Inventory management and performance of Brazilian firms listed on B3

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Abstract

Objective: Decisions concerning inventory management involve a trade-off in which firms must choose between keeping high inventory levels, thus decreasing the risk of product shortage, or keeping low inventory levels and applying excess cash in other investments. Therefore, this paper addresses the relationship between inventory management and performance.

Method: This sample is composed of non-financial firms listed on Brazil's stock exchange operator B3, from 2010 to 2018. Because inventory is not relevant for all the companies included in the initial sample, we applied a procedure using simple linear regression to refine the sample. Only firms with a significant relationship between inventory and sales continued in the sample. A quantitative approach based on regression analysis was used to test the research assumptions.

Results: The results of the model that considers performance measuring from the perspective of aggregate value show no relationship between inventory and performance. Robustness was verified using ROA to measure performance from the perspective of profitability. We found an inverted U relationship between profitability, the net trade cycle, and its square. That is, we found a non-linear relationship between the variables, corroborating the idea that there is an optimal level between inventory and profitability.

Contributions: As far as we know, this is the first study investigating whether there is a point of inflection of inventory management and performance among Brazilian firms. The results present relevant and practical guidelines for Brazilian firms and researchers addressing performance related to the net trade cycle, as they suggest that Brazilian shareholders are not concerned with internal factors such as inventory management, but rather with whether a firm is being profitably managed.

Keywords: Inventory Management, Performance, Point of Inflection.

1. Introduction

Inventories are assets that make up the largest volume of short-term investments both in industry and retail firms. Decisions concerning inventory management are complex because excess cash invested in inventory overwhelms firms with high maintenance and opportunity costs. High inventory levels, on the other hand, may increase sales revenues as costumers enjoy more flexibility in making purchasing decisions, decreasing the risk of going out of stock (Deloof, 2003). Therefore, efficient inventory management influences a firm's operational efficiency in seeking lower storage costs and greater costumer loyalty.

Taking into account the dynamics of a firm's investment decisions, much has been discussed about the trade-off between investing in an asset and its impact on performance. Companies expect to maximize their utility through inventory management frameworks that enable profitable options between different classes of assets. When dealing with inventory management, one should bear in mind the costs and variables that might influence investment in terms of acquisition, handling and sales. Thus, choosing between technology and outsourcing may be a strategic decision that changes little in the long term (Chauhan, 2019).

Based on these assumptions, Baños-Caballero, García-Teruel, and Martínez-Solano (2014) suggest the existence of an inflection point of inventory and performance. This implies the existence of an optimal level of investment in working capital, which balances costs and benefits and maximizes a firm's value. According to Kieschnick, Laplante, and Moussawi (2013), the expectation of future sales significantly influences working capital management. As a result, companies are concerned with the possibility of product shortage. As shown in Corsten and Gruen (2004), up to 43% of costumers are likely to opt for another store when products are lacking.

Baños-Caballero et al. (2014) note that the assessment of inventories should take into account not only indexes that measure its turnover. Credit policies available to costumers and from suppliers are important as well. Therefore, this study addresses inventory management considering the net trade cycle (NTC). In this context, we attempt to verify how a trade-off in terms of inventory management affects firms. What is the difference between keeping high inventory levels and decreasing the risk of stock-outs, or keeping low inventory levels and applying excess cash in other investments? This paper's objective is to assess the effects of inventory management on the performance of Brazilian firms and identify an inflection point in the net trade cycle of these firms.

The sample is composed of non-financial Brazilian firms listed on B3 from 2010 to 2018. Because inventory may not be a relevant factor in the revenues of all the companies included in the initial sample, simple linear regression was performed to refine the sample to keep only those firms with a significant relationship between inventory and sales. To test the research assumptions, we used a quantitative approach based on regression analysis. The results show that, from a profitability perspective, there is an inverted U relationship between profitability, the net trade cycle, and its square. This means that a non-linear relationship exists between the variables, corroborating the idea of an optimal level of inventory and performance.

