

Article

Inventory management and firm performance in wholesale and retail trade

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Abstract: Inventory management is an indispensable element of the firm's operational efficiency that determines the results of its activity and its long-term performance. The present study aims to analyze the influence of efficient inventory management on the performance of firms in the Wholesale and Retail trade sector, trying to isolate this relationship in order to bring out as many peculiarities as possible. In order to achieve the aim, fixed effects panel linear regression analysis was undertaken, applying the least squares dummy variables method. The regression models were constructed separately for the dependent variables of Gross Margin and Gross operating surplus as proxies for performance, and separately for the three datasets: Wholesale and Retail trade, Wholesale trade and Retail trade. The results of the analysis reveal the existence of significant relationships between inventory management and firm performance. The significant relationships identified did not confirm the expectations, although were validated by previous results identified in the literature.

Keywords: inventory; inventory management; firm performance; wholesale and retail trade; fixed effects panel linear regression

Classification-JEL: C23, G31, L25, L81

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INTRODUCTION

Operational efficiency has a decisive impact on business results. A key element of this is efficient inventory management, which ensures the availability of the required products at the right time, minimizing costs and maximizing performance. The relationship between inventory management and performance is multidimensional, with many aspects directly or indirectly involved in this relationship.

The purpose of this study is to analyze the influence of efficient inventory management on the performance of the firms operating in the Wholesale and Retail trade sector.

In achieving this aim, no other factors were considered, in order to isolate the impact of the dynamics of efficient inventory management, as Koumanakos (2008) did in a study on the influence of inventory management policies on performance. For the inventory management efficiency the author used two proxy variables focusing on change in stocks of goods and services, in line with the approach of most of the literature on inventory management optimization, which uses the cost minimization criterion (Koumanakos, 2008). At the same time, the author moved away from the commonly used variable in analyses of this kind, Inventory turnover, not only for the sake of originality, but also because some studies consider that this variable should not be used in performance analysis (Gaur, Fisher and Raman, 2005).

On the other hand, the author used two variables as proxies for performance: Gross margin and Gross operating surplus. Both have been used because they are important indicators of performance: both Gross margin (Alan, Gao and Gaur, 2014) and Gross operating income (Deloof, 2003) have important advantages in being used as proxies for profitability, specifically in investigating the relationship between inventory management and performance.

The author's focus on the trade sector is due to the extraordinary importance of inventories specifically in this sector, but also to the reduced complexity of the relationship between inventory management and firm performance compared to firms from the manufacturing sector (Marzolf, Miller and Peinkofer, 2024). The importance of inventories in retailing, for example, could be reflected in the fact that, on average, more than one-third of all assets and more than half of current assets of retailers are represented by inventories (Gaur et al., 2005).

The results of this analysis will advance the understanding of how inventory management influences firm performance, what peculiarities exist in the application of different performance

indicators, and also in the approach to the Wholesale trade and Retail trade sectors, as well as the Trade sector in general.

The paper continues with a brief literature review section, followed by the section on methodological issues and the section on research results. Finally, conclusions are presented, followed by limitations and future research directions.

LITERATURE REVIEW

The influence of inventory management on firm performance is a frequently addressed topic in the literature and, what is equally important, it does not lose its topicality over time. At the same time, this topic is also of major interest to the members of the operational management community (Gaur et al., 2005), due to multiple obvious reasons, including the importance that investors attach to performance indicators (Lee, 2022). The main reason is, of course, the major influence that inventory management efficiency has on firm performance. In this context, the basic principle applied in the literature is cost minimization and profit maximization: minimizing inventories in order to optimize the related costs and achieve performance growth (Koumanakos, 2008). However, this relationship is not so simple. The goal is to avoid overstocking, but at the same time to avoid out-of-stock. Both situations have negative connotations for the firm in terms of costs and financial performance. Therefore, the aim is to minimize inventory, but within the limits given by the economic efficiency of the activity.

