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Reexamining the relationship between inventory management and firm performance: An organizational life cycle perspective

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Abstract

Existing evidence regarding inventory-performance relationship is inconclusive. A perspective that this paper stresses in considering this relationship is that it might depend on organizational life cycle stage. The underlying assumptions of this argument are that organization's strategies and relationships vary with its life cycle stage, organizations develop their own strategies to fit between inventory system and organizational settings, and design of inventory system is not a linear process, rather it is a dynamic process that emerges and evolves in response to the power and interests of the stakeholders. Econometric analysis provides support for this argument. Specifically, the results show that while inventory to sales ratio affects organization performance negatively in the initial growth stage and the maturity stage, it exerts a positive and significant coefficient on performance in either the rapid growth stage or the revival stage. An implication of these findings is that existing perspectives might need to be treated as complementary viewpoints, each of which comprises a part of the whole picture because depending on just one single perspective is likely to result in misleading conclusions about the whole structure.

Keywords: Firm performance; Inventory management; Organizational life cycle; Panel data

1. Introduction

Notwithstanding academicians and practitioners believe that inventory is a costly activity, they disagree on its necessity (Elsayed, in press). One research area that has grown considerably, in the operations management literature, and provided mixed findings is inventory-performance relationship. Specifically, while the positive effect of inventory reduction on organization performance has been reported in various studies that are based on either survey (Claycomb, Germain, & Dröge, 1999; Fullerton & McWatters, 2001; Fullerton, McWatters, & Fawson, 2003) or archival data (Boute, Lambrecht, Lambrechts, & Sterckx, 2006; Capkun, Hameri, & Weiss, 2009; Chen, Frank, & Wu, 2005; Elsayed, 2015a; Huson & Nanda, 1995; Koumanakos, 2008; Lieberman & Demeester, 1999; Shah & Shin, 2007; Swamidass, 2007; Voulgaris, Doumpos, & Zopounidis, 2000), other studies (e.g., Balakrishnan,

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Linsmeier, & Venkatachalam, 1996; Cannon, 2008; Demeter, 2003; Tunc & Gupta, 1993; Vastag & Clay Whybark, 2005) found no clear evidence for this relationship.

Critical examination of prior work indicates that the influence of organizational life cycle issues on the relationship between inventory and organization performance has not been examined. In fact, considering the effect of organizational life cycle on the relationship between inventory and performance recognizes that managing inventory not only cannot be isolated from other organizational settings, but also is subject to the power and interests of stakeholders (De Vries, 2011). This is a realistic theme as different studies demonstrated that inventory decision-making is a dynamic process that entails different stakeholders with conflicting interests (De Vries, 2009). Thus, taking into account the effect of life cycle stage on inventory-performance relationship explains how internal and external variables may collaborate or interact with inventory decisions to affect organization performance. Such interaction may signify that the inventory-performance relationship is a non-monotonic one. For instance, to hypothesis that any reduction in inventory can only be attained by increasing investment in another type of resource is not always the case. Organizations with higher bargaining power, for example, often enforce their suppliers to take some actions to reduce inventory (Poirier, 1999). Moreover, benefits of increasing investment in information technology to reduce inventory in many cases are found to accrue to the supplier and not the buyer (Kim, 2012). In addition, to assume that increasing inventory is always evidence for inefficiency is a shortsighted view as it overlooks the relationship between competition and inventory holding. For instance, as Rotemberg and Saloner (1989) argued, "firms hold greater inventories as a strategic threat to maintain collusive pricing arrangements. Higher inventories allow firms punish price deviations of cheaters more strongly by flooding the market with product, which has similarly been reduced in price" (Blazenko & Vandezande, 2003, p. 257).

Consequently, a perspective that this paper stresses in considering inventory-performance relationship is that it might depend on organizational life cycle stage. The underlying assumptions of this argument are that organization's strategies and relationships vary with its life cycle stage (Jawahar & McLaughlin, 2001), organizations develop their own strategies to fit between inventory system and organizational settings (De Vries, 2005), and design of inventory system is not a linear process, rather it is a dynamic process that emerges and evolves in response to the power and interests of the stakeholders (De Vries, 2011).

The next part of the paper presents existing theoretical and empirical evidence regarding inventory-performance relationship. The third part introduces organizational life cycle perspective. The fourth part sets up the theoretical mechanisms by which organizational life cycle may exert a moderating effect on the relationship between inventory and organization performance and develops some specific hypotheses. The fifth part covers the Egyptian sample and variables measurement, whereas the sixth part introduces the key findings of empirical analysis. The final part deals with discussions and conclusion.

2. Inventory and organizational performance

In this section, we review literature exploring the relationship between inventory management and organizational performance. Presenting this literature in a chronological way may make it is very hard to follow. A more helpful way is to present literature review in a thematic approach. This should give the readers a fuller and clearer picture of the accumulated research evidence. Accordingly, literature review was grouped into three themes: positive relationship, negative or no relationship, and moderators/mediators to the relationship (we would like to thank the first anonymous reviewer for this suggestion).

2.1. Positive relationship

Huson and Nanda (1995) provided evidence that those firms that adopted JIT system were able to improve their earnings per share as a result of inventory turnover improvement. Afterward, Lieberman and Demeester (1999) observed a positive relationship between inventory reduction and productivity growth. Specifically, their findings showed that 10% reduction in inventory is responsibility for 1% gain in labor productivity. They concluded that inventory reduction can be considered as an important driver of process improvement. In addition, the results of Claycomb et al. (1999) and Fullerton and McWatters (2001) supported the positive effect of inventory reduction on organization performance in a JIT context. Particularly, while the findings of Claycomb et al indicate that inventory reduction improves three measures of organization performance (return on investment, profits, and return on sales),

the results of Fullerton and McWatters demonstrated that organization performance has been enhanced through reducing inventory as well as quality costs and increasing customer responsiveness. Fullerton et al. (2003) studied inventory-performance relationship in a JIT context and documented a positive association between inventory turnover and organization performance expressed by return on assets, return on sales, and cash flow margin.