These findings present relevant practical guidelines for Brazilian firms and researchers investigating performance concerning the net trade cycle. First, Brazilian shareholders are not concerned with internal factors such as inventory management, but rather with whether a company is being profitably managed. Second, there is evidence of a non-linear effect of inventory management on performance, which corroborates the idea that there is an optimal level between inventory and performance. Third, we present a statistical tool to select relevant firms for this study to avoid selection bias. Inventory is an asset that represents a relevant amount of short-term investments. This justifies an investigation about the ideal level of investment in inventory, performance and the creation of value, as it may improve our knowledge of whether there is an ideal level of inventory. Finally, robustness tests were performed to decompose the sample and variables, together with the generalized method of moments to deal with endogeneity issues.

The remainder of the paper is organized as follows: the second section presents the theoretical framework; the third describes the method and sample; the fourth section discusses the results, and the last section presents the final considerations, as well as limitations and suggestions for future studies.

2. Theoretical framework

2.1 Working capital management

Companies exist in an uncertain context in which working capital management plays a key role in maintaining their financial health during the normal course of business (Scherr, 1989). A firm may choose to allocate its working capital strategically and follow specific business models appropriate to its comparative advantages such as a firm's control over its resources, including management, or the adoption of a specific technology in its specific sector (Chauhan, 2019). Therefore, efficient working capital management is an essential part of the overall strategy of any firm to create value for its shareholders (Almeida & Eid Jr, 2014). As stated by Schiff and Lieber (1974), both production and credit terms may change over time due to seasonal changes in the demand curve and the establishment of rules to respond to that demand. Acknowledging the interface between credit and inventory management results in improved decision-making.

Companies subject to seasonal demand should be able to respond to expected demand deviations. Operational responses available include a change in prices, implementing extra capacity to change the rate of production, and establishing customer or product queues (Emery, 1987). Companies facing a process of seeking resources for investment may adopt an aggressive working capital policy, pressing for lower inventory levels and decreasing customer credit policies (Palombini & Nakamura, 2012). Investment in accounts receivable and inventories represents a considerable part of corporate assets, while commercial credit is an important source of resources for many companies (Baños-Caballero et al., 2014).

Deloof (2003) notes that many firms have a large amount of money invested in working capital, and the way these resources are managed has a considerable impact on companies' performance. With large amounts invested in working capital, the management of these assets is expected to affect the performance of companies considerably, and as a result, companies strive to obtain optimal working capital, paying their bills as late as possible, delivering products quickly and collecting accounts receivable. This inflection point, however, may vary according to conditions (Enqvist, Graham, & Nikkinen, 2013), and the impact of the institutional context on the net working capital depends on its current level (Baños-Caballero, García-Teruel, & Martínez-Solano, 2019).

A complete measure of the net trade cycle that considers accounts receivable and inventory turnover measure in the concept of operating cycle is a more appropriate way to represent liquidity management compared to indicators of current liquidity or acid test ratio. Accounts receivable, inventory and accounts payable are the main components of a company's operating working capital. The ability of its financial manager to deal with these variables optimally (Prasad, Narayanasamy, Paul, Chattopadhyay, & Saravanan, 2019) determines the success of a firm. Entrepreneurs should choose between profitability goals and risk control. Working capital management is extremely important for firms with restricted access to capital, but also when firms are expanding their investments in times of economic recovery (Le, 2019). Kieschnick et al. (2013) add that the net trade cycle does not only concern cash management but also net operating capital management, thereby, accounts receivable, inventory and use of commercial credit.

2.2 Inventory management and performance

Inventory management is one of the oldest concerns addressed in management studies. Companies must adjust price and production processes according to seasonal markets and put up products for sale (Scherr, 1989). Inventory management means understanding the context of business and making decisions that balance current demand with future needs while maintaining overhead and operating costs at a minimum. An inventory includes a firm's raw material, processing products, inputs used in its operations, and finished goods (Muller, 2011). The availability of cash flow may favor companies, improving their performance, extending credit to costumers, increasing inventory in stock and paying in advance to obtain cash discounts (Afrifa & Tingbani, 2018).