Ali et al. (2022) mention a study that identified the existence of significant relationship between inventory management practices and firms' financial performance. As expected, high inventory levels are associated with poor firm financial performance (Boute et al., 2006; Koumanakos, 2008), while low inventory levels have a strong positive relationship with firm performance (Koumanakos, 2008), although this is not significant for all industries analyzed.

In analyzing the relationship between efficient inventory management and performance, the latter is frequently represented by Gross margin. On the other hand, the relationship between inventories and Gross margin is a relationship of interest to researchers as such. Some authors believe that Gross margin is a suitable indicator for investigating this relationship due to the fact that it does not include fixed costs, amortization, taxes and other items not directly associated with inventory management (Rumyantsev and Netessine, 2007), while others

highlight with the importance of margins for investors (Lee, 2022).

The relationship between inventories and Gross margin can be both direct and indirect (Gaur et al., 2005). The direct connection is given by the fact that Gross margin has a decisive impact on the optimal service level (a basic indicator in inventory management), while the indirect connection manifests itself through factors such as price and product life cycle, which influence both Gross margin and inventory turnover (Gaur et al., 2005). In a study on the retail sector, Alan et al. (2014) use Gross margin as a proxy for firm profitability and identify a negative correlation with inventory turnover, which is to be expected, other studies confirming this relationship (Gaur et al., 2005). Increasing inventory turnover is usually associated with decreasing inventory levels, consequently low inventory levels are associated with increasing Gross margin (Gaur et al., 2005). At the same time, practice shows that excessive and rapid reduction in inventory levels can lead to a reduction in margin indicators (Nassauer, 2022). Moreover, Rumyantsev and Netessine (2007) identify a positive relationship between inventory level and Gross margin. This relationship is accompanied by factors, such as uncertain demand and longer lead times, but manifests itself to a lesser extent in large firms due to economies of scale.

Another important performance indicator is Gross operating income, which is also commonly addressed in the context of the relationship with inventory management. It is mentioned in this sense by Koumanakos (2008), why Deloof (2003) uses it as a proxy for measuring profitability. The latter author applies it in a relationship in which inventories are represented by the Days in inventory indicator and identifies a significant negative relationship between the variables: reducing the number of Days in inventory increases the profitability of the firm (Deloof, 2003). In the context of the present study, this conclusion could be reformulated: reducing the level of inventories positively influences Gross operating income. However, it should also be noted in this context that Ali et al. (2022) did not find a significant relationship between Inventory Turnover and Operating Profits.

The present study addresses the relationship between efficient inventory management and firm performance for the Wholesale and Retail trade sector, for this reason it is important to mention the positioning of the literature in this regard. It was already mentioned that the main reason of this positioning is the extraordinary role of inventory management in the performance of firms in this

sector compared to the manufacturing sector. Manufacturing processes lead to a greater variety of inventories and an increased complexity in the relationships between inventories and firm performance (Marzolf et al., 2024). Instead, firms in trade do not process the products they source in a substantial way, which reduces some of the dynamism associated with the variability of inventory types in production sector (Marzolf et al., 2024). This aspect also favors the use of aggregate data. Regarding the retail sector, the topic of inventory management is of major importance for both wholesale and retail firms (Lee, 2022; Nassauer, 2022), with efficient inventory management being essential for both (Marzolf et al., 2024).

At the same time, it should also be mentioned that there is a predominant interest in the literature for studies on inventory management specifically in the retail sector, as opposed to the wholesale sector (Marzolf et al., 2024). Even in an already mentioned study focusing on the relationship between Inventory Turnover and Gross margin, the authors focus on firms in the Retail trade sector (Alan et al., 2014). Gaur et al. (2005) also explicitly mention that retailers pay increased attention to inventory productivity and are constantly looking to improve their inventory management processes and systems with the aim of reducing inventory levels. All these aspects have influenced and led the author to develop the research design as it is presented below.

