RETAIL STORE STOCK INVENTORY ANALYTICS

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Abstract—In recent years, the correct management of inventories has become a fundamental pillar for achieving success in enterprises. Unfortunately, studies suggesting the investment and adoption of advanced inventory management and control systems are not easy to find. In this context, this article aims to analyse and present an extensive literature concerning inventory management, containing multiple definitions and fundamental concepts for the retail sector. A systematic literature review was carried out to de termite the main trends and indicators of inventory management in Small and Medium-sized Enterprises (SMEs). This research covers five years, between 2015 and 2019, focusing specifically on the retail sector.

The primary outcomes of this study are the leading inventory management systems and models, the Key Performance Indicators (KPIs) for their correct management, and the benefits and challenges for choosing or adopting an efficient inventory control and management system. Findings indicate that SMEs do not invest resources in sophisticated systems; instead, a simple Enterprise Resource Planning (ERP) system or even programs such as Excel or manual inventories.

The ongoing crisis within traditional brick-and-mortar retail stores has received growing media attention in recent years. “High street delivers worst performance in 12 years as retail crisis deepens” (Clarke, 2018) is an example of a headline from such media coverage. Several factors contribute to this crisis, such as costs rising at a faster pace than revenue, high debt, and competition with online shopping (Thomas, 2018). Economic data for the period 2012–2017 simultaneously show that for US retail, the inventory to sales ratio has grown (US Bureau of the Census, 2018). This indicates that inventory performance for some retailers deteriorates, leading to additional costs that impair store earnings and thus, contribute to the crisis.

Inventory management is considered an important management practice in any retail business because of its impact on retail profits (see, e.g., Cronin, 1985). The most frequently used measure of inventory management performance is inventory turnover. This measure is closely monitored by senior executives in practice at both retail chain and store levels, and is the only performance measure on inventory management available to other stakeholders through publicly available financial statements. Business analysts and shareholders are showing an increased interest in this business performance measure.
An example of a recent occurrence of such interest is the report of Hennes & Mauritz following its capital market day in which the analysts of Credit Suisse commented, "We remain unclear as to how H&M is going to trade out the inventory mountain without doing further damage to full price sales…"

The early discovery of the EOQ (Economic Order Quantity) model of the optimal number of items to order as to minimize total inventory holding costs and ordering costs (Harris, 1913), and has been significant to the inventory management literature. From the advent of this model, research has been growing significantly over a lengthy span of time, originally in the single entity model setting and more recently in the collaborative and across business framework (Williams & Tokar, 2008). Recent empirical findings indicate inventory performance to be positively related to financial performance measures, such as return on assets, return on sales, earnings before interest and taxes (Alan, Gao, & Gaur, 2014; Capkun, Hameri, & Weiss, 2009; Chen, Frank, & Wu, 2005, 2007; Eroglu & Hofer, 2011a; Isaksson & Seifert, 2014; Kesavan & Mani, 2013; Rumyantsev & Netessine, 2007a; Shockley & Turner, 2014), and stock value and return (Alan et al., 2014; Chen et al., 2005, 2007). This makes inventory turnover a popular indicator for evaluating the profitability of a firm. Moreover, time trends in inventory turnover were initially found to be improving; for manufacturing firms in particular (Chen et al., 2005; Rajagopalan & Malhotra, 2001). For wholesale and retail, there have been contradictory findings for some time, but recent research on time trends for retail firms suggests that inventor turnover deteriorates (Gaur, Fisher, & Raman, 2005; Kolias, Dimelis, & Filios, 2011).

Our study contributes to the literature on time trends in inventory turnover and is to the best of our knowledge the first study on the effect of voluntary chain affiliation on inventory turnover of independent retail stores. Research on inventory turnover has mostly been conducted using data from large American-listed retail corporations (e.g. Gaur et al., 2005), and the findings may thus not be valid across other geographical regions, firm sizes, or for privately owned firms. We therefore further contribute to the literature by providing findings from privately owned small and medium-sized corporations. We examine inventory turnover based on public financial data for the period 1998–2013 on businesses operating stores affiliated to either one of three voluntary cooperative retail chains belonging to the same segment of stores selling home improvement products.