According to Deloof (2003), shareholder value can be created by decreasing the number of days accounts receivable and keeping inventories to a reasonable minimum, while the negative relationship between accounts payable and performance is consistent with the view that less profitable companies wait longer to pay their bills. Excessive and unnecessary investment in inventory and accounts receivable may not benefit a company and may result in low cash flow. Efficient management, however, may minimize investment in inventory and accounts receivable and improve cash flow. Consequently, efficient working capital management improves internal financing sources to decrease external debt. Short-term loans are subject to more frequent monitoring on the part of creditors. More frequent monitoring, then, may decrease information asymmetry and refinancing risks (Gill, Amiraslany, Obradovich, & Mathur, 2019).

According to Costa, Macedo, Câmara, and Batista (2013), the net trade cycle represents the period in which a firm will effectively demand financing for its activities. This cycle measures cash flow, covering all its payments and receivables. The day sales outstanding, day sales of inventory, and days payable outstanding respectively represent the ratio between the number of accounts receivable and sales in days, between inventory and sales in days, and between accounts payable and sales in days. The following formula is used to calculate this index:

$$NTC = DSO + DSI - DPO \qquad (1)$$

Where: NTC = Net trade cycle; DSO=Day sales outstanding; DSI = Day sales of inventory; DPO = Days payable outstanding.

Baños-Caballero et al. (2014) report an inverted U relationship between firms' working capital and performance. The authors suggest that an optimal level of investment in inventory and credit balances costs and benefits and maximizes performance. A firm may choose to keep very low inventory levels due to the adoption of technology that permits just-in-time production. Another firm in the same industry may choose to outsource its production and work with minimum fixed assets, keeping its stock of finished products as a guarantee. Choosing between technology and outsourcing may be a strategic consideration that changes little over time (Chauhan, 2019). Therefore, firms should attempt to keep their inventory levels as close as possible to this point to avoid a shortage of products and loss of performance.

The trade-off in terms of inventory management affects companies, however, whether a firm should keep high inventory levels and decrease the risk of a shortage of products, or keep inventories low and apply excess cash in other investments is not a direct concern of shareholders. As stated by Jensen and Meckling (1976), shareholders are rather concerned about how firms behave, that is, with whether the value of a firm increases in the long run. Additionally, even if there is an ideal working capital level, companies in emerging markets may not be able to achieve that level given financial or managerial constraints (Chauhan & Banerjee, 2018). Therefore, the following hypothesis is proposed:

H0: There is no relationship between inventory and performance

Inventories' main role is to buffer firms against uncertainties. Hence, a company keeps inventory to cope with uncertainties concerning market demand and, according to Baños-Caballero et al. (2014), high inventory levels may decrease supply costs and price fluctuations and prevent product shortages. The idea of special orders of missing items with no additional cost to costumers, assuming there will be increased sales and decreased inventory shortage, may increase profitability. Greater variability in demand when manufacturers have additional pricing flexibility may be favorable (Gupta, Gurnani, & Chen, 2010). Higher inventory levels protect firms from adversities related to inputs' price fluctuations and minimize the loss of sales due to a potential shortage of products in stock (Panda & Nanda, 2018).

There is, however, a downside to the decision to keep high inventory levels. The reason is that high inventory levels prevent the adoption of technology that would enable a company to produce just in time and decrease costs (Chauhan, 2019). Additionally, excessive inventory decreases a company's ability to respond to a constantly changing market, possibly harming sales (Kim & Kim, 2016). Higher levels of working capital indicate a need for additional capital that involves financial and opportunity costs; high levels of capital also represent greater expenses with interest as a result, and therefore, greater credit risk (Kieschnick, LaPlante, & Moussawi, 2006). Additionally, keeping high levels of working capital means that money is committed with short-term activities (Deloof, 2003), that is, large investments with working capital may also harm a company's ability to work with other projects that aggregate value.