In addition, Demeter (2003) reported a positive effect of inventory turnover on organization performance, measured by return on sales, using a dataset that was drawn from the International Manufacturing Strategy Survey (IMSS), which contains more than 700 companies from 23 countries. Vastag and Clay Whybark (2005) used a sample of 1222 world-wide organizations that was drawn from the Global Manufacturing Research Group (GMRG) database and concluded that although inventory turnover has a knock-out effect, it has not a direct relationship with organization performance.

Furthermore, while Deloof (2003), in a Belgian context, observed that lower inventory and higher performance are positively correlated, Boute et al. (2006) found that those organizations that have high inventory levels are more likely to achieve bad financial performance. The results of Chen et al. (2005) showed that firms with good stock long-term returns have slightly lower than average inventories. Swamidass (2007) found that organizations that have outstanding performance carry lower inventory level than those organizations that achieved poor performance. A similar conclusion is also documented in Koumanakos (2008) who employed a sample of Greek organizations and revealed that the higher the organization inventory level, the lower its profitability rate. The positive inventory-performance relationship was also supported by the results of Ramachandran and Jankriaman (2009) in an Indian context. Pong and Mitchell (2012) reported a positive and significant relationship between inventory days-reduction and profitability using a sample of UK firms. Recently, Elsayed (2015a) observed a positive relationship between inventory efficiency and financial performance using a sample of Egyptian firms.

2.2. Negative or no relationship

The first empirical evidence has started to emerge in the US context with the work of Tunc and Gupta (1993) who revealed that inventory turnover and total sales are not correlated. Likewise, the analysis of Balakrishnan et al. (1996) was not able to detect a significant difference in return on assets between JIT firms and non-JIT firms. The results of Cannon (2008) revealed that inventory and organization performance have no significant relationship. In Germany, Obermaier and Donhauser (2009) pointed out that inventory reduction has a limited effect on organization performance. However, Obermaier and Donhauser (2012) demonstrated that organizations that have the lowest (highest) inventory level have also the worst (better) performance level. They concluded that moving toward zero-inventory case is not always recommended.

2.3. Moderators/mediators to the relationship

Sim and Killough (1998) found that the positive effect of inventory reduction, in a JIT context, on organization performance is subject to the implementation of TQM and performance goals. Moreover, the positive inventory-performance relationship was found only apply to large organizations according to Kinney and Wempe (2002). Shah and Shin (2007) examined the effect of inventory, as a mediator variable, on the relationship between investment in information technology and performance. They concluded that inventory reduction has a direct and significant effect on performance. Capkun et al. (2009) revealed that although inventory reduction affects organization performance positively, the positive effect varies with inventory type. In a similar vein, Eroglu and Hofer (2011) found that inventory-performance relationship varies not only with inventory type, but also with industry type. Specifically, they found that raw material inventory has a greater impact of performance than either work in process inventory or finished goods inventory. In addition, Basu and Wang (2011) pointed out that inventory-performance relationship differs with macroeconomic and industry-specific environment. Finally, Hofer, Eroglu, and Hofer (2012) provided empirical evidence that inventory-performance relationship is partially mediated by inventory leanness.

3. Organizational life cycle perspective

A number of scholars starting with Chandler (1962) have considered modern organizations as dynamic in nature, in the sense that strategy, structure and decisions vary with the stage of the organization's life. Later scholars (e.g.,

Galbraith, 1982; Miller & Friesen, 1984; Quinn & Cameron, 1983) have sought to develop either theoretical or conceptual models to explain the process of organizational growth and development.

The underlying theoretical assumptions of the organizational life cycle approach can be summed up as follows. First, although organizations evolve in stages, it cannot be assumed that evolvement is linear. This is because every stage has its own specific problems that diverge from other stages (Kazanjian & Drazin, 1989). Second, several organizational life cycle stages can be found in any cross-sectional dataset and it is likely to determine these stages by clustering (grouping) organizations based on common configurations (Hanks, Watson, Hansen, & Chandler, 1993). This implies that organizational orientation and managerial priorities as well as opportunities and threats will differ over organizational development stages (Miller & Friesen, 1984; Smith, Mitchell, & Summer, 1985). Third, being able to differentiate among organization life cycle stages can improve the ability of managers to develop and to execute proper strategies (Galbraith, 1982), and to benchmark their performance against other organizations in the same contextual settings (Hanks et al., 1993).

Despite scholars have examined various variables as well as their interrelationships to differentiate one life cycle stage from another, there is no agreement in the literature on either the time span for each stage, or the deterministic linkage or development of that stages (Galbraith, 1982; Miller & Friesen, 1984; Quinn & Cameron, 1983). Rather, organizations may move forth and back between stages (Miller & Friesen, 1984). Within the literature, organizational life cycle is typically characterized as comprising five stages: inception (initial growth), expansion (rapid growth), maturity, revival and decline. Many models do not consider decline as an explicit life cycle stage (Adizes, 1989; Miller & Friesen, 1984, are exceptions). Hanks et al. (1993) and Miller and Friesen (1984) attributed this omission of the decline stage to two reasons. First, decline can occur at any time and in any stage of organization development. Second, the effect of decline is less predictable if it is compared with the effect of growth and expansion.

Notwithstanding the organizational life cycle approach is open to criticism regarding, for example, the possible generalization inherent in classifying organizations into a finite number of life cycle stages (Mintzberg, 1984) and the operational definitions that should be adopted to discriminate the life cycle stages (Olson & Terpstra, 1992), it has been applied widely to explain various managerial and organizational issues. Examples of these issues include organizational effectiveness (Quinn & Cameron, 1983), organizational power (Mintzberg, 1984), strategic human resource (Milliman, Von Glinow, & Nathan, 1991), response of stock market (Anthony & Ramesh, 1992), management accounting systems (Moores & Yuen, 2001), performance appraisal (Chen & Kuo, 2004), incentive reward systems (Chen & Hsieh, 2005), product innovation (Liao, 2006), corporate governance (Filatotchev, Toms, & Wright, 2006), corporate environmental policy (Elsayed & Paton, 2009), R&D expenditure (Ahmed & Jinan, 2011), and inventory management (Elsayed, 2014).

