-Paap rk Wald F	1,789.324	1,921.455	500.004	1,773.227	1,914.952	500.138	1,624.901	1,783.686	505.458
Stock-Yogo critical values									
10% maximal IV size	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38
15% maximal IV size	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96
20% maximal IV size	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66

Notes: R^2 is not reported in the context of 2SLS/IV since it has little statistical meaning. t-statistics in parentheses. Results of the Kleibergen-Paap rk LM statistic and the Kleibergen-Paap rk Wald F statistic indicate that the 2SLS/IV estimator is well specified and adequately defined. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$

inventory performance indicators considered in our study are all positively correlated with FP and product quality, as well as the positive impacts of FP on product quality, providing evidences that inventory performance has both direct and indirect effects on product quality. Specifically, more than 20 percent of the direct effect of inventory performance on product quality is mediated by FP, which suggests that FP partially mediates the relationship between IE and product quality. Meanwhile, the direct effects of both IP and IL on product quality, decrease in magnitude by around 25 percent when FP is incorporated into the regression analysis. All these results indicate that FP has a partial mediating effect on the relationship between inventory performance and product quality, in support of *H2*. These findings further imply that inventory performance affects product quality not only through improved FP, but also through other mechanisms. Most notably and in line with previous studies, inventory management may mainly directly contribute to product quality improvement by optimizing the inventory structure and improving operation management (Steven and Britto, 2016).

In addition, to examine the robustness of the results, we carry out additional robustness checks using alternative measures of inventory performance, FP and firm size. Our analysis shows strong supports for *H1* and *H2*, as the signs and statistical significance of each inventory performance indicator remains unchanged basically. Furthermore, all these robustness checks hopefully improve the transparency and validity of our results.

5.2 Managerial implications

This research offers several implications for inventory management in emerging countries, in particular China. Our findings show that the increased inventory performance can not only improve product quality directly, but also bring product quality improvement indirectly, mediated by FP. From a practical standpoint, our research provides mangers evidence of the benefits of inventory performance as an antecedent of product quality. Enterprises can reap product quality improvement by enhancing their inventory performance and FP. However, according to results on direct effects and indirect effects, we find that only 20 to 25 percent of the effects of inventory performance on product quality is mediated by FP. In this regard, managers should pay more attention to inventory management. These results suggest managers, without sufficient liquidity or cost advantage, to get better FP can achieve product quality improvement through enhancing inventory management performance.

5.3 Limitations and future research

This study hereby proposes several limitations that future research could address. First, this research only examines the mediating role of FP on the relationship between inventory performance and product quality. While FP is key to product quality improvement, additional research should consider other mediators, such as market risk or product variety, to provide a broader view of the indirect effects of inventory performance on product quality. Second, even though the 2SLS/IV estimator is applied to minimize endogeneity, endogenous problems may still exist. Future research should consider the sample selection bias, such as the use of quasi-experimental method to study the causal effects of inventory performance on product quality.

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