Verifying this trade-off between investing or not in short-term assets and the performance of Brazilian firms means that an inflection point of inventory and performance exists. Decisions related to inventory management are complex, considering that excess money invested in inventory overwhelms firms with high maintenance and opportunity costs. High inventory levels, however, help increase sales as clients have more flexibility to make purchasing decisions and firms decrease the risk of a shortage of products for sales. Based on these assumptions, the following hypotheses were established:

H1: There is a positive relationship between lower inventory levels and performance.

H2: There is a negative relationship between higher inventory levels and performance.

3. Method

3.1 Sample and data

This study's sample is composed of Brazilian companies listed on B3 between 2010 and 2018. All companies active any time during the study period were considered for inclusion to avoid selection bias, also known as survival bias. Data were imported from the Economática database. This period was chosen because 2010 was when Brazilian companies started adopting the International Financial Reporting Standards (IFRS). Additionally, this study only considered non-financial companies given the accounting and financial characteristics inherent to financial firms, while accounting values were deflated according to the *Índice Preços ao Consumidor Amplo* (IPCA) [Extended National Consumer Price Index]. The values were deflated due to changes in the general price level during the period. Uncorrected numbers are misleading as they give the wrong impression of a real increase in the stock market.

Previous studies (Elsayed & Wahba, 2016; Gill et al., 2019; Kroes & Manikas, 2014; Shah & Shin, 2007) addressing the inventory and performance issue assign different degrees of importance to a sector's specific environment. Hence, this study refined the sample to include only companies that present a significant relationship between inventory and revenue. This approach leads to more precise results on how a company's performance may be affected by its inventory level. The reason is that there are companies, or even sectors, such as Software and Programming, in which inventories are not important for revenues.

A statistical procedure was applied to maintain this separation. Simple linear regression was used between total sales and inventory to determine which companies had significant levels of inventory over their sales considering a level of significance at 10%. The initial sample consisted of non-financial companies and, after applying the technique, the sample was restricted to those companies with a significant relationship between inventory and operation, in which 1,050 observations were identified. Table 1 presents a detailed summary of the data collected from this sample and the refining process.

Table 1
Sample summary

	Period								
	2010	2011	2012	2013	2014	2015	2016	2017	2018
Firms	436	438	431	428	420	406	403	396	386
Financial firms	(36)	(39)	(39)	(39)	(40)	(39)	(37)	(35)	(35)
Non-financial firms	400	396	392	389	380	367	366	361	351
Inventory-related firms	128	132	135	129	124	121	124	121	118

Note: Detailed summary of sample data collection and refinement process. Data provided by Economática.

3.2 Definition of variables

This paper is based on the study of Baños-Caballero et al. (2014), which addresses the relationship between inventory management and performance of Brazilian non-financial companies. The net trade cycle (NTC) is considered as an explanatory variable. NTC corresponds to the number of day sales outstanding plus day sales of inventory minus days payables outstanding. According to the study used to ground this paper, inventory assessment should not be seen only from the perspective of indexes that measure its turnover, but credit policies available to costumers and from suppliers should also be taken into account.

The model-dependent variable is Performance (PERF), which is the ratio of market value equity and the book value of debt and the book value of assets and is used in previous studies addressing the relationship between net trade cycle and performance (Baños-Caballero et al., 2014; Kieschnick et al., 2013).

Four additional control variables were added to ensure a better fit of the model, namely:

(a) Size of the company (SIZE): the size of a company may influence its working capital management. Larger companies may demand higher investments in working capital given higher levels of sales, and also because of their size, these firms may be able to establish relationships with suppliers, which are important to decrease investments in working capital (Kieschnick et al., 2006). In this study, the firms' sizes were calculated using the logarithm of total assets.

(b) Leverage (LEV): the degree of debt influences decisions related to inventory management. Gill, Biger, and Mathur (2010) present a significant negative relationship with performance, which means that the higher a firm's leverage, the worst its performance. In this study, leverage was calculated by the ratio between total debt and total assets.