4. Hypothesis development

Organizations in the initial growth stage of their life tend to be concerned more with survival and securing the needed resources to develop their product and market in the right way (Dodge, Fullerton, & Robbins, 1994). In this context, Lant and Montgomery (1987) concluded that performance below aspirations leads to riskier choices than performance that meets or exceeds aspirations. March and Shapira (1987, 1992) suggest that managers in firms threatened by organizational failure may focus on a survival level. Thus, low performance and lack of resources drive risk taking, but the risks taken may have poor outcomes (Bromiley, 1991). The expected problems depend much on the expected level of competition in the market (Dodge ad Robbins, 1992; Kazanjian, 1988), and threat of organizational failure induces decision makers to adopt a risk-seeking strategy that entails the choice of risky options (Jawahar & McLaughlin, 2001).

In fact, intensive competition and low volume sales collaborate with importance of product availability and increasing of stock-out cost to weaken initial growth organizations' market-power. Organizations often mitigate weak market-power by holding more inventories (Blazenko & Vandezande, 2003). Holding more inventories is expected to affect performance negatively given that organizations in the initial growth stage have fluctuated demand, relatively small ordering quantity, and limited choices either in possibilities for purchasing or in supplier selection. For instance, organizations in the initial growth stage make "an exclusive commitment to a single supplier for a specific duration in order to obtain a steady supply of an item (or items) (Jawahar & McLaughlin, 2001, p. 406). The preceding argument will be tested empirically through the following hypothesis:

H1. Inventory and organization performance are negatively correlated in the initial growth stage.

For organizations in the rapid growth stage, concerns about survival are less crucial than in the initial growth stage and this drives organizations to adopt a risk-averse strategy and focus more on internal operations (Jawahar & McLaughlin, 2001; Quinn & Cameron, 1983). An implication of this argument is that distinctive problems that face rapid growth organizations are stabilizing production and product availability, as well as matching demand increases, as demand progressively increases in this stage (Dodge & Robbins, 1992; Jawahar & McLaughlin, 2001). Since potential for profit is greater in this stage, organizations may "pursue growth at the cost of excess inventory in the short-term" (Gaur & Kesavan, 2009) to avoid stock outs (Blazenko & Vandezande, 2003). Thus, it is expected that inventory in the rapid growth organizations affects their performance positively not only to match demand, but also "to translate this demand into sales rather than stock outs" (Blazenko & Vandezande, 2003, p. 362). This is likely to occur as unexploited market potential need more inventory to increase sales growth by increase service levels of existing products in order to stimulate demand, open new stores, or add new product lines (Gaur & Kesavan, 2009). The preceding argument will be tested empirically through the following hypothesis:

H2. Inventory and organization performance are positively correlated in the rapid growth stage.

In the maturity stage, not only organizations' growth continues increasing but at a decreasing rate relative to its rate in the rapid growth stage, but also demand and return rate become more stable (Jawahar & McLaughlin, 2001; Laan & Salomon, 1997; Rink & Fox, 1999). Although growth rate has slowed, organizations at this stage have more market power as well as market share (Pashley & Philippatos, 1990), which encourages them to adopt a risk-averse strategy and focus more on profitability (Elsayed & Paton, 2005; Jawahar & McLaughlin, 2001). Thus, the ability to reduce inventory levels, and hence translating any inventory reduction into improved financial performance, will be grater in the maturity stage. This is because, first, as organizations move from the rapid growth to the maturity stage, they put more emphasis on cost control (Miller & Friesen, 1984; Quinn & Cameron, 1983) to improve efficiency and reduce overall cost (Anderson & Zeithaml, 1984). One possible way to improve efficiency, in this stage, is by balancing customer service levels and inventory costs (Kaminski & Rink, 1984). Second, "firms decrease their inventory holdings with an increase in their market power. An interpretation is that a less competitive product market reduces the adverse consequences of stock outs and firm respond by reducing inventories" (Blazenko & Vandezande, 2003, p. 362). Third, organizations with slow sales growth find it harder to manage inventory than those firms that experience high sales growth because the former have to find ways to dispose off excess inventory (Gaur & Kesavan, 2009). Finally, since increasing profitability, and rather increasing the market share, is the key objective in the maturity stage (Elsayed & Paton, 2005), inventory levels would be reduced to attain a high rate of return (Anderson & Zeithaml, 1984). Thus, the preceding discussion suggests that it is most appropriate and beneficial for mature organizations to reduce inventory. Put in another way, increasing inventory in mature organizations is expected to drain their financial performance. Thus, the above presented argument will be tested empirically through the following hypothesis:

H3. Inventory and organization performance are negatively correlated in the maturity stage.

As organizations move from the maturity stage to the revival stage, they need to make a significant shift in their product–market strategies and undergoing dramatic diversification in their products and markets (Miller & Friesen, 1984). Although all organizations do not enter the revival stage at the same point, revival organizations seek to developing new product to stimulate growth (Kazanjian, 1988), and rebuilding their market share (Jawahar & McLaughlin, 2001). As with rapid growth stage, since organizations in the revival stage are aiming to expand the market share, and rather profitability (Elsayed & Paton, 2009), they need to increase inventory to boost sales growth by increasing service levels. This implies that inventory and organization performance are expected to be positively correlated in this stage. However, this relationship is likely to be somewhat weaker than that in the repaid growth stage. This is because organizations in the revival stage, as compared with organizations in the growth stage, put significantly more emphasis on formal cost controls and performance (Silvola, 2008), to secure financial resources that are needed to invest in a more general program of product (re-)development (Elsayed & Paton, 2009; Jawahar & McLaughlin, 2001). Thus, the preceding argument will be tested empirically through the following hypothesis:

H4. Inventory and organization performance are positively correlated in the revival stage.