This period reflects rapidly increasing knowledge on efficient business management, historically unprecedented growth in computational force, increases in consumer affluence, and not least a steady rise of e-commerce in size and reach. Earlier studies on time trends in inventory turnover cover periods with quite different economic and societal conditions. There is as such a need to revisit this issue again.

Our paper reports three main findings. First, we estimate inventory turnover, both with and without controlling for explanatory variables, and we find that inventory turnover on average has deteriorated annually with a much higher percentage than comparable figures reported in the study by Gaur et al. (2005). Second, we find that retail chain affiliation affects inventory turnover at the store level when controlled for gross margin, capital intensity, growth in sales, and firm size. This finding has implications for practice as it demonstrates that some retail chains outperform others on inventory management. Third, we find the firm size to affect inventory turnover. This implies that the small business owner should give inventory management more attention to withstand competition, for instance by more closely monitoring inventory levels.

The remainder of this article is organized as follows. Section two reviews the relevant literature, while section three describes the data and methods. The fourth section contains results and is followed by a conclusion section that discusses the main findings, limitations, and implications for practice.

Another approach to measuring inventory performance is the performance metric empirical leanness indicator (ELI) developed by Eroglu and Hofer (2011b). The ELI measures, by industry segment, the level of inventory relative to sale and control for economies of scale. This performance indicator provides a single-value benchmark measure of firms within defined segments or industries. In measuring ELI, Eroglu and Hofer (2011b) find a concave relationship for a large number of industry segments. A similar measure that can be used as an industry yardstick is the adjusted inventory turnover (AIT) metric proposed by Gaur et al. (2005). This measure controls for gross margin, capital intensity and sales surprise; however, it does not include a proxy for firm size.

A large part of the more recent literature on inventory performance metrics focuses on establishing a link between efficient inventory management and financial performance. So far, this strand of research suggests that such a link exists (Alan et al., 2014; Capku net al., 2009; Chen et al., 2005, 2007; Eroglu & Hofer, 2011b; Isaksson & Seifert, 2014; Kesavan et al., 2016; Kesavan & Mani, 2013; Rumyantsev & Netessine, 2007a; Shockley & Turner, 2014). Of the discrete components of inventory, which are of particular interest to the manufacturer, RMI appear to have the strongest relationship with financial performance.

For the retailer and wholesaler, the level of FGI is positively linked to measures of financial adeptness (Capkun et al., 2009; Eroglu & Hofer, 2011a, 2011b; Isaksson & Seifert, 2014; Kesavan et al., 2016; Kesavan & Mani, 2013; Shockley & Turner, 2014). Some authors have also been able to establish a relation between relative levels of inventory and the long-run value of firms. (Alan et al., 2014; Chen et al., 2005, 2007). Finally, several articles indicate that when firms respond to changing demand by adjusting inventories rather than

prices (e.g. responsiveness), financial performance is positively impacted (Kesavan et al., 2016; Rumyantsev & Netessine, 2007a; Shockley & Turner, 2014).

The dataset consists of yearly financial statements for all firms affiliated with one of three retail chains, namely, XL-Bygg, Byggmakker and Byggtorget. These chains operate within the industry of retail sale of hardware, paints and glass, and have similarities of the larger and more well-known retailers Bauhaus in Europe and The Home Depot in North America. We record chain affiliation as of the end of 2013, and changes in chain affiliation during the sample period are disregarded. The sample period is 1998–2013 and contains 184 firms with 2107 observations. These retail chains represent approximately 30% of the total domestic industry revenue and are all represented in the top 10 largest home improvement retail chains of Norway. Broad metrics for the remaining dominating retail chains suggest only marginal differences in measures constituting the base of this analysis.
The Norwegian economy has during the same period grown steadily; consumer prices and GDP for instance increasing by 31% and 24.4%, respectively.