(c) Profitability (PROFIT): profitability is measured using gross operating profit, defined as sales minus cash cost of sold products and is divided by the total assets minus financial assets (Deloof, 2003). In this study, PROFIT refers to the operating profit on total assets

(d) Growth opportunity (GROW): in this study, the growth opportunity is measured by the ratio of the book value of intangibles, assets, and total assets, as reported in Baños-Caballero et al. (2014). This variable shows investment in assets that provide new sources of growth.

The variables used in this study are represented in Table 2:

Table 2
Summary of variables

Variables	Acronym	Definition	Expected Signal	Base Studies[a]
Explanatory Variable				
Net trade cycle	NTC	Sum of days sales outstanding, day sales of inventory and days payable outstanding	(+) (-)	(1) (6)
Dependent Variable				
Performance	PERF	Ratio of the sum of the market value of equity and the book value of debt to the book value of assets		(1) (2) (7)
Control Variables				
Firm Size	SIZE	Natural logarithm of sales	(+)	(1) (2) (3) (4)
Leverage	LEV	Ratio of total debt to total assets	(-)	(1) (3)
Profitability	PROF	Return on assets	(+)	(1) (4)
Growth Opportunities	GROW	Book value of intangible assets to total assets	(+)	(1)

Note: (a) Underlying studies: (1) Baños-Caballero et al. (2014); (2) Kieschnick et al. (2013); (3) Palombini & Nakamura (2012); (4) Deloof (2003); (5) Afza & Sajid (2008); (6) Shin and Soenen (1998); (7) Almeida & Eid Jr (2014).

3.3 Technical analysis model

This study's data were treated in Stata using Multiple Regression and panel data, which according to Wooldrige (2016) simultaneously analyzes variations of individual units over time. The following multiple regression model was proposed to test non-linearity of inventory behavior with performance and its significance among non-financial Brazilian companies listed on B3:

$$PERF_{i,t} = \beta_0 + \beta_1 NTC_{i,t} + \beta_2 NTC_{i,t}^2 + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 ROA_{i,t} + \beta_6 GROW_{i,t} + \sum_{j}^{j-1} \beta_j YEAR + \varepsilon_{it} \quad (2)$$

Tests were performed for this regression model to verify the best model to be used and also to detect and treat the presence of outliers, multicollinearity, heteroscedasticity, and autocorrelation. Additionally, NTC square was included to show the influence of NTC non-linearity on performance, following the approach of Baños-Caballero et al. (2014). We also used the generalized moment method to deal with endogeneity issues based on the estimator proposed by Arellano and Bond (1991).

Therefore, it is possible to determine the inflection point of performance using the net trade cycle coefficients, which is calculated according to the formula:

$$Turning\ point = -\beta1/2\beta2 \qquad (3)$$

Where: $\beta1$ is the coefficient of a variable in the linear form and $\beta2$ is the coefficient in the square form. The point of inflection is a point in the curve where the sign of curvature changes and, in this case, the optimal size of the inventory. In this stage, a different relationship of signs between the first and second angular coefficient is expected, following a non-linear approach that represents the presence of an inflection point of inventory and performance.

4. Results

This section presents a discussion of the results. The objective is to show the relationship between inventory management and performance. We intend to verify the existence of a non-linear relationship between variables, due to the existence of an inflection point in this relationship. Finally, this paper presents an analysis of results concerning verification of robustness. Data in this study were obtained from the Económática database and the sample corresponds to non-financial Brazilian firms listed on B3 from 2010 to 2018. Outliers were treated with the winsorization technique at 0.05 in each tail.

4.1 Descriptive statistics

Before analyzing the results, we present descriptive data, showing the composition of data in the proposed model. Table 3 presents the number of observations, mean, standard deviation, maximum and minimum, and some descriptive statistics in the regression model, which show that the average performance is 0.98%, with an average net trade cycle of 104.43 days.