5. Sample and data

The sample of this study was drawn from the lists of the most ***active firms*** trading on the ***Egyptian*** Stock Exchange published by the Egyptian stock market authority. These lists include firms that constitute around 45 percent of the total market capitalization (Abdel Shahid, 2003; Elsayed & Wahba, 2013). Published lists from 2005 to 2010 were examined and firms from financial industries were ruled out as their operations and regulations are fairly different. The study did not consider data after 2010 to avoid the expected effect of the Egyptian revolution that was started in January 2011. The required data were existed for 84 firms covering eighteen industrial sectors with total number of observations of 504.

5.1. Dependent variable

Organization performance (PER), as a key dependent variable, is measured in prior work using either accounting measures or market-based measures. In this study, we use accounting-based measures rather than stock market based measures because, first, "our focus is the operational performance of the firm rather than its perception by the financial markets" (Hamori & Bura, 2015, p. 29). Second, "stock markets are forward looking and market values reflect the likelihood to undertake restructuring measures. For example, a shareholder-value oriented company may experience a smaller drop in valuation for the same decline in operating performance because the stock market anticipates value enhancing restructuring" (Atanassov & Kim, 2009, p. 348).

Specifically, organization performance is measured in this study by return on assets and return on equity. Although return on assets (ROA) is preferred over return on equity (ROE) on the basis that it mainly reflects operating results rather than capital structure decisions (Schmalensee, 1989; Wahba & Elsayed, 2015), both measures are used in order to check the robustness of results. Each of which is computed by dividing organization profits before taxes by its total assets and total equity, respectively (Fullerton et al., 2003; Swamidass, 2007).

5.2. Independent variable

Inventory performance (IVP) is the main dependent variable in this study and expressed by inventory to sales ratio (Capkun et al., 2009; Eroglu & Hofer, 2011; Obermaier & Donhauser, 2009; Shah & Shin, 2007). Inventory to sales ratio is computed by dividing of average inventory to sales. It shows whether the organization is able to keep inventory level low with regard to its current sales figures. Increasing this ratio from one period to another can be a sign for poor management of inventory (Elsayed and Whaba, 2014).

5.3. Moderating variable

With regard to organizational life cycle (OLC), this study does not start with any presupposition regarding the number of life cycle stages. This is not only because there is little agreement on the proper method for classifying organizational life cycle stages (Hanks et al., 1993; Miller & Friesen, 1984; Quinn & Cameron, 1983), but also because different researchers suggest different numbers of life cycle stages (see Hanks et al. (1993), for a good review of that). A further implication of the Miller and Friesen's (1984) methodology is that stages are not presumed to develop in a deterministic progression. Rather, organizations can retreat from one stage to another according to existing configurations of variables. Moreover, there is no expectation that organizations will spend the same amount of time in each stage (Quinn & Cameron, 1983). Thus, organizational life cycle, as a moderator variable, is a matter of empirical analysis as it is explained in detail below.

5.4. Covariate variables

A number of associated variables that may affect the relationship between inventory and organization performance are also controlled for to avoid model misspecification problem (Elsayed, 2015b). Organization size (SIZ) is included to capture the effect of economies of scale and fluctuation in inventory between large and small organizations (Carpenter, Fazzari, & Petersen, 1998), and represented by organization's total assets (Elsayed & Wahba, 2013). The natural logarithm is employed to transform organization size, as the Shapiro–Wilk W test for normality is significant

($W=0.511$, $p<0.001$). Financial leverage (LVG) is controlled for on the basis that high leverage might diminish firm's ability to finance inventory investment (Carpenter et al., 1998), and the documented relationship between inventory management and firm's capital structure (Luciano & Peccati, 1999). Firm leverage is measured by the ratio of total debt to total assets (Kashyap, Stein, & Wilcox, 1993). The effect of ownership structure is also controlled for. Specifically, managerial ownership (MAN), institutional ownership (INT), private ownership (PRV), and state holding ownership (STA) are captured based on the proportion of each stake in the total equity, respectively (Elsayed & Wahba, 2013). Besides, as organization performance may have altered significantly over the time of the study period, a year effect (YER) is included in each model (Elsayed & Paton, 2005). Moreover, as inventory-performance relationship may vary with industry type (Basu & Wang, 2011; Eroglu & Hofer, 2011), dummy variables using the two-digit standard industrial classification code (SIC) are included to capture the expected differences between industries (Elsayed & Wahba, 2013).

Table 1 presents descriptive statistics for all of above-explained variables. To assess whether there are differences between industrial sectors based on explanatory and covariate variables, parametric and nonparametric analyses were performed using one-way analysis of variance test (ANOVA) and Kruskal–Wallis test, respectively. The findings indicate that there is a systematic variation across the eighteen industrial sectors along with all of the above-discussed variables.

6. Empirical analysis

6.1. Organizational life cycle classification

As it explained above, this study does not start with any presupposition regarding the number of organizational life cycle stages as it is a matter of empirical findings. Given that, organizational life cycle stages were classified as follows. Firstly, dividend payout ratio, sales growth ratio, capital intensity and organization age, as four key variables in prior studies, were explored to configure organizational life cycle as a multidimensional phenomenon (see, for example, Anandarajan, Chiang, & Lee, 2010; Anthony & Ramesh, 1992; Elsayed & Paton, 2009; Galbraith, 1982; Grabowski & Mueller, 1975; Hanks et al., 1993; Kazanjian & Drazin, 1989; Miller & Friesen, 1984). Dividend payout ratio (DIV) is the ratio of dividends to income before extraordinary items and discounted operations. Sales growth ratio (SGR) is the change in sales relative to last year divided by last year sales. Capital intensity (FIX) is the ratio of fixed assets to total assets. Organization age (AGE) is the time period from the incorporation date and the year of analysis.

