Inventory Management and Firm's Performance During the Period of Financial Constraints: An Empirical Analysis of SME Sector in Greece

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Abstract
In the last years, inventory management has become an integral part of all companies. Inventory management involves a trade-off decision between the advantages and the disadvantages of holding stock. Our research aims to investigate the relationship between firm level inventories and financial performance during the crisis periods, using SMEs' data for the region of Epirus in Greece. The study covers ten years period, which we split into two periods, before and post to 2008, considering 2008 as the beginning period of the recession in Greece and the first year of serious financial constraints for Greek firms. The study empirically examines differences in inventory ratios, both total inventory and its discrete components (finished goods, work in process and raw materials) between main sectors of economic activity in the region of Epirus, and the relationship between inventory management and firm performance on a sample of financial data of 612 enterprises. The results of the correlation and the regression analysis show negative relations between inventories and profitability. This indicates that the policy of minimization of inventories' level may improve firms' profitability. The significance of this study stems from the fact that it sheds light for the desirable firms' policy during the period of financial constraints.

Keywords: inventory management, firm performance, elasticity, small and medium enterprises (SMEs), financial crisis, Greece

Introduction

The SME sector plays a very important role in today's economy. It is confirmed by the experience of highly developed countries, whose economies are dominated by the network of small (or virtually very small) and medium-sized enterprises (Mulhern, 1995; Hyz, 2006). Greece is considered as the country where SMEs amount for 99,9% businesses, 57,4% of value added, 69% of total employment and 85% of private employment (EC 2013). More than 97% of all Greek enterprises are micro companies (EC 2013). The currently observed slowdown in the development of the SME sector, poses a threat to the economic situation of Greece and especially for some regions of Greece[1].

The term "inventory" in manufacturing companies refers to the stockpile of the products a firm is offering for sale and the components that make up the product. The assets which firms store as inventory are raw materials, work in process, finished goods and supplies. The last asset, normally, form a very minor part of total inventory and do not involve significant investment.

In the last years inventory management has become an integral part of all companies. Inventory management involves a trade-off decision between the advantages and the disadvantages of holding stock. The benefits of holding inventory must be weighed against any costs incurred. During the period of financial constraints firms have to find ways to gain funds (Bukowski, 2011; Hyz, 2011). One of the sources may be the reduction of inventories keeping by firms. As a result, effective inventory management during the period of recession gets even more importance.

In the last decades, inventories have been decreasing in many firms. Evidences of improvement of firm performance are mixed. Table 1 provides an overview of the impact found in different studies of inventory management on firm's profitability.

[1] For the situation of Greek SMEs during the last economic crisis see EWCO (2013); Hyż and Gikas, (2012)

Table 1. Impact of inventory management on firm's profitability

Researcher(s)	Impact
Demeter (2003)	Inventory improvement tends to influence only indirectly the firm's profitability
Gaur et al. (2004)	The annual inventory turnover is negatively correlated with gross margin and positively correlated with capital intensity and sales surprise
Chen et al. (2005)	Firms with abnormally high inventories had a poor long term stock return, firms with low inventory showed ordinary returns and the firms having an average inventory shown good stock returns
Roumiantsen and Netessine (2005)	Firms operating with more uncertain demand, longer lead times, higher gross margins and lower inventory holding costs have higher inventory levels
Gaur and Kesavan (2008)	Inventory turnover increases with sales growth rate, but its rate of increase depends on firm size and on whether sales growth rate is positive or negative
Boute et al. (2007)	Negative coefficients relationship between the inventory ratio and financial performance (ROA). These coefficients are only significant in 29% of the cases studied. The analysis of variance shows that companies with a very high inventory ratio have much more chance to be bad financial performers than companies with a very low inventory ratio
Shah and Shin (2007)	Inventory performance is positively associated with financial performance
Cannon (2008)	Turnover improvement an average had a slightly negative effect on ROA
Koumanakos (2008)	Among firms belonging to the food, textiles and chemicals sectors only in the sector of chemicals exists linear relationship
Capkun et al. (2009)	Significant positive correlation between inventory performance and measures of financial performance for firms in manufacturing industries. Raw materials performance has the highest correlation with all financial performance measures. Between work in process and finished goods performance, the former is more highly correlated with gross profit measures while the latter is more highly correlated with operating profit measures
Kolias et al. (2011)	Inventory turnover ratio is negatively correlated with gross margin and positively correlated with capital intensity and a measure of sales surprise