Table 3

Descriptive statistics

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
PERF	1,194	0.9829984	1.19344	-.2577339	24.18373
NTC	1,143	104.4276	138.0656	-391.6232	531.4668
SIZE	1,412	21.04444	2.217196	10.52451	26.79697
LEV	1,442	0.3340592	0.3235645	0	7.009169
PROF	1,441	0.6208512	22.83619	-10.35011	866.7535
GROW	1,252	0.2397398	4.749309	-3.727607	121.8832

Notes: Variables: PERF – Performance; NTC – Net trade cycle; SIZE – Logarithm of sales; LEV- Leverage; PROF – Profitability; GROW – Growth Opportunities.

Table 4 presents the correlation matrix of the proposed model. Data show that variables have a low mutual correlation (all below 0.5), which corresponds to a good endogeneity index and autocorrelation of regressors. Additionally, VIF was used to check for multicollinearity between the variables. The mean VIF in the model was 3.20, which shows that there is no multicollinearity problem.

Table 4

Correlation Matrix

	PERF	NTC	SIZE	LEV	PROF	GROW
PERF	1.0000					
NTC	-0.1785***	1.0000				
SIZE	0.1640***	-0.2287***	1.0000			
LEV	-0.0136	-0.0223	0.1410***	1.0000		
PROF	0.4339***	-0.2264***	0.3511***	-0.0806***	1.0000	
GROW	0.1430***	-0.2384***	0.2852***	0.0236	0.3668***	1.0000

Notes: Variables: PERF – Performance; NTC – Net trade cycle; SIZE – Logarithm of sales; LEV- Leverage; PROF – Profitability; GROW – Growth Opportunities.
*, **, *** Significant at 10%, 5% and 1%, respectively.

4.2 Effects of net trade cycle on the performance of aggregate value

Non-linear regression with fixed effects was used to check the relationship between performance and net trade cycle. This model was chosen based on the tests proposed in the method section and the results are presented in Table 5. It is important to note that the net trade cycle represents lower inventory levels and that its square refers to higher inventory levels. The idea of a non-linear approach is to show the point on the curve in which the sign changes, i.e., optimal inventory size.

The results obtained in the proposed model confirm this study's null hypothesis (H0), in which there is no relationship between the net trade cycle and the performance of Brazilian non-financial firms. It implies that there is no inflection point between the performance and net trade cycle of Brazilian non-financial firms in the period under analysis as the two coefficients of the net trade cycle (NTC and NTC^2) were not significant. This finding may be analyzed from the perspective of inventory shortage. Inventory levels affect a company's performance due to a shortage of products and the likelihood of losing clients, and thereby sales, as shown in Corsten and Gruen (2004).

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As the results show, the variables introduced in this study to control for potential influences on the performance of companies, were significant. Therefore, there are three significant variables in the proposed model. The size of firms is significantly negative while the level of debt and profitability are significantly positive for the firms' performance. Additionally, note that size, leverage, and profitability are strongly related to performance measured by the firms' values.

Note that other factors related to inventory management and credit policies affect the performance of Brazilian non-financial firms in the period under analysis. Therefore, the companies in the analysis did not present an inflection point with the net trade cycle and performance, which would indicate an optimal level of inventory.

Table 5
Estimated Results

Model Variables	PERF – Performance (Tobin's Q)	
	Expected signal	Fixed effects model
Intercept		3.5309***
NTC	(+)	-0.0449
NTCSQ	(-)	0.0041
SIZE	(+)	-0.1343***
LEV	(-)	0.6055***
PROF	(+)	1.2100***
GROW	(+)	0.0208
Observations		1050
Year Dummy		Yes
Adjusted R-Squared		0.148

Notes: PERF is Tobin's Q; NTC is the net trade cycle divided by 100 and NTC^2 is its square; SIZE the size; LEV the leverage; GROWTH the growth opportunities; and ROA the return on assets.
*, **, *** Significant at 10%, 5% and 1%, respectively.

4.3 Robustness Check

To verify the results' empirical and theoretical robustness, the same analyses were performed using Return on assets (ROA) as the dependent variable. Baños-Caballero et al. (2014) use this same approach to verify robustness and the same results were found when performance was analyzed from the perspective of value and profitability, while Deloof (2003) presents a significant negative relationship between gross operating income and net trade cycle.