Secondly, cluster analysis was performed to classify organizations in the sample into groups according to their characteristics. Cluster analysis as a grouping technique seeks to enhance homogeneity among members of the same group and heterogeneity between groups. Hierarchical cluster analysis and the stopping rule (Hair, Anderson, Tatham, & Black, 1998) were employed to determine the appropriate number of organizational life cycle stages in the data. This process involves checking for jumps or relative increases in the agglomeration coefficients at each

Table 1
Descriptive statistics.

	Mean	Med	Sd
ROA	7.53	5.63	9.52
ROE	14.78	11.14	15.34
IVP	2.02	0.22	10.13
SIZ	13.78	13.54	1.99
LVG	45.45	30.66	80.42
MAN	8.24	0.40	17.43
INT	24.28	19.48	23.56
PRV	49.07	45.8	24.17
STA	10.73	0	21.67

ROA: return on assets; ROE: return on equity; IVP: inventory to sales ratio; OLC: organizational life cycle; SIZ: organization size; LVG: financial leverage; MAN: managerial ownership; INT: institutional ownership; PRV: private ownership; STA: state ownership.

stage and choosing the number of clusters occurring before the relative increase or jump. The Ward's algorithm was used as there is evidence (for example, Punj & Stewart, 1983) that this method outperforms other alternatives such as centroid linkage, single linkage, complete linkage or average linkage in many situations. Following the stopping rule (Hair et al., 1998), the relative increase in coefficients (49%) occurred from four clusters (agglomeration coefficient = 225.05) to three clusters (agglomeration coefficient = 335.45). The implication of this result is that the appropriate number of clusters is four. Table 2 presents descriptive statistics for each cluster.

A series of tests was performed to provide internal and external validation of organizational life cycle classification. First, following Hanks et al. (1993), a multivariate analysis of variance (MANOVA) test is used to confirm the extent to which the centroids of the resulting clusters differ. In this test, the clustering variables were specified as a dependent variable and the derived life-cycle stage clusters as independent variables. The MANOVA test of the four clusters and four variables has a Wilks' Lambda statistic of 0.2930 and a multivariate F-statistic of 42.06 ($p < 0.001$). This indicates that the clusters differ across the key four variables.

Second, this was supplemented by conducting one-way analysis of variance (ANOVA) test and Kruskal–Wallis equality-of-population test using each of the clustering variables as a separate dependent variable and life cycle stage again as the independent variable. The F-statistics of ANOVA as well as the χ^2-statistics of Kruskal–Wallis test indicate that significant differences exist in mean values for each of the four variables.

Third, the analysis was supplemented by performing ANOVA test and Kruskal–Wallis test to test how the four clusters differ in their profile according to regression variables that have not been used in the classification and results are reported in Table 3. The resulting F-statistics and χ^2-statistics validate that there significant differences exist in mean values for all variables.

Fourth, clusters internal validity was checked by performing multiple discriminant analysis on the results of the cluster analysis to predict the (cluster) membership (Hanks et al., 1993; Moores & Yuen, 2001, Elsayed & Paton, 2009). The results show that about 91.8 % of original grouped cases are correctly classified. This result is comparable

Table 2
Descriptive statistics for organizational life cycle variables.

	Cluster 1 ($n=40$)		Cluster 2 ($n=126$)		Cluster 3 ($n=172$)		Cluster 4 ($n=166$)	
	Mean	**Sd**	**Mean**	**Sd**	**Mean**	**Sd**	**Mean**	**Sd**
DIV	0	0	2.70	16.12	26.23	38.95	3.11	9.82
SGR	2.44	11.90	19.22	42.53	−68.13	2.55	6.84	30.33
FIX	63.32	24.54	62.10	21.26	44.60	21.24	17.40	17.80
AGE	6.81	3.61	15.33	5.12	30.84	12.74	56.75	28.91

DIV: dividend payout ratio; SGR: sales growth ratio; FIX: fixed assets ratio; AGE: organization age.

Table 3
ANOVA and Kruskal–Wallis of regression variables across organizational life cycle classification.

	ANOVA (F)	**Kruskal–Wallis (χ^2)**
ROA	7.25*	20.53*
ROE	11.72*	36.52*
IVP	9.62*	33.73*
SIZ	54.78*	113.37*
LVG	5.75*	39.86*
MAN	13.55*	0.29
INT	14.98*	30.10*
PRV	16.57*	50.38*
STA	9.34*	56.65*

ROA: return on assets; ROE: return on equity; IVP: inventory to sales ratio; OLC: organizational life cycle; SIZ: organization size; LVG: financial leverage; MAN: managerial ownership; INT: institutional ownership; PRV: private ownership; STA: state ownership.
*$p < 0.001$.

with previous work using the same methodology (e.g. 90% in the work of Hanks et al. (1993) and 93.9% in the work of Moores and Yuen (2001)).

In short, internal and external validation tests provided considerable reassurance that the organizations have been clustered appropriately. Thus, the mean values of four clustering variables, as reported in Table 2, was used to identify and label the clusters as follows: cluster one as initial growth stage, cluster two as rapid growth stage, cluster three as maturity stage and cluster four as revival stage.

6.2. Multivariate analysis

Multivariate regression analysis was performed to check for the validity of this argument after taken into account the joint effect of other covariate variables. The investigated model is proposed as follows:

$$PER_{it} = \alpha + \beta_1 IVP_{it} + \beta_2 OLC_{it} + \beta_3 IVS_{it} * OLC_{it} + \beta_4 SIZ_{it} + \beta_5 LVG_{it} + \beta_6 MAN_{it} + \beta_7 INT_{it} + \beta_8 PRV_{it} + \beta_9 STA_{it} + \beta_{10} YER_{it} + \beta_{11} SEC_{it} + \mu_i + v_{it}$$

where α is a constant, $B_1 : B_{11}$ are the parameters for the explanatory and covariate variables. The subscript i refers to the organization number and the subscript t denotes the time period. μ_i is the unobservable individual heterogeneity, and v_{it} is the remainder disturbance or the usual disturbance in the regression model that varies with individual units and time.

