



The impact of inventory dynamics on long-term stock returns – An empirical investigation of U.S. manufacturing companies

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ABSTRACT

This paper investigates the relationship between the inventory dynamics and long-term stock returns of a large panel of U.S. manufacturing firms over the time period from 1991 to 2010. We propose two measures of inventory dynamics: one metric to assess the fluctuations of quarterly inventories within the year and a second metric to quantify relative year-over-year inventory growth. Our results indicate that within-year inventory volatility (IV) and abnormal year-over-year inventory growth (ABI) are associated with abnormal stock returns. Both metrics cannot be entirely explained by common risk factors. We find that firms with high IV and low ABI have the best long-term stock returns, and that stock performance decreases monotonically with higher ABI values. Our results are robust to various control variables including size, book-to-market value, industry and prior performance. We therefore conclude that changes in inventory levels provide valuable insights into the risks and opportunities faced by a company.

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1. Introduction

Given the important role that inventory plays within manufacturing firms, it is natural to conjecture that inventory mismatches will have adverse financial consequences for companies. On the one hand inventory shortages and their resultant poor customer service will have negative implications for current and future sales (Hendricks and Singhal, 2005a). On the other hand, Hendricks and Singhal (2009) find that excess inventories are costly and bear the risk of obsolescence, particularly in fast-paced sectors such as apparel manufacturing, computer hardware and electronic components manufacturing (O'Glove, 1987). Accordingly, stakeholders focus on firm-level inventories, and inventories are frequently reported on in the business news.

- **Dealers Balk as Chrysler strains to cut inventory** [...] Daimler-Chrysler AG's Chrysler Group is running into resistance from some big dealers to its latest efforts to shrink its bloated inventory of unsold vehicles, a development that could make it harder for Chrysler to bounce back from an expected loss in the third quarter. – Wall Street Journal, October 16, 2006, Boudette (2006)
- **Sony to Corral TV inventory – finance chief says firm is willing to forgo some sales to rein in supply chain** [...] Sony and its TV rivals, Samsung Electronics Co. and LG Electronics Inc., have already said they expect price competition to be especially fierce this holiday

season because manufacturers are sitting on excess inventory from aggressive growth targets. [...] Following the global financial crisis, Sony implemented tighter inventory controls to prevent the type of punishing losses from slow demand that forced deep discounting or write-downs for unsold goods. – Wall Street Journal, November 02, 2010, Wakabayashi (2010)

- **Intel cuts production as PC makers' orders drop** [...] Its fourth-quarter outlook predicted stagnating revenues and margin erosion from underutilized plants and inventory write-offs, with PC makers keeping inventories lean as they wait to gauge consumer demand for the new Windows 8 operating system. – Financial Times, October 17, 2012, Nuttall (2012)

Given these examples, it is not surprising that there has been increasing interest in investigating firm-level inventories by leveraging secondary empirical data in the field of operations and supply chain management (Roth, 2007; Fisher, 2007). Most of the contemporary empirical papers on firm-level inventories either examine Just-In-Time (JIT) implementations or inventory levels and their linkages to financial performance (Gaur et al., 2005; Chen et al., 2007). However, relatively little effort has been spent on understanding inventory dynamics during the calendar year. The few papers that investigate inventory dynamics find that investors seem to fail to fully incorporate the information content that these inventory changes have for sales (Kesavan et al., 2010) or earnings (Kesavan and Mani, 2012).

Moreover, most of the previously published empirical research papers that investigate firm-level inventories have either focused on the retail sector alone (Gaur et al., 2005; Chen et al., 2007;

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Kesavan et al., 2010; Kesavan and Mani, 2012) or used aggregate samples that did not differentiate between retail and manufacturing firms (Abarbanell and Bushee, 1997; Thomas and Zhang, 2002; Rumyantsev and Netessine, 2007; Hendricks and Singhal, 2009). Thus, there are fewer clear-cut empirical results available for manufacturers. We conjecture that insights and findings from the retail sector cannot be readily translated to manufacturing companies because the value creation process involved in manufacturing might entail different implications for inventory management. The objective of this paper is to overcome this gap in the operations management literature by studying the implications of abnormal inventory oscillations in the manufacturing sector.

We propose two measures with which to study the dynamics of inventories and their linkages to the financial performance of a large panel of U.S. manufacturing companies for the time period from 1991 to 2010. More specifically, in this paper, we analyze the within-year volatility of quarterly inventories (IV) and the year-over-year growth of quarterly inventories relative to sales growth (ABI). Since abnormally high fluctuations in quarterly inventories and abnormal inventory growth indicate temporary mismatches between demand and supply, we expect those measures to convey information regarding the operational risks and opportunities faced by companies. Using a sort-portfolio approach rooted in financial research (e.g., Fama and French, 1992) we find that IV and ABI are both significantly associated with long-term stock returns. While low (high) ABI is significantly correlated with superior (poor) stock returns, we document the opposite for IV. Unlike prior studies (Eroglu and Hofer, 2011; Rumyantsev and Netessine, 2007; Kesavan and Mani, 2012) our portfolio analysis does not provide any evidence of an inverted U-shaped relationship between inventory and financial performance. However, when we control for common risk factors of stock returns we find that both measures seem to be asymmetrically associated with stock returns. Both IV and ABI seem to provide information beyond that provided by common risk factors. Generally, our results for the ABI metric are more robust than those for the IV metric. Even after controlling for various variables, we show that portfolio returns for ABI are highly significant and in many cases monotonically decrease with ABI.