All the above mentioned studies aim to investigate the relationship between inventory management and firm's profitability during non-crisis periods. To the best of our knowledge, this study is the first that investigates the relationship between firm level inventories and financial performance during crisis periods[2]. In other words, we try to find the answer to the following questions: how SMEs in Greece manage their inventories during the financial crisis? Are there any changes between inventory management performance during the non-crisis period and the crisis-period?

The paper is organized as follows: in the next section we present the research methodology and the data sources used in the analysis. The results are presented and discussed in section three. In the last section, we present conclusions and directions for further research.

Methodology and data collection

The data was extracted from ICAP database containing income statements and annual balance sheets of Greek companies. We use SMEs data for the Epirus region in Greece. We get a data set of 612 companies split up over 18 sectors. We define three main sectors of economic activities in the region, according to the European NACE classification scheme of economic activities based on the number of firms and percentage of total sales. These three sectors represent about 87% of total sales in the region and above 58% of total number of firms, mainly wholesale and retail trade (26,2% in total number of firms in region and 41,2% in total sales), manufacturing (23,2% and 40,8% in total number of firms and total sales respectively) and construction (8,9% and 4,9% respectively).

The current research covers the period of 2003-2012, which gives ten-year period of observations of financial results of selected companies: this period covers five years (2003 – 2007) before the economic crisis in Greece and the first five years of the crisis (2008 – 2012).

The criteria used for selection of the companies are two: 1/. European Commission criteria for small and medium enterprises[3], 2/. Data available for ten years continuously. We exclude all firm-year observations without data available on inventories and their components, sales, cost of goods sold, net fixed assets and total assets.

As a result we obtained a balanced panel dataset of 612 firms and a number of 6120 firms-years observations. Outlying observations were removed via a 90% winsorization. For all variables, the bottom 5% of the values are set equal to the value corresponding to the 5th percentile, while the upper 5% of the values are set equal to the value corresponding to the 95th percentile.

Our research has three main purposes:

[2] For more information on economic crisis in Greece see Gikas et al. (2012).
[3] http://ec.europa.eu/enterprise/enterprise_policy/sme_definition/index_en.htm

Purpose 1. Estimation of inventory turnover trend over the entire period and in two sub-periods in all sectors in the region and in three main sectors. We analyze total inventories turnover and finished goods, work in process and raw materials turnover separately for three main sectors during the non-crisis years and crisis years.

Purpose 2. Evaluation of the elasticity of inventory to sales. We will measure the degree of elasticity as a rate in which inventories change in response to the changes in sale. This measure gives the percentage change in inventories in response to a one percent change in sales (ceteris paribus). Since inventory depends on the level of production and distribution, inventories increase (decrease) because sales increase (decrease). During the period of increasing sales the values lower than 1 mean good signs and improvement in inventory management. When sales decrease the elasticity values higher than 1 are more desired.

Purpose 3. Investigation the relationship between inventories and its elements and firm's financial performance during non-crisis period and crisis period.

The model used in this study is given bellow and is based on the variables presented in Table 2.

$$GM_{j,t} = \alpha + \beta_1 I_{j,t} + \beta_2 Ie_{j,t} + \beta_3 CI_{j,t} + \beta_4 Size_{j,t} + Fir_k + Year_k + \varepsilon$$

where:

j is representing the firm and t the year,

α is the constant term,

$\beta_1, \beta_2, \beta_3, \beta_4$ are the coefficients of $I_{j,t}$, $Ie_{j,t}$, $CI_{j,t}$, $Size_{j,t}$ respectively.