The hypotheses in this study were examined using panel data regression. Panel data estimate enables researchers to control for unobservable organization-specific effects, and hence, it has the potential to offer a much more powerful evidence base (Baltagi, 1995). Tables 4 and 5 present panel data estimates using of ROA and ROE, respectively, as two alternative measures of organization performance. The F-test (Baltagi, 1995), and the Breusch and Pagan (1980) Lagrange Multiplier (B–P LM) test (χ^2-test) were performed to test the alternatives of panel data (i.e., fixed and random effects, respectively) against the pooled regression. As reported in Tables 4 and 5, both tests are significant. These findings imply that it is appropriate to use the panel data model, as the null hypothesis of both tests can be rejected. Hausman's (1978) specification test was performed to decide between employing the fixed effects model or the random effects model (Baltagi, 1995). The null hypothesis of the Hausman test, as reported in Tables 4 and 5, could not be rejected as the Hausman test statistic is insignificant. Simply put, the regressors and the organization effects are not correlated, and hence, the Hausman test points in favor of the random effects model.

Heteroscedasticity and serial correlation are two serious problems that can affect the estimate of random effects model. The presence of these problems means that the standard errors associated with each regression coefficient will not be correct (Greene, 2003). Therefore, the modified Wald test (Greene, 2003), and the Wooldridge test (Wooldridge, 2002) were performed to check for heteroscedasticity and serial correlation, respectively. The results, reported in Tables 4 and 5, show that heteroscedasticity and serial correlation are present. Therefore, the generalized least squares (GLS) method was employed to correct for heteroscedasticity and serial correlation (Hausman, 1978).

Since organization performance can not only be a result of inventory decisions, but can also be a determinant of one or more of these decisions, expected endogeneity represents a crucial matter that should be considered to validate the results of this research. This is because estimating organization performance and inventory management individually, in the presence of endogeneity effect, leads to biased and inconsistent estimates as a result of the expected correlation between the error term and endogenous variable. The implication of this is that the estimates will not approach their true values in the population with increasing the sample size (Maddala, 2001). Following the suggestion of Davidson and Mackinnon (1993), the Durbin–Wu–Hausman test, as an augmented regression test, was performed to check for possible endogeneity. The test was conducted by including the residuals of endogenous right-hand side variable (i.e., ROA and ROE), as a function of all exogenous variables. In fact, the Durbin–Wu–Hausman shows no sign for possible endogeneity as the χ^2 test for the predicted residual values of organization performance are not significant under any case. For instance, when ROA is used as a proxy for organization performance, the χ^2-statistic is 0.96 ($p = 0.3283$).

Accordingly, the results of the GLS restricted model, which omits organizational life cycle dummy variables, are introduced in Tables 4 and 5, using of ROA and ROE as two different proxies for organization performance, correspondingly. Both tables show that inventory to sales ratio has exerted a negative and significant coefficient on organization performance, -0.032 ($p < 0.01$) and -0.194 ($p < 0.001$), respectively.

Table 4
Impact of inventory on return on assets: the moderating effect of organizational life cycle.

Dependent variable: ROA	Random effects model	GLS restricted	Unrestricted GLS			
			Initial growth	Rapid growth	Maturity	Revival
IVP	−0.012	−0.032**	−0.036**	−0.092***	0.00002	−0.036**
	(0.019)	(0.012)	(0.013)	(0.014)	(0.011)	(0.012)
OLC			2.567***	−2.011***	1.404***	−0.122
			(0.606)	(0.245)	(0.344)	(0.362)
IVP × OLC			−2.181***	0.104***	−0.111***	0.162*
			(0.309)	(0.015)	(0.023)	(0.083)
SIZ	−0.341	−0.392***	−0.315***	−0.105	−0.209*	−0.367***
	(0.219)	(0.086)	(0.091)	(0.093)	(0.095)	(0.091)
LVG	0.088***	0.092***	0.092***	0.092***	0.092***	0.092***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
MAN	0.205***	0.217***	0.217***	0.219***	0.232***	0.223***
	(0.041)	(0.06)	(0.017)	(0.014)	(0.015)	(0.017)
INT	0.051	0.055***	0.061***	0.033*	0.039*	0.057***
	(0.033)	(0.015)	(0.014)	(0.014)	(0.015)	(0.015)
PRV	0.011	0.024	0.020	0.019	0.027	0.025
	(0.034)	(0.014)	(0.014)	(0.013)	(0.014)	(0.014)
STA	0.077*	0.077***	0.071***	0.053**	0.075***	0.078***
	(0.039)	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)
Industry effects (χ^2-test)	124.84***	1660.69***	1525.95***	1650.28***	1726.34***	1868.84***
Year effects (χ^2-test)	8.02	11.12*	4.22	14.24**	37.74***	16.46***
Model goodness-of-fit test (Wald χ^2)	1603.72***	4775.8***	5102.51***	5453.18***	3595.45***	5367.14***
***F*-test**	4.44***					
B–P LM test	127.15***					
Hausman	12.63					
Heteroscedasticity	$1.5e^{+31}$***					
Serial correlation	14.10***					

(i) $^{+}p < 0.10$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$.
(ii) Figures in brackets are standard errors.
(iii) *F*-test provides a test of the pooled OLS model against the fixed effects model based on the OLS residuals.
(iv) B–P LM test is the Breusch and Pagan (1980)'s Lagrange Multiplier statistic that provides a test of the pooled OLS model against the random effects model based on the OLS residuals.
(v) Hausman test is the Hausman (1978)'s specification test that is used to decide between employing the fixed effects model or the random effects model.
(vi) Heteroscedasticity is the modified Wald statistic for group-wise heteroscedasticity (Greene, 2003).
(vii) Serial correlation is the Wooldridge test for autocorrelation in panel-data models (Wooldridge, 2002).
(viii) ROA: return on assets; IVP: inventory to sales ratio; OLC: organizational life cycle; SIZ: organization size; LVG: financial leverage; MAN: managerial ownership; INT: institutional ownership; PRV: private ownership; STA: state ownership.

