



The effect of environmental dynamism on returns to inventory leanness



Cuneyt Eroglu^{a,*}, Christian Hofer^{b,1}

^a Supply Chain and Information Management Group, D'Amore-McKim School of Business, Northeastern University, Boston, MA 02115, USA

^b Department of Supply Chain Management, Sam M. Walton College of Business, University of Arkansas, Fayetteville, AR 72701-1201, USA

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ABSTRACT

This paper adds to the empirical inventory management literature by examining the moderating effects of environmental dynamism on the relationship between inventory leanness and financial performance. While the financial implications of inventory management practices have been extensively studied in the literature, it is clear that lean inventory strategies may not have the same payoff for all firms in all industries. Grounded in inventory theory, this study explores how firm characteristics and environmental dynamism—measured in terms of innovative intensity, demand uncertainty and competitive intensity—moderate the inventory leanness–performance link. We use hierarchical linear modeling to analyze a data set of 5749 firm-year observations from 123 U.S. manufacturing industries. In line with the hypotheses set forth, the results indicate that innovative intensity in an industry increases the effect of inventory leanness on firm performance while competitive intensity has the opposite effect. The hypothesis with respect to the moderating role of demand uncertainty is not supported. Another interesting and important finding is that inventory leanness accounts for nearly one third of the variation in firm performance after controlling for firm size and growth, thus underlining the importance of efficient and effective inventory management for overall firm success.

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1. Introduction

Inventory leanness is widely pursued by many firms regardless of industry, product or region (Gorman et al., 2009). Substantial reductions in inventories—even complete elimination of inventories—have been advocated starting with books like *Zero Inventories* (Hall, 1983) and videos like *Stockless Production* (Hewlett-Packard, 1983). It is intuitively appealing to think of inventories as a drain on scarce and valuable resources like capital and space. The view that inventory reductions are inherently and unquestionably desirable has been widespread not only in practitioner publications but also in the academic literature (Meredith et al., 1989). Yet, empirical operations management research provides only weak evidence of performance benefits of inventory leanness (e.g., Sakakibara et al., 1997).

Taking a contingency view, we argue that the leanness–performance relationship is moderated by the environment in

which a firm operates. The contingency view is well established in the operations management literature (Sousa and Voss, 2008). In the context of inventory management, Zipkin (1991) proposes that the relationship between inventory leanness and firm performance is moderated by firm and industry characteristics. Empirical evidence suggests that performance benefits of inventory leanness depend on firm attributes (Gaur and Kesavan, 2009) as well as industry characteristics (Eroglu and Hofer, 2011). We thus add to the empirical inventory literature to provide greater insight into how environmental factors shape the inventory–performance relationship.

Environmental dynamism is a contextual variable that was first studied in the strategic management literature as a moderator of the relationship between firm characteristics and firm performance (Dess and Beard, 1984). It refers to the rate of change or unpredictability prevalent in a firm's environment. Environmental dynamism was subsequently adopted in the operations management literature as an industry characteristic that impacts firm-level decisions and performance outcomes (e.g., Swamidass and Newell, 1987; Ward et al., 1995). More recently, environmental dynamism has been studied as an important contingency factor with respect to lean production practices (Azadegan et al., 2013). As such, we seek to explore how the leanness–performance relationship changes

* Corresponding author. Tel.: +1 617 373 8015; fax: +1 617 373 3166.

E-mail addresses: c.eroglu@neu.edu (C. Eroglu), chofer@walton.uark.edu (C. Hofer).

¹ Tel.: +1 479 575 6154; fax: +1 479 575 8407.

in different industries marked by varying levels of environmental dynamism.

It is important to understand the subtleties and nuances present in the relationship between inventory leanness and firm performance. From an academic perspective, inventory leanness mediates the relationship between operations management initiatives and firm financial performance. Many operations management initiatives, such as just-in-time, total quality management and total productive maintenance, lead to inventory leanness, which, in turn, is expected to lead to better firm performance (Sakakibara et al., 1997; Kaynak, 2003; McKone et al., 2001). Thus, a deeper understanding of the nature of the leanness–performance relationship helps to shed light on much that is of interest in operations management research. From a managerial perspective, inventory management forms an integral part of a firm's operations strategy. Managers are typically advised to reduce inventories without much qualification (Ceccagnoli, 2009), yet it is clear that inventory reductions are not universally beneficial (Mackelprang and Nair, 2010; Dehning et al., 2007).

We contribute to the understanding of the inventory leanness–performance relationship by examining the moderating effects of environmental dynamism. We operationalize environmental dynamism in a given industry along three dimensions: innovative intensity, demand uncertainty and competitive intensity. Using multilevel (hierarchical) linear modeling to analyze a data set of 5749 firm-year observations from 123 U.S. manufacturing industries compiled from the COMPUSTAT database, we find that the innovative intensity in an industry increases the effect of inventory leanness on firm performance, while competitive intensity has the opposite effect. Demand uncertainty is not found to have a significant moderating effect. Importantly, we find that inventory leanness accounts for about 31% of the variation in firm performance after controlling for firm size and growth.