METHODOLOGY

For the analysis the author used secondary data aggregated at the country level for firms in the Wholesale and Retail trade sector, as well as separately for the two subsectors. The use of aggregate data is supported both by the literature (Rajagopalan and Malhotra, 2001) and by the specifics of the Wholesale and retail trade sector, mentioned in the previous section. The Annual detailed enterprise statistics for trade database provided by Eurostat (European Commission, 2024) was used as the data source. After taking into account the availability of data for the chosen variables by countries and years, a dataset covering 26 countries and 13 years (2008-2020) was obtained. The use of panel data in the context of analyzing the relationships between inventory management and performance is in line with the situation reflected in the literature and is advantageous in the context of this study as it allows controlling for the influence of country-specific and time-specific factors that

cannot be observed (Gaur et al., 2005; Alan et al., 2014).

The variables used in the analysis, explanations and data sources are presented in Table 1. Two variables related to Change in stocks of goods and services were used as proxies for inventory management efficiency, while Gross margin on goods for resale and Gross operating surplus were used as proxies for firm performance.

Fixed effects panel linear regression was used to analyze the impact of inventory management efficiency on firm performance. The least squares dummy variables (LSDV) method was applied for regression analysis. The use of fixed effects (DeLoof, 2003), panel (Alan et al., 2014), linear regression (Koumanakos, 2008) is also in accordance with the literature.

RESULTS

Regression models were constructed separately for the dependent variables of Gross Margin and Gross operating surplus as proxies for performance, and separately for the three datasets: Wholesale and Retail trade, Wholesale trade and Retail trade.

Table 2 reflects the regression model for the impact of efficient inventory management on Gross margin of Wholesale and Retail Trade companies. This model demonstrates a high predictive power, with R Squared being 0.967 (0.964 after adjustment), which is largely explained by the use of panel data. It should also be mentioned that only one of the two independent variables has a significant positive impact on performance: Change in stocks of goods and services purchased for resale in the same condition as received has a significant positive impact on Gross margin. This positive relationship should be interpreted carefully: Change in stocks is an indicator of inventory management efficiency with a “minus” (it could be even called „inefficiency”), meaning that for inventory management to be efficient, inventory must decrease. What this result actually represents is that an increase in stocks of goods and services (an indicator of (in)efficiency) is associated with an increase in performance. At the same time, for the general variable, Change in stocks of goods and services, no significant relationship was identified.

When focusing only on the Wholesale trade sector (Table 3), it can be observed that the model also appears to be very strong: about 95% of the Gross margin variance is explained by the independent variables. The problem is that this is provided by time-specific and country-specific factors, while the

variables focused on stock management efficiency do not have a significant influence on performance. Regarding the Retail trade sector (Table 4), the influence of the predictors on the dependent variable remains very high: the R Squared is 0.969 and the Adjusted R Squared is 0.966. Also, here again, a significant relationship between (inefficient) inventory management and performance is demonstrated: the same variable, Change in stocks of goods and services purchased for resale in the same condition as received has a significant positive influence on Gross Margin.

The results of the development of models in which the dependent variable is given by Gross margin as a proxy for firms' performance revealed that only Change in stocks meant for resale in the same condition as received has a statistically significant relationship with it. Once the dependent variable was replaced by Gross operating surplus the situation changed.

Out of the three models related to the three sector data sets (Wholesale + Retail, Wholesale and Retail) only one identifies a significant relationship between a variable related to efficient inventory management and firm performance and, this time, it is the other variable (Table 5). In the context of the analysis of the Wholesale and Retail trade sector, a model with a high predictive power, comparable to the previous ones, has been found: 96.5% of the variance of the Gross operating surplus is explained by the predictors. Among the variables focused on inventory management, only ZChangeStocks1 (Change in stocks of goods and services) has a significant positive impact (close to the limit, given the Sig. value of 0.046) on the performance represented by Gross operating surplus. On the other hand, Change in stocks purchased for resale in the same condition as received does not register, this time, a significant relationship with the dependent variable. The models developed separately for the Wholesale (Table 6) and Retail trade (Table 7) sectors do not show any significant influence of changes in inventory level on performance when the latter is represented by Gross operating surplus. Also, it should be mentioned that these models are characterized, as the previous ones, by very high R Squared values (0.946 and 0.943, respectively), which suggests high predictive power and characterizes them as strong ones.