$I_{j,t}$ is the measure of total inventory and its components' efficiency (we use $ITR_{j,t}$ - number of days inventory total turnover of firm j in the year t, $RMTR_{j,t}$ - number of days raw materials total turnover of firm j in the year t, $WIPTR_{j,t}$ - number of days work in process turnover of firm j in the year t, $FGTR_{j,t}$ - number of days finished goods turnover of firm j in the year t respectively)

$Ie_{j,t}$ is inventory elasticity of firm j in the year t,

$CI_{i,t}$ - capital intensity of firm j in the year t and

$Size_{j,t}$ - size of firm j in the year t

Since GM can be correlated with factors that are omitted in our dataset, we minimize their effects by using firm-specific control variables and time-specific effects. These control variables can be modelled either as fixed effects or as random effects. To test whether fixed effects are present we employ a Hausman test (Baltagi, et al., 2003). Fir_k denotes the firm-specific effects, which are unobservable effects, constant over time but varying across firms, e.g. differences in accounting policy, managerial efficiency, and $Year_k$ is year - specific fixed effect for year k, which are unobservable effects constant across firms but varying over time, e.g. interest rates. ε indicates the error term for the observations of firm j in the year t.

Table 2. Variables of the model

	The Dependent variable
GM	Gross Margin
	The Explanatory variables
ITR	Inventory turnover ratio
RMTR	Raw material turnover ratio
WIPTR	Work in process turnover ratio
FGTR	Finished goods turnover ratio
	The Control Variables
Ie	Inventory elasticity
CI	Capital intensity
Size	Firm's Size

Table 3. Calculation of Variables

Gross margin	$GM_{j,t} = \frac{S_{j,t} - CGS_{j,t}}{CGS_{j,t}}$	$GM_{j,t}$ - Gross Margin for firm *j* in period *t* $S_{i,t}$ - Sales for firm *j* in period *t* $CGS_{i,t}$ - Cost of goods sold for firm *j* in period *t*
Inventory turnover ratio	$ITR_{j,t} = \frac{avgI_{j,t} * Days}{CGS_{j,t}}$	$ITR_{j,t}$ - Inventory turnover ratio for firm *j* in period *t*, $avgI_{i,t}$ - Average inventory for firm *j* in period *t*, $CGS_{j,t}$ - Cost of goods sold for firm *j* in period *t*
Raw material turnover ratio	$RMTR_{j,t} = \frac{avgRM_{j,t} * Days}{CGS_{j,t}}$	$RMTR_{j,t}$ - Raw materials turnover ratio for firm *j* in period *t* $avgRM_{i,t}$ - Average raw material inventory for firm *j* in period *t* $CGS_{j,t}$ - Cost of goods sold for firm *j* in period *t*
Work in process turnover ratio	$WIPTR_{j,t} = \frac{avgWIP_{j,t} * Days}{CGS_{j,t}}$	$WIPTR_{j,t}$ - Work in process inventory turnover ratio for firm *j* in period *t* $avgWIP_{i,t}$ - Average work in process inventory for firm *j* in period *t* $CGS_{j,t}$ - Cost of goods sold for firm *j* in period *t*
Finished goods turnover ratio	$FGTR_{j,t} = \frac{avgFG_{j,t} * Days}{CGS_{j,t}}$	$FGTR_{j,t}$ - Finished goods inventory turnover ratio for firm *j* in period *t* $avgFG_{i,t}$ - Average finished goods inventory for firm *j* in period *t*