Our paper contributes to the recent empirical operations management literature in two ways. First, to the best of our knowledge our paper is the first that explicitly analyzes the volatility of quarterly inventories within the calendar year. We also show that both of our measures for inventory dynamics reveal information that is not already contained in a static view of quarterly- or year-end inventory levels. Second, we provide evidence that the relationship between abnormal inventory growth and stock returns not only holds for retail companies, as shown by Kesavan and Mani (2012), but is also valid for manufacturing companies. These results are robust for various controls. High-level managers could also use our abnormal inventory growth metric as a benchmark to gauge the inventory and stock performance of their company.

The implications for the investment community are immediately obvious, as we show that inventory dynamics provide clues about the risks and opportunities faced by a firm. There is anecdotal evidence from the investment community that an investment strategy that considers the mutual growth rates of sales and inventory generates abnormal returns. However, at least for the manufacturing sector, this relationship has not been tested previously with rigorous statistical methods.

The paper is structured as follows. In Section 2 we give an overview of relevant empirical papers on firm level inventories. In Section 3, we derive our measures for inventory volatility and abnormal inventory growth. We provide theoretical arguments why and how both measures are related to financial performance. In Section 4, we introduce our research setup, data and

methodology. In Section 5, empirical results are presented. In Section 6, we conclude the paper.

2. Literature review

Empirical research on firm-level inventories dates to the early 1990s, when researchers first analyzed the effects of JIT implementation and lean inventory management on operational and financial performance. These studies generally document improvements with respect to inventory performance metrics (Billesbach and Hayen, 1994; Huson and Nanda, 1995; Demeter and Matyusz, 2011), but they provide only mixed evidence regarding financial performance improvements (e.g., Huson and Nanda, 1995; Vastag and Whybark, 2005; Vergin, 1998). While some studies show a positive relationship between inventory management and financial performance (Chen et al., 2005; Fullerton et al., 2003; Capkun et al., 2009; Eroglu and Hofer, 2011; Modi and Mishra, 2011) others do not find such a relationship (Balakrishnan et al., 1996; Ahmad et al., 2004; Cannon, 2008). A paper of particular interest to our study by Singhal and Raturi (1990) documents that inventory management decisions and parameters can have implications for business risks of firms. Thus, there exist indirect links between inventories and financial performance, in particular stock performance, that work by increasing business risks.

Studies that link short-term changes in inventories, rather than inventory levels, to financial performance are generally more consistent in reporting the effects of inventory management on financial performance. In a seminal paper, Sloan (1996) found that accruals explain future earnings. Abarbanell and Bushee (1997) refined Sloan's (1996) analysis by studying the relationship between inventory changes (a component of accruals) and future changes in earnings. The authors found that inventory changes have predictive power for changes in future earnings. The results by Abarbanell and Bushee (1997) were confirmed in a subsequent paper by Thomas and Zhang (2002), who found that the relationship between future earnings and accruals shown earlier by Sloan (1996) is mainly driven by inventory changes. More specifically, Thomas and Zhang (2002) document that inventory growth is associated with negative abnormal returns. However, unlike our paper, their study did not consider inventory and sales growth simultaneously, but it examined "plain" inventory changes only. Further, the authors did not provide consistent explanations for their findings.

While there are numerous practical examples (see Raman et al., 2006 or O'Glove, 1987) that point to the existence of a strong relationship between inventory dynamics and stock performance, empirical evidence is still relatively scarce, and most studies stem from the field of accounting research.

There are even fewer studies from operations management that analyze the relationship between short term inventory dynamics and financial performance. Kesavan et al. (2010) considered the joint dynamics of sales, gross margins and inventories and their implications for sales forecasts. In a recent paper, Kesavan and Mani (2012) refined earlier results by examining the relationship between abnormal inventory growth and future earnings and stock returns for retail companies. However, both studies focused exclusively on the retail sector.

The only empirical operations management paper that considers the joint growth rates of inventories and sales and their implications for financial performance across all sectors is by Rumyantsev and Netessine (2007). This paper comes closest to our study, as we analyze inventory dynamics in the manufacturing sector. However, the inventory metric of Rumyantsev and Netessine (2007) differs in an important way from our metrics, as discussed in Section 3. Moreover, unlike our study, Rumyantsev and Netessine (2007) link inventory growth to ROA and do not consider

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