Then, organizational life cycle dummy variables were added to models of analysis and results are reported in Tables 4 and 5 under unrestricted GLS model. In each mode, a dummy variable was included that takes the value of one to refer to each firm life cycle stage and zero otherwise (please see the 4 separate models at the right-hand side of Tables 4 and 5). According to results of Table 4, interaction term between inventory to sales ratio and each dummy variable of initial growth, rapid growth, maturity, and revival has exerted a significant coefficient on ROA (-2.181, $p < 0.001$), 0.104 ($p < 0.001$), -0.111 ($p < 0.001$), and 0.162 ($p < 0.05$), respectively. Moreover, the results of using ROE, as reported in Table 5, give quite similar findings to those of using ROA. These findings give strong supportive evidence for the applicability of the suggested hypotheses in this study and demonstrate that the effect of inventory on organization performance varies with organizational life cycle stage. Specifically, the results support that first and third hypotheses in which it was expected that increasing inventory in either the initial growth stage or the maturity stage affects organization performance negatively. In addition, the findings validate the second and forth hypotheses in which it was predicted that increasing inventory has a positive effect on organization performance in either the rapid growth stage or the revival stage.

Table 5
Impact of inventory on return on equity: the moderating effect of organizational life cycle.

Dependent variable: ROE	Random effects model	GLS Restricted	Unrestricted GLS			
			Initial growth	Rapid growth	Maturity	Revival
IVP	−0.134*	−0.194***	−0.198***	−0.336***	−0.122*	−0.139**
	(0.052)	(0.052)	(0.059)	(0.0719)	(0.058)	(0.044)
OLC			8.532***	−2.819***	0.649	3.611***
			(1.863)	(0.675)	(0.544)	(0.923)
IVP × OLC			−8.153***	0.273***	−0.178*	0.510***
			(1.074)	(0.080)	(0.090)	(0.121)
SIZ	0.520	0.091	0.264	0.269	0.170	0.194
	(0.466)	(0.199)	(0.204)	(0.214)	(0.200)	(0.219)
LVG	0.019*	0.102***	0.105***	0.107***	0.102***	0.102***
	(0.007)	(0.014)	(0.104)	(0.014)	(0.014)	(0.014)
MAN	0.215*	0.243***	0.271***	0.246***	0.249***	0.188***
	(0.086)	(0.027)	(0.028)	(0.028)	(0.027)	(0.034)
INT	0.138*	0.123***	0.131***	0.100***	0.122***	0.092***
	(0.070)	(0.021)	(0.021)	(0.023)	(0.022)	(0.023)
PRV	−0.009	−0.012	0.007	−0.014	−0.011	−0.026
	(0.072)	(0.022)	(0.021)	(0.023)	(0.022)	(0.026)
STA	0.204*	0.025	0.030	0.009	0.028	−0.035
	(0.082)	(0.036)	(0.035)	(0.036)	(0.036)	(0.041)
Industry effects (χ^2-test)	53.15***	643.51***	555.13***	686.46***	627.60***	387.80***
Year effects (χ^2-test)	32.75***	38.88***	26.34***	37.21***	38.55***	19.69***
Model goodness-of-fit test (Wald χ^2)	485.28***	1128.75***	1162.81***	1423.15***	1211.17***	811.28***
***F*-test**	6.17***					
B–P LM test	84.30***					
Hausman	11.81					
Heteroscedasticity	3.3^{e+33}***					
Serial correlation	53.21***					

(i) $^{+}p < 0.10$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$.
(ii) Figures in brackets are standard errors.
(iii) *F*-test provides a test of the pooled OLS model against the fixed effects model based on the OLS residuals.
(iv) B–P LM test is the Breusch and Pagan (1980)'s Lagrange Multiplier statistic that provides a test of the pooled OLS model against the random effects model based on the OLS residuals.
(v) Hausman test is the Hausman (1978)'s specification test that is used to decide between employing the fixed effects model or the random effects model.
(vi) Heteroscedasticity is the modified Wald statistic for group-wise heteroscedasticity (Greene, 2003).
(vii) Serial correlation is the Wooldridge test for autocorrelation in panel-data models (Wooldridge, 2002).
(viii) ROE: return on equity; IVP: inventory to sales ratio; OLC: organizational life cycle; SIZ: organization size; LVG: financial leverage; MAN: managerial ownership; INT: institutional ownership; PRV: private ownership; STA: state ownership.

Although empirical findings referred to the significance of most of control variables, the results did not demonstrate a clear pattern with regard to organization size, private ownership, and state holding ownership, as it seems that the relationships between these variables and organization performance vary with not only the proxy used for organization performance, but also organizational life cycle stage. Each of financial leverage, managerial ownership, and institutional ownership has exerted a positive and significant coefficient on organization performance, under any case. Furthermore, the validity of the industry effect as an important control variable was supported in all cases. The joint *F*-test for industry effect is significant under any model reported in Tables 4 and 5. This indicates that organization performance varies with industry type.