		$CGS_{i,t}$ - Cost of goods sold for firm *j* in period *t*
Inventory elasticity	$Ie_{j,t} = \frac{(I_{j,t} - I_{j,t-1})/I_{j,t} * 100\%}{(S_{j,t} - S_{j,t-1})/S_{j,t} * 100\%}$	$Ie_{j,t}$ - Inventory elasticity for firm *j* in period *t* $I_{j,t}$ - Inventory for firm *j* in period *t* $I_{j,t-1}$ - Inventory for firm *j* in period *t-1* $S_{j,t}$ - Sales for firm *j* in period *t* $S_{i,t-1}$ - Sales for firm *j* in period *t-1*
Capital intensity	$CI_{j,t} = \frac{NA_{j,t}}{TA_{j,t}}$	$CI_{i,t}$ - Capital Intensity for firm *j* in period *t* $NA_{i,t}$ - Net fixed Assets for firm *j* in period *t* $TA_{i,t}$ - Total Assets for firm *j* in period *t*
Firm's Size	$Size_{j,t} = lnS_{j,t}$	$lnS_{j,t}$ - Natural logarithm of sales

Analysis, Results and Discussion

Table 4 presents a comparison between the descriptive statistics of the relevant variables for three main sectors for the non-crisis (2003 – 2007) and the crisis period (2008 – 2012) respectively.

Table 4. Comparison of the descriptive statistics for non-crisis and crisis period

	Mean		St. Deviation	
	Non-crisis period	Crisis period	Non-crisis period	Crisis period
GM				
Manufacturing (C)	0,22	0,20	0,21	0,22
Wholesale (G)	0,21	0,21	0,12	0,16
Construction (F)	0,26	0,20	0,23	0,34
TOTAL	0,29	0,24	0,19	0,34
ITR				
Manufacturing (C)	171,09	179,25	194,17	213,85
Wholesale (G)	145,42	172,56	170,54	197,42
Construction (F)	159,42	295,36	164,89	176,34
TOTAL	149,66	175,3	122,65	127,56
RMTR				
Manufacturing (C)	51,42	55,69	57,90	59,91
Wholesale (G)	14,00	23,86	30,97	49,57
Construction (F)	15,44	41,53	43,12	67,34
TOTAL	34,79	41,16	56,65	69,54
WIPTR				
Manufacturing (C)	80,10	87,32	91,00	105,48
Wholesale (G)	56,28	66,00	14,62	60,24
Construction (F)	196,19	261,22	7,89	67,45
TOTAL	186,42	217,82	54,12	123,34
FGTR				
Manufacturing (C)	26,58	22,05	49,83	46,46
Wholesale (G)	9,76	10,92	20,90	26,36
Construction (F)	49,23	42,85	34,65	45,23
TOTAL	29,58	27,52	34,78	34,78
Ie				
Manufacturing (C)	0,21	0,76	4,28	4,77
Wholesale (G)	0,28	0,66	4,40	4,39
Construction (F)	-0,60	1,04	3,14	3,78
TOTAL	0,10	0,68	2,12	5,34
CI				
Manufacturing (C)	0,48	0,46	0,23	0,24
Wholesale (G)	0,27	0,29	0,21	0,24
Construction (F)	0,30	0,28	0,43	0,34
TOTAL	0,45	0,45	0,21	0,18
Size				
Manufacturing (C)	2.659,6	2.363,9	2.895,3	2.797,2
Wholesale (G)	3.092,3	2.859,5	3.114,9	3.025,1

Construction (F)	1.512,3	1.223,6	2.564,7	2.034,7
TOTAL	1.882,4	1.720,6	1.985,7	3.067,2

For SMEs, inventories represent on average 33% of total assets and 42% of current assets. The mean of total inventory holding periods increased from 149,66 days in 2003-2008 to 175,3 in 2009-2012. The mean work in process turnover ratio increased from 186,42 during 2003-2008 to 217,82 days for the period 2009-2012. Raw materials turnover ratio increased from 34,79 to 41,16 and finished goods slightly dropped from 29,58 to 27,52 respectively. The biggest increase was observed for total inventories turnover measured in days in construction sector (159,42 to 295,36) and among inventories' components for raw materials turnover ratio in construction sector from 15,44 days to 41,53 days.