CONCLUSION

The analysis conducted revealed important issues related to the relationship between inventory management and firm performance. Firstly,

significant relationships identified between efficient inventory management and variables representing performance were not as expected, even though they follow the literature and can be logically explained as well.

It could be stated that models with the dependent variable of Gross margin have better results in terms of statistical significance. A significant influence of Change in stocks of goods and services purchased for resale in the same condition as received on firm performance was identified in the case of Wholesale and Retail trade and Retail trade. In other words, the increase in the level of inventory purchased for resale in the same condition influences the growth of the firms' Gross margin. This result seems counterintuitive if one would interpret decreasing inventory levels as an indicator of inventory management efficiency. At the same time, these results are consistent with some results in the literature (Rumyantsev and Netessine, 2007; Nassauer, 2022). This might be due to the intervention of factors, such as uncertain demand and longer lead times (Rumyantsev and Netessine, 2007), which the author did not take into account. Another explanation could be the lack of any change in inventory management efficiency; under these conditions it could be the case of extensive increase in firm performance associated with a corresponding increase in inventories. The statistical significance only of the Change in stocks of goods and services purchased for resale in the same condition out of the two proxy variables for efficient inventory management can be explained by the major importance of these inventories in the trade sector.

In models with the variable of Gross operating surplus as proxy for performance, the same type of significant relationship was identified for the influence of Change in stocks of goods and services on the dependent variable for firms in the entire Wholesale and retail trade sector. Thus, the increase in the overall level of inventory influences the increase in the performance of firms measured by Gross operating surplus. While interpreting this relationship in terms of the positive association of inventory level with firm performance, one could state that the results are consistent with those obtained by Rumyantsev and Netessine (2007). On the other hand, two out of three models with the dependent variable of Gross operating surplus did not show any significant relationships along the lines of inventory management - performance, which is consistent with the results of Ali et al. (2022). One could observe a stronger relationship between Change in stocks purchased for resale in the same condition and Gross margin on the one hand, and Change in stocks (overall) and Gross operating

surplus on the other hand as a result of the analysis performed.

It should also be emphasized that none of the separately constructed models for the Wholesale sector identified significant relationships between the efficient inventory management variables and the performance variables. It could be that a more complex situation regarding these relationships in the Wholesale sector firms, associated with unidentified influencing factors, could represent one of the reasons why the literature prefers to analyze the Retail trade sector (Marzolf et al., 2024).

The fixed effects panel linear regression models that have been developed have high predictive power, with R Square value above 0.9. This also suggests that country-specific or time-specific factors are responsible for a large part of the fluctuation of performance indicators.

These results complement the state of knowledge in the literature, contradicting some claims but confirming other ones. This study confirms the existence of significant relationships between inventory management and the performance of firms in the Wholesale and Retail trade sectors. It contributes to the awareness of the complexity of these relationships and the need for future research to further clarify them.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The limitations of this study come from the attempt to isolate the influence of inventory management on performance, a relationship in which, of course, there is a multitude of factors of different nature, which have not been taken into account. Another limitation is the aggregate data used in the analysis, which does not allow a more detailed approach to the subject.

Future research could consider broadening the range of factors included in the analysis, the use of more detailed datasets, even at the firm-level, but also the analysis of the dynamics of indicators related to inventory management within firms.

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LIST OF TABLES

Table 1
Variables used in regression models

No.	Variable	Description	Source of data
1.	ZChangeStocks1	Wholesale and retail trade; standardized change in stocks of goods and services	European Commission (2024)
2.	ZWSChangeStocks1	Wholesale trade; standardized change in stocks of goods and services	European Commission (2024)
3.	ZRChangeStocks1	Retail trade; standardized change in stocks of goods and services	European Commission (2024)
4.	ZChangeStocks2	Wholesale and retail trade; standardized change in stocks of goods and services purchased for resale in the same condition as received	European Commission (2024)
5.	ZWSChangeStocks2	Wholesale trade; standardized change in stocks of goods and services purchased for resale in the same condition as received	European Commission (2024)
6.	ZRChangeStocks2	Retail trade; standardized change in stocks of goods and services purchased for resale in the same condition as received	European Commission (2024)
7.	ZGrossMargin	Wholesale and retail trade; standardized gross margin on goods for resale	European Commission (2024)
8.	ZWSGrossMargin	Wholesale trade; standardized gross margin on goods for resale	European Commission (2024)
9.	ZRGrossMargin	Retail trade; standardized gross margin on goods for resale	European Commission (2024)
10.	ZGrossOSurplus	Wholesale and retail trade; standardized gross operating surplus	European Commission (2024)
11.	ZWSGrossOSurplus	Wholesale trade; standardized gross operating surplus	European Commission (2024)
12.	ZRGrossOSurplus	Retail trade; standardized gross operating surplus	European Commission (2024)