6.3. Additional analyses

In fact, an important issue that deserves more analysis is the possibility that the full effect of the driving mechanisms that is considered here is felt only in the long run. This issue can be explored by conducting dynamic panel data estimates in which the lagged dependent variable is included as an independent variable. Arellano and

Bond (1991) GMM estimator is used to control for endogeneity of this variable. The results of dynamic panel data analysis demonstrate that the coefficient on the lagged dependent variable is insignificant at conventional levels (10%) in every specification. For instance, the coefficient (standard deviation) on the lagged return on assets is −0.047 (0.041) in the initial growth stage, −0.043 (0.039) in the rapid growth stage, −0.034 (0.042) in the maturity stage, and −0.042 (0.044) in the revival stage. For reasons of space, the results of using either ROA or ROE are not reported here, but are available from the author on request.

Despite the strength of the statistical results in this paper, it is worth questioning whether the concept of life cycle really adds more to our understanding of the relationship between inventory and organization performance than had we focused on the underlying components of the organizational life cycle. This issue is explored by conducting more tests by setting up an unrestricted model in which both organizational life cycle and the four component criteria are included as explanatory variables (in addition to the control variables). Then, two restricted models nested within this are considered. The first restricted model (i.e., components only model) excludes the organizational life cycle variables. The second restricted model (i.e., organizational life cycle only model) excludes the four component variables. After that, a likelihood ratio (LR) test of each of the restricted models against the unrestricted model is conducted. When return on equity is used, for example, as a proxy for organization performance, the LR χ^2-statistics are 28.46 ($p < 0.001$) for the 'components only' model and 6.97 ($p = 0.1375$) for the 'organizational life cycle only' model. The implication of this is that the component variables can be safely dropped, but not the organizational life cycle variables.

More analysis was performed on this point by computing the standard information criteria (namely the Akaike information criterion or AIC and the Bayesian information criterion or BIC) for the unrestricted and restricted models. The AICs for the unrestricted model, components only model and organizational life cycle model are −235.886, −213.425, and −236.917, respectively, while the values of the BIC, correspondingly, are −137.109, −126.045, and −154.337. Remembering that for both AIC and BIC a lower figure means a better specified model (Greene, 2003), both criteria confirm that the 'organizational life cycle only' model used in the study is superior to both the 'components only' model and the 'unrestricted model'. The results follow a similar pattern for return on assets. In sum, this is very strong evidence that the overall organizational life cycle measure does indeed show a stronger pattern of association with inventory than the components. Put another way, the organizational life cycle does appear to add something unique in explaining differences in the relationship between inventory and organization performance.

7. Discussion and conclusion

Empirical evidence regarding the role of inventory in predicting organization performance is conflicting. It is argued here that the relationship is likely to vary with organizational life cycle stage. This is because the decision of inventory depends, like any other decision, not only on the perceived costs and benefits of the decision but also on the institutional environment that the organization is confronting. This argument is consistent with the findings of prior studies that organizations in the same industry context respond differently to similar external pressures (Bhambri & Sonnenfeld, 1988), that organizations are likely to respond to different stakeholders in a way that varies steadily with firm life cycle (Jawahar & McLaughlin, 2001), and that the decision by managers to change inventory systems depends on the state of competition within the market (Blazenko & Vandezande, 2003; Rotemberg & Saloner, 1989), organizational settings (De Vries, 2005), and the power and interests of stakeholders (De Vries, 2011).

Drawing on interdisciplinary theoretical arguments from the organizational life cycle and inventory management literature, four testable hypotheses are developed regarding the moderating effect of organizational life cycle on the relationship between inventory and organization performance. These hypotheses have been tested using a sample of 84 Egyptian listed firms between 2005 and 2010. Econometric analysis using panel data techniques provides considerable support for the four hypotheses. The results suggest that while the relationship between inventory to sales ratio and organization performance is negative in the initial growth stage and the maturity stage, it is positive in the rapid growth stage and the revival stage.

Certainly, these findings reveal the value of studying the impact of dynamic change in organization characteristics on inventory decisions. They provide supportive evidence for those studies (e.g., De Vries, 2005) that argue that organizations often develop their strategies in order to match between inventory systems and organizational setting.

Moreover, these findings are in the line with those studies (e.g., De Vries, 2011) that describe design of inventory systems as a dynamic process that emerges and evolves in response to change in stakeholders' power and interests. The results of this study are also in the line with prior work (e.g., Eroglu & Hofer, 2011; Shah & Shin, 2007) that demonstrate that industry and firm's specific factors may shape the relationship between inventory and organization performance.

It would clearly be desirable to test the above stated hypotheses on other data sets, especially covering other countries and large samples. Despite this caveat and also noting that the results of this study are based on real data and, hence, reflect the practice of actual managers, it is believed that the findings have implications for management research and practice. For managers interested in optimizing their organizations' value, thinking in terms of the stages of the organizational life cycle may guide them in choosing and implementing appropriate inventory investment decisions. Further, it is important that managers and their assessors need to benchmark inventory management against rivals at a similar organizational stage. For researchers in inventory management, it is believed that the significant role of organizational life cycle in explaining other related issues still needs to be exploited. For example, it would be useful to examine the extent to which the results reported here are robust to the use of a multidimensional measure of inventory management. The question of whether inventory management is correlated with product life cycle represents another promising opportunity for further research. Moreover, the moderating role of industry in inventory-performance relationship represents another promising area for future research as it may be misleading to talk about the inventory-performance relationship for industry as a whole since this relationship may vary across industries according to the structure of particular markets. In addition, existing literature, including this study, has focused intensively on examining the relationship between inventory and organization performance on large and listed organizations and rather on small and medium size enterprises (SMEs). Thus, future research is invited to examine the argument that is introduced here in SMEs context. Getting more evidence about this issue may help in understanding the dynamics of inventory-performance relationship, as SMEs have not only some unique characteristics that differentiate them from large firms, but also a higher failure rate than large firms (Queen & Roll, 1987).

In conclusion, the results of this study demonstrate that the concept of organizational life cycle has implications for inventory decisions, as organizational life cycle may affect the relationship between inventory management and organization performance. It is believed that this is novel theoretical and empirical evidence that has significant implications for understanding of the inventory-performance literature.

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