Our financial performance measure shows a decrease of mean Gross Margin from 0,29 to 0,24, with the biggest decrease in construction sector (from 0,26 to 0,20). Till the end of 2008, the ratio of inventory to sales elasticity mean was 0,10, which means that 1% of increase in sales caused 0,10% increase in inventories. In the construction sector, the value of elasticity in this period was negative, which means that increase of sales was accompanied by decrease in inventories. It denotes effective management of inventories in this sector. As far as the period 2009-2012 is examined, we can observe an increase in the elasticity (mean 0,68), with the biggest increase in construction sector. It has to be mentioned that when sales decrease, elasticity higher than 1 is more desired.

Tables 5, 6 and 7, present the correlation matrix of the model's variables based on Pearson correlation coefficient for total inventories and their components in all surveyed SMEs and the three main sectors in two sub-periods (non-crisis period and crisis period). The results of the correlation analysis for all sectors during the non-crisis period show that the inventory turnover (total and its components) is negatively related to the dependent variable gross margin. There is absence of a significant relation for raw materials days turnover and work in process. It is interesting to note a significant negative relation for finished goods in the case of construction sector. It should be noted also that correlation coefficients of gross margin differ between three analyzed sectors. As far as the two periods are considered, the results show stronger negative relations between gross margin and inventory turnover and its components during the crisis period. The control variables, inventory elasticity, capital intensity and firm's size, show a positive relation with the dependent variable. These results show the possibility to create value through profitability in SMEs by minimizing the levels of inventories. It may also imply that higher capital intensity causes greater value and reduction in inventories.

Table 5. Correlation matrix, all SMEs, two periods

	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size
				All SMEs (2003-2007)				
GM	1							
ITR	-.034*	1						
RMTR	-.017*	.476**	1					
WIPTR	-.023	.915**	.012	1				
FGTR	-.097**	.862**	.123**	.028	1			
Ie	.056*	.231*	.034*	.092	.210	1		
CI	.165**	.180**	.008	.089	.182**	.032	1	
Size	.043**	.022*	.003	.203*	.067*	.007*	.108	1
	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size
				All SMEs (2008-2012)				
GM	1							
ITR	-.068*	1						
RMTR	-.090*	.595**	1					
WIPTR	-.107	.918**	.345**	1				
FGTR	.107**	.905**	.266**	.025	1			
Ie	.066*	.167*	.054*	.023	.004*	1		
CI	.153**	.195**	.027	.053	.182**	.048*	1	
Size	.024*	.326**	.213*	.021	.039*	.237	.341*	1

Table 6. Correlation matrix, three sectors, non-crisis period

	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size
				Manufacturing (2003-2007)				
GM	1							
ITR	-.360**	1						
RMTR	-.029	.525**	1					
WIPTR	-.003	.713**	.252*	1				
FGTR	-.396**	.868**	.112**	.285*	1			
Ie	-.210	.201*	.205*	.219*	.230**	1		
CI	.183**	.190*	.006	.144*	.168**	.119*	1	
Size	.005*	.045*	.322	.112*	.034*	.036	.215	1
	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size
				Wholesale and Retail Trade (2003-2007)				
GM	1							
ITR	-.332**	1						
RMTR	-.083	.525**	1					
WIPTR	-.354	.626*		1				
FGTR	.380**	.971**	.175**	.142*	1			
Ie	.028	.009	.007*	.029*	-.102	1		
CI	.040	-.003	.265**	.068*	-.024	-.091	1	
Size	.324*	.045*	.312*	.002**	-.034	.323	.023*	1
	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size
				Construction (2003-2007)				
GM	1							
ITR	-.227*	1						
RMTR	-.228*	.424**	1					

WIPTR	-.032	.945**	.159	1				
FGTR	-.238**	.694**	.011	.311	1			
Ie	.234	.034*	.093*	.034**	.209**	1		
CI	.331**	.140**	.091*	.057**	.069*	-.034	1	
Size	.152*	.126	.091*	.029*	.034	.254*	.002	1
	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size

