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Macroeconomic factor, firm characteristics and inventory holding in Nigeria: A quantile regression approach

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Abstract

Purpose: Prior studies show that inventory holding is closely linked to liquidity and procyclical dependent on the combination of macroeconomic and firm characteristics. Thus, conditional linear factor models such as OLS should fail to explain the inventory-holding motive, especially in the context of developing countries. This study seeks to empirically investigate the determinants of corporate inventory holding based on evidence from pharmaceutical companies in Nigeria.

Research methodology: The study adopts the ex post facto research design. The final sample was eight pharmaceutical & healthcare firms quoted on the Nigerian Stock Exchange (NSE). The data were analysed using the quantile regression technique.

Results: The results showed that the inflation rate had a positive effect on the inventory holding distribution at upper quantiles (75th); and, the cash conversion cycle on the inventory holding was significant at different quantiles (25th, 50th and 75th). Profitability and liquidity were non-significant at different quantile distributions.

Limitations: The focus on pharmaceutical firms limits the generalizability of the study findings to other sectors of the economy.

Contributions: The study contributes to the literature in the context of developing countries, on the impact of varying firm characteristics and inflation rates on the different conditional distribution of the regressand, i.e., inventory holding.

Keywords: *Inventory Holding, Firm Characteristics, Cash Conversion Cycle, Quantile Regression*

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1. Introduction

Inventories are a significant part of the assets of manufacturing companies. Inventory holding is therefore the extent to which corporations hold or keep inventories prior to disposal. “Inventory, accounts for one of the significant variables in management accounting, and a significant proportion of the assets of a firm” (Kurtuluş, Nakkas, & Ülkü, 2014). More than 35% of the firm’s total assets and around 50% of current liabilities are represented by inventory holding (Kurtuluş et al., 2014). Firms adopt different inventory holding strategies depending on the business cycle and rate of fluctuations in supply disruptions (Saithong & Luong, 2022). The importance of holding inventory was recently documented in the study by Okeke, Okere, Dafyak, and Abiahu (2022), which documented evidence that inventory levels as shown by the cash conversion cycle were positively correlated with financial health. Another research by Isaksson and Seifert (2014), revealed that the

relationship between variations in inventory holding and short-term changes in corporate profits is 'U-shaped'. Prior related studies on the subject of inventory holding have employed different indicators to examine the effect of firm characteristics on inventory holding. These metrics include firm financial profitability, firm size, duration of the cash conversion cycle, and firm growth.

The key object of managing corporate inventory is to find an optimal inventory operational level (Okeke *et al.*, 2022), which includes the carrying (holding) costs and the cost of ordering. In seeking an optimal inventory point given by the Economic Order Quantity (EOQ), there is a need to minimize the trade-off between holding costs and ordering costs that become peremptory. However, under uncertain conditions, it is expected that firms maintain a cushion to hedge against possible future stock-outs which are best recommended during inflationary and economically unstable economies. Increasing the level of inventory holding would increase the costs associated with it (Govindasamy & Antonidoss, 2022; Wang *et al.*, 2022). This would have the concomitant effect of tying up the capital of the firm (Wang *et al.*, 2022).

Studies by authors, such as Alessandria, Kaboski, and Midrigan (2010); Jones and Tuzel (2013); Lai, Ren, and Robb (2014); Belo and Lin (2012); Cornaggia (2013) utilize the inventory conversion period to measure inventory management.

According to Onawumi and Oluleye (2011), the non-inclusion of conflicting economic and business cycle fluctuations has hindered the realization of the optimal quantity of production using the classical EOQ model. Thus, the inventory holding decision is determined by cyclical fluctuations, occasioned by economic and business trends. In this sense, macro-and-micro uncertainties must be considered to determine inventory holding. In related studies by Blinder and Maccini (1991a); Blinder and Maccini (1991b) the authors found that during recessions, inventory investments decline drastically suggesting that the external economic environment plays a very crucial role in inventory management investment. Other scholars have shown that the gross domestic product growth rate affects profitability and consequently the investment in working capital of which inventory is part (Egbunike & Okerekeoti, 2018). For instance, utilizing a Bayesian time-varying VAR method, Benati and Lubik (2014) find a positive association between inventory holding and interest rates. Their argument was premised on the suggestion that interest rate shocks may lead to an upward or downward change in inventory holding but also hinges upon the recessionary effect. Maccini, Moore, and Schaller (2004) find that corporate inventory holding tends to be lower when the economy is experiencing a regime of high-interest rates. The authors presented a framework consistent with a regime-switching effect of interest rate and inventory holding. Using a sample of Spanish firms, García-Teruel and Martínez-Solano (2007)found a positive association between shortening the days of inventory holding and the return on assets. This was also confirmed in the study by Padachi (2006) on a sample of Malaysian firms.

Yet other scholars have also found a link between inflation rate and firm performance ((Enqvist, Graham, & Nikkinen, 2014); (Shi, Zhu, & Yang, 2016)). According to Soukhakian and Khodakarami (2019), the inflation rate is an indicator of purchasing power of an economy's currency. The authors further stated that the rate of volatility of this measure indicates the extent of stability of the national currency. The inflation rate, therefore, affects the managerial policy by increasing the prices of productive inputs, e.g. raw materials inherently affecting production volumes (Soukhakian & Khodakarami, 2019). Additionally, the persistent rise in prices may also negatively deter customers from sustained purchase inflation thereby affecting the ability to pay and increasing trade credit (Golverdi & Mehrabanpour, 2017). The management may also accumulate more finished goods to take advantage of price increases thereby increasing the inventory turnover period (Soukhakian & Khodakarami, 2019). Prior studies have documented varying results from a developing country context. For instance, Egbunike and Okerekeoti (2018) found a significant positive effect of inflation rate on ROA; while interest and exchange rate had a non-significant negative association with ROA of the firms in Nigeria. Using empirical data from Kenya, Kiganda (2014) showed that selected macroeconomic factors such as the real GDP, exchange and inflation rates have an insignificant effect

on bank profitability in Kenya. Thus, economic factors exert pressure on the financial operations and consequently inventory decisions of quoted manufacturing firms. According to Guariglia and Mateut (2010), financial factors play a crucial and decisive role in inventory investment. Lv (2014) in his study explained that firms accounting performance of return on the total assets are the only significant factor that may influence firms' level of inventory holding. But other variables such as capital structure, firm size, the board size, level of cash holdings and capital investment were found to have a significant relationship in determining the effects of inventory holding on corporate firm performance ((Disatnik, Duchin, & Schmidt, 2014); (Garcia-Appendini & Montoriol-Garriga, 2013); (Xu, Xue, & Che, 2012); (Yang, Yang, & Wu, 2015); (Abrahamsen & Hartwig, 2011); (Bolton, Chen, & Wang, 2011); (Zhang & Chen, 2010)).

Therefore, existing prior studies have documented mixed results on the relationship between firms' inventory holding and corporate performance