Table 6 shows that the use of performance measured by ROA implies that there is an optimal point in inventory management and performance because the regression results show an inverted U relationship between profitability, net trade cycle, and its square. Therefore, these results corroborate the findings of Baños-Caballero et al. (2014), Baños-Caballero et al. (2019), Le (2019) and Panda and Nanda (2018). Thus, the coefficients of the net trade cycle variable allow us to determine in this sample an inflection point between the firms' performance and net trade cycle. The inflection point found here was 256.62 days, i.e., the model's inflection point that represents the optimal structure of NTC in terms of performance.

The results show that lower levels of inventory improve performance due to the possibility of firms increasing and improving their sales and credit policies as shown by Baños-Caballero et al. (2014), Baños-Caballero et al. (2019), Le (2019), and Panda and Nanda (2018). The second time when higher inventory levels are related to a fall in performance shows that higher inventory levels result in low working capital, too long credit policies and cost of opportunities lost. These results corroborate the findings reported by Baños-Caballero et al. (2014); Deloof (2003); Kieschnick et al. (2013). When assessing performance from a profitability perspective, hypotheses H1 and H2 would be confirmed, in which low inventory levels are positively related to performance and high inventory levels are negatively related to performance.

Table 6

Estimated results of the robustness check

Model Variables	Value Outlook	Profitability Outlook
	PERF - Tobin's Q	ROA – Return on assets
Intercept	3.5309***	-0.2200
NTC	-0.0449	0.0349**
NTCSQ	0.0041	-0.0068***
SIZE	-0.1343***	0.0139*
LEV	0.6055***	-0.0995**
PROF	1.2100***	
GROW	0.0208	0.0469***
Observations	1050	1241
Year Dummy	Yes	Yes
Adjusted R-Squared	0.148	0.142

Notes: The PERF is Tobin's Q; NTC is the net trade cycle divided by 100 and NTC^2 is its square; SIZE=size; LEV=leverage; GROWTH=growth opportunities; and ROA=return on assets.
*, **, *** Significant at 10%, 5% and 1%, respectively.

Therefore, this study shows that the relationship between the net trade cycle and the performance of Brazilian firms is not significant when portrayed from the perspective of value, meaning that shareholders only consider whether a company is being profitable. An analysis of Brazilian companies from the perspective of profitability reflects companies' decision-making, which is based on increased performance to achieve objectives. Companies also take into account the net trade cycle as an important variable that presents an optimal level of performance.

Additionally, the independent variable was divided to test part of the NTC separately and verify whether the results are confirmed (Table 7). The results corroborate the idea that efficient inventory management reflects on firms' operational efficiency in seeking lower inventory costs and greater customer loyalty because valorization of inventory should not be analyzed only taking its turnover into account; credit policies to clients and from suppliers should be taken into account as well. Therefore, these results show that a non-linear relationship is not presented in terms of inventory separately, but as a whole, in combination with credit policies for clients and from suppliers.

Table 7

Estimated results of the robustness check (decomposition of independent variables)

Model Variables	Value Outlook			Profitability Outlook		
	PERF	PERF	PERF	ROA	ROA	ROA
Intercept	3.4512***	3.4035***	3.6423***	-0.2938*	-0.2024	-0.2084
DSO	-0.1629			0.0044		
DSOSQ	0.0454*			0.0003		
DSI		-0.2014			-0.0111	
DSISQ		0.0490			-0.0039	
DPO			-0.3870**			-0.1285***
DPOSQ			0.1541*			0.0518***
SIZE	-0.1288***	-0.1263***	-0.1364***	0.0181**	0.0145*	0.0159**
LEV	0.6175***	0.6181***	0.6335***	-0.1076***	-0.1080***	-0.1005**
PROF	1.1910***	1.1881***	1.0978***			
GROW	0.0305	0.0147	0.0208	0.0507***	0.0472***	0.0466***
Observations	1050	1050	1050	1241	1241	1241
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.151	0.150	0.156	0.127	0.135	0.155