Table 7. Correlation matrix, three sectors, crisis period

	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size
				Manufacturing (2008-2012)				
GM	1							
ITR	-.270**	1						
RMTR	-.019	.335**	1					
WIPTR	-.004	.443**	.233*	1				
FGTR	-.276**	.156**	.102**	.135*	1			
Ie	-.205	.121*	.165*	.235*	.340**	1		
CI	.083**	.010	.012	.111*	.058**	.123*	1	
Size	.010*	.033*	.242	.211*	.043*	.043	.135	1
	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size
				Wholesale and Retail Trade (2008-2012)				
GM	1							
ITR	-.222**	1						
RMTR	-.073	.345**	1					
WIPTR	-.243	.566*		1				
FGTR	.327**	.873**	.105**	.132	1			
Ie	.017	.018	.010*	.033*	-.101	1		
CI	.130	-.023	.175**	.054*	-.023	-.075	1	
Size	.215*	.043*	.212*	.011**	-.024	.176	.022*	1
	GM	ITR	RMTR	WIPTR	FGTR	Ie	CI	Size
				Construction (2008-2012)				
GM	1							
ITR	-.324*	1						
RMTR	-.158*	.323**	1					
WIPTR	-.042	.795**	.106	1				
FGTR	-.125**	.573**	.012	.213	1			
Ie	.196	.045*	.084*	.129**	.211**	1		
CI	.291**	.132**	.070*	.031**	.065*	-.022	1	
Size	.111*	.145	.074*	.031*	.032	.189*	.010	1

Note: Variables are defined at the beginning of this section. For every pair of variables, the table provides the Pearson's correlation coefficient, t-Statistic (* p-value<0,1; ** p-value<0,05; *** p-value<0,01)

Table 8. Results of Regression Analysis

Independent Variables	Dependent Variable: GM			
	(1)	(2)	(3)	(4)
ITR	-.0027** (-4,14)	-	-	-
RMTR	-	-.0001* (-1,13)	-	-
WIPTR	-	-	-.0017** (-3,19)	-
FGTR	-	-	-	-.0087** (-3,82)
Ie	.0004* (5,14)	.0017** (3,16)	0.012** (5,12)	0.184** (3,14)
CI	.0423** (6.03)	.0211* (7.16)	.0233** (11.00)	.0312* (13.17)
Firms' Controls	Included	Included	Included	Included
Year Controls	Included	Included	Included	Included
Adjusted R^2	0.64	0.83	0.61	0.57
Wu-Hausman Test	0.00	0.00	0.00	0.00

Note: t-values in parentheses

The coefficient of inventory turnover ratio (in days) is negative and statistically significant at least at 5 per cent level of significance, which means that as inventory turnover ratio (in days) is decreasing, the firm's profitability is increasing.

Conclusions and Recommendations

The study is an attempt to examine the inventory management performance of small and medium enterprises in the region of Epirus, in Greece, during the crisis period. The following measures were used in this study: (1) Inventory Turnover Ratio, (2) Raw Material Turnover Ratio, (3) Work in process turnover ratio, (4) Finished Goods Turnover Ratio, (5) Inventory Elasticity, (6) Gross Margin, (7) Capital Intensity, (8) Firm's Size. The ICAP database has been used for collecting the financial data of SMEs sample. The results of the correlation and the regression analysis with GM as dependent variable, show negative relations between inventories and profitability. This indicates that proper inventory management will improve the management efficiency, which translates into profit growth. It may be obtained by increasing the speed of movement of all types of inventories and lowering costs by reducing inventories' components level. On the other hand, the results show that during the crisis period the relations seem to be lower. The main conclusion is that for both periods, we get negative signs, so firms have to implement the same policy in order to minimize inventories' level.

The main limitation of this study is the fact that it is focused on one region of Greece. In order to understand better the impact of financial crisis on Greek SMEs' performance, the research could be extended by including more regions and more years in the crisis period.

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