The remainder of this paper is organized as follows: the relevant literature is reviewed and hypotheses are developed in Section 2. Data collection and variable measurement issues are discussed in Section 3, followed by the presentation of the empirical results in Section 4. Section 5 offers a discussion of the findings of this study as well as concluding remarks.

2. Literature review and hypothesis development

2.1. Inventory management and firm performance

Evidence of performance benefits of inventory leanness has been mixed. Some research has concluded that the overall effect of inventory efficiency on firm performance is negligible (e.g., Cannon, 2008). Other studies, however, have found evidence of a positive relationship between inventory and firm performance (e.g., Capkun et al., 2009). Eroglu and Hofer (2011) identified three potential reasons for these seemingly contradictory results. First, both Cannon (2008) and Capkun et al. (2009) employed inventory-turnover-based metrics to measure inventory management performance, thus ignoring potential economies of scale in inventory management (Rumyantsev and Netessine, 2007; Shan and Zhu, 2013). As a result, observed increases in inventory turns may be reflections of increases in firm size rather than inventory management efficiency. Ultimately, this may lead to attenuation bias (Eroglu and Hofer, 2011).

Second, prior research typically assumed a linear relationship between inventories and firm performance (e.g., Cannon, 2008; Capkun et al., 2009), implying that greater inventory turnover is always associated with greater performance. This assumption conflicts with one of the central tenets of inventory theory: there is an optimal level of inventory such that both positive and negative

deviations from this optimum carry performance penalties (e.g., Chen et al., 2005). Modeling the inventory–performance relationship in a linear fashion, thus, fails to recognize the fundamental cost tradeoffs in inventory management and can distort the statistical significance of findings.

Third, both Cannon (2008) and Capkun et al. (2009) assumed the relationship between inventory leanness and firm performance to be similar across all industries. However, this relationship can be significant in some industries and insignificant in others (Eroglu and Hofer, 2011). Accordingly, empirical findings may vary depending on the industry composition of the data samples studied.

To address these and other shortcomings in earlier empirical studies, Eroglu and Hofer (2011) developed an inventory leanness metric that takes into account economies of scale in inventory management. Then, they specified a quadratic relationship between inventory leanness and firm performance so as to capture the nonlinear nature of this relationship. Finally, they estimated the inventory–performance relationship in 54 distinct U.S. manufacturing industries. The empirical results presented by Eroglu and Hofer (2011) demonstrated that the relationship between inventory leanness and firm performance is nonlinear and industry-specific. The present study picks up where Eroglu and Hofer (2011) left off. Specifically, we seek to investigate how environmental dynamism—as a key industry characteristic—moderates this relationship while also taking into account important firm characteristics.

2.2. Environmental dynamism

In broad terms, environmental dynamism refers to the volatility, uncertainty, instability, unpredictability and rate of change present in a firm's environment. It is a construct that was originally developed in the strategic management literature as a contextual variable that moderates the relationship between various strategies and firm performance (Lawrence and Lorsch, 1967; Thompson, 1967). Empirical studies have documented the moderating effects of environmental dynamism on a large number of firm-level constructs such as organizational structure (Burns and Stalker, 1961), business level strategy (Miller, 1988), ownership structure (Li and Simerly, 1998), dynamic capabilities (Drnevich and Kriauciunas, 2011) and strategic decision making (Mitchell et al., 2011), among others. Environmental dynamism has also been studied within the context of operations management (e.g., Garg et al., 2003; Anand and Ward, 2004). Azadegan et al. (2013), for example, investigated the moderating effects of environmental dynamism on the relationship between lean production practices and firm performance.

Some authors have defined environmental dynamism as a unidimensional construct (e.g., Azadegan et al., 2013), while others have treated environmental dynamism as a multifaceted construct (e.g., Dess and Beard, 1984). Defining environmental dynamism as a unidimensional construct serves the purposes of parsimony and clarity in modeling and theory building, while examining multiple dimensions of environmental dynamism brings richness to the analysis. We view environmental dynamism as a multi-dimensional construct and define it as the “amount and unpredictability of change in customer tastes, production or service technologies, and the modes of competition in the firm's principal industries” (Miller and Friesen, 1983, p. 233). This definition highlights three fundamental dimensions of environmental dynamism: (1) technological innovation, (2) uncertainty in customer demand and (3) competitive intensity. In the following subsections, we examine each of these three dimensions in more detail and develop relevant hypotheses.

Our arguments are grounded in microeconomic theory and inventory theory. Microeconomic theory suggests that facets of environmental dynamism affect firms' cost and demand characteristics. Inventory theory, in turn, examines how these characteristics

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