Source: author's elaboration

Table 2
Regression model for the impact of inventory management efficiency on Gross margin in companies within Wholesale and Retail trade sector

Model	R Squared	Adjusted R Squared	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.967	0.964	319.221	27	11.823	320.715	0.000
Parameter	B		Std. Error	t	Sig.		
(Constant)	0.199		0.054	3.677	0.000		
ZChangeStocks1	-0.012		0.015	-0.830	0.407		
ZChangeStocks2	0.046		0.017	2.653	0.008		

Source: author's calculations.

Note. Dependent variable: ZGrossMargin

Table 3

Regression model for the impact of inventory management efficiency on Gross margin in companies within Wholesale trade sector

Model	R Squared	Adjusted R Squared	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.946	0.941	318.833	27	11.809	201.499	0.000
Parameter	B		Std. Error	t	Sig.		
(Constant)	0.380		0.069	5.485	0.000		
ZWSChangeStocks1	-0.028		0.024	-1.198	0.232		
ZWSChangeStocks2	0.037		0.026	1.430	0.154		

Source: author's calculations.

Note. Dependent variable: ZGrossMargin

Table 4

Regression model for the impact of inventory management efficiency on Gross margin in companies within Retail trade sector

Model	R Squared	Adjusted R Squared	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.969	0.966	326.484	27	12.092	356.475	0.000
Parameter	B		Std. Error	t	Sig.		
(Constant)	0.037		0.051	0.719	0.473		
ZRChangeStocks1	0.002		0.012	0.158	0.874		
ZRChangeStocks2	0.037		0.013	2.903	0.004		

Source: author's calculations.

Note. Dependent variable: ZGrossMargin

Table 5

Regression model for the impact of inventory management efficiency on Gross operating surplus in companies within Wholesale and Retail trade sector

Model	R Squared	Adjusted R Squared	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.965	0.961	322.510	27	11.945	304.175	0.000
Parameter	B		Std. Error	t	Sig.		
(Constant)	0.129		0.056	2.308	0.022		
ZChangeStocks1	0.031		0.015	2.003	0.046		
ZChangeStocks2	-0.026		0.017	-1.495	0.136		

Source: author's calculations.

Note. Dependent variable: ZGrossOSurplus

Table 6

Regression model for the impact of inventory management efficiency on Gross operating surplus in companies within Wholesale trade sector

Model	R Squared	Adjusted R Squared	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.946	0.942	318.867	27	11.810	201.905	0.000
Parameter	B		Std. Error	t	Sig.		
(Constant)	0.117		0.069	1.691	0.092		
ZWSChangeStocks1	0.027		0.024	1.159	0.248		
ZWSChangeStocks2	-0.023		0.026	-0.885	0.377		

Source: author's calculations.

Note. Dependent variable: ZGrossOSurplus

Table 7

Regression model for the impact of inventory management efficiency on Gross operating surplus in companies within Retail trade sector

Model	R Squared	Adjusted R Squared	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.943	0.938	317.844	27	11.772	190.501	0.000
Parameter	B		Std. Error	t	Sig.		
(Constant)	0.096		0.069	1.398	0.163		
ZRChangeStocks1	0.020		0.016	1.308	0.192		
ZRChangeStocks2	-0.022		0.017	-1.249	0.213		

Source: author's calculations.

Note. Dependent variable: ZGrossOSurplus