Notes: The PERF is Tobin's Q; DSO is days sales outstanding divided by 100 and NTC2 is its square; DSI is days sales inventory divided by 100 and NTC2 is its square; DPO is days payable outstanding divided by 100 and NTC2 is its square; SIZE the size; LEV the leverage; GROWTH the growth opportunities; and ROA the return on assets.
*, **, *** Significant at 10%, 5% and 1%, respectively

Finally, the generalized moments method(GMM) was used to deal with potential endogeneity problems as mentioned in the method section. Based on Arellano and Bond (1991), the models were estimated using the GMM estimator in two stages, which permit controlling for endogeneity using instruments. Specifically, the dependent variables were lagged in four periods and used in the models as instruments in the different equations, following the procedures of Baños-Caballero et al. (2014). This approach concerns endogeneity problems, in that the relationships between firms' performance and specific characteristics only reflect the effect of independent variables on their performance. The results are in agreement with previous results, as shown in Table 8, concerning a non-linear relationship between inventory and profitability, but not the aggregated value variable. This corroborates the idea that Brazilian shareholders are not concerned with internal factors, such as the role of inventory management as a factor that creates value.

Table 8

Estimated results of the endogeneity check using GMM models

Model Variables	Value Outlook	Profitability Outlook
	PERF - Tobin's Q	ROA – Return on assets
Intercept	3.9944***	0.1766
L1.IV	0.2811**	0.3388***
L2.IV	-0.2163**	-0.1286**
L3.IV	-0.0188	0.0872*
L4.IV	0.0379	-0.0732
NTC	-0.0364	0.0535***
NTCSQ	-0.0218	-0.0077***
SIZE	-0.1543***	-0.0068
LEV	0.5237	-0.1175*
PROF	0.3405	
GROW	0.1463***	0.0517***
Observations	453	579
Wald Chi-Square	42.29	82.36
Prob. Chi-square	0.00	0.00

Notes: The instrumental variables used are the four lagged dependent variables ranging from L1.IV to L4.IV; PERF is Tobin's Q; NTC is net trade cycle divided by 100 and NTC2 is its square; SIZE=size; LEV=leverage; GROWTH=growth opportunities; and ROA=return on assets.
*, **, *** Significant at 10%, 5% and 1%, respectively.

5. Conclusions

This study's objective was to assess the effects of inventory management on firms' performance and identify the existence of an inflection point of net trade cycle among non-financial companies listed on B3 from 2010 to 2018. Non-linear multiple regression was used and data were collected from Económatica. The sample is composed of Brazilian non-financial companies listed on B3. Simple linear regression was applied to each company and all companies presenting a significant relationship between inventory and revenue were selected. The final sample consisted of 92 companies with 557 observations per firm/year.

The results confirm hypothesis H0, that is, there is no relationship between net trade cycle and performance. The reason is that the model using Tobin's Q to measure performance does not present a significant relationship between net trade cycle (NTC and NTC^2) coefficients and performance measured from the firms' value perspective. When firms are assessed from the perspective of profit (ROA), however, the results show the presence of an inverted U relationship between the net trade cycle and performance. These results are in line with Baños-Caballero et al. (2014), who shows the existence of an optimal inventory level. In this study, this level corresponds to 256.62 days.

These results present relevant practical guidelines for Brazilian companies and researchers analyzing performance related to the net trade cycle. First, as the results show the presence of an inflection point of net trade cycle and profitability, companies can optimize asset management in the short term. Second, these results indicate differences between value and profitability perspectives in Brazilian firms. They suggest that Brazilian shareholders are not concerned with inventory management, but rather with whether a company is profitably managed. Inventories are an asset that represents a relevant amount of investments in the short term. Therefore, identifying the existence of an optimal level between investment in inventory and performance and value creation is important because it contributes to improving our understanding of whether there is an optimal inventory level.

This study's limitations include the fact that external factors that influence decision-making concerning performance, such as macroeconomic events and regulation policies, were not addressed in this analysis. Thus, they may have influenced the results. Therefore, we should bear in mind that not only factors inherent to working capital management and inventory management influence performance.

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