Although there is some variability between stores, in general, these product groups are present: lumber, roofing, masonry, stones, brick, doors and windows, hardware and tools, paint, floor covering, and cabinets. In addition, some of these stores carry products such as light fixtures, electrical fittings and plumbing. Although a product might be on display, it is not necessarily in stock and hence may need to be ordered based on the specifications of the customer. For larger construction projects, a substantial part of the materials needed is delivered directly to the building site without passing through the store. These stores are generally specialized to serve both professionals, such as carpenters, builders, and general contractors, and homeowners in both product guidance and supplies for home improvement, remodelling, new home builds, or the construction of offices and industrial facilities. The mix of customers by type of professional and homeowner varies for each store.

Several model specifications have been applied and tested; however, the constructed models and estimations techniques reported in the following sections this paper are the most consistent.

We test for serial correlation using the Wooldridge test (Drukker, 2003) and find evidence of an AR(1) structure in the data.

We employ a Prais-Winsten estimator (a special case of the feasible generalized least squares, FGLS), controlling for a panel-specific first-order autocorrelation because we have a relatively long time dimension in our data and thus assume varying serial correlations within firms. We further assume that the disturbance is heteroscedastic and contemporaneously correlated across panels. Because our data are unbalanced with no common time periods for all panels, calculation of the covariance is based on the pairwise estimation of observations present in the panels. In addition, the applied estimator return panel corrected standard errors (Stata: xtpcse) found to be less optimistic than that of the traditional FGLS estimator (Beck & Katz, 1995; Katz, 2016).

The initial dataset consists of 192 firms with 2448 observations.
We delete observations for only three reasons. First, by computing the variables, the first year of data is lost in the transformation process due to the calculation of variables by use of prior year values, such as for inventory turnover. All observations that are missing due to these calculations are deleted, as well as observations missing for other reasons. Furthermore, observations equal to zero drop out due to log transformation, as the natural logarithm is defined only for positive values. Second, because this is an unbalanced dataset, the number of time periods is not the same across all individuals.
This difference indicates that the data are unequally spaced and that different firms may have observations in different periods. In addition, these observations might include firms with non-consecutive runs; data belonging to one given firm might be missing and constitute a gap in the time dimension, implying that one year might be missing in the middle section, resulting in two consecutive runs. For firms with non-consecutive runs, only the sections within

each firm containing the most observations are retained. Third, we delete observations with values exceeding 75 for inventory turnover and 100 for growth in sales because a few observations contain values that severely influence the analysis. In addition, firms with only one remaining observation, owing to the fact that they do not contribute to adding information to the construct, are dropped. No further deletion of observations is performed, as we trust the model specifications to handle such deviations. These deletions result in a final dataset that consists of 184 firms with 2107 years of financial statements.

In addition to the limitations described above, there is overwhelming potential for further research on this issue. Access to business data, such as the ratio of sales to professionals versus regular customers, or the degree of wholesale versus retail distribution, may contribute to explain inventory turnover beyond what can be determined through metrics used in this study. In addition, it is known that lead time significantly affects inventory turnover, and a study that includes store location can potentially be of help in understanding this important metric from the microeconomic perspective. Furthermore, different approaches are available to access information on efficiency or productivity, such as stochastic frontiers or data envelopment analysis. This approach aims to define the frontier of the most efficient firms, thereby identifying those firms that are not efficient, and may potentially provide insight into inventory productivity.

The importance of inventory management:

A retail business is useless without its inventory. And so while it may not be the most exciting subject, inventory management is vitally important to your business’s longevity. Good inventory management helps with:

1.Customer experience. Not having enough stock to fulfil orders you’ve already taken payment for can be a real negative.

2. Improving cash flow. Putting cash into too much inventory at once means it's not available for other things - like payroll or marketing.

3. Avoiding shrinkage. Purchasing too much of the wrong inventory and/or not storing it correctly can lead to it becoming 'dead', spoiled, or stolen.

4. Optimizing fulfilment. Inventory that's put away and stored correctly can be picked, packed and shipped off to customers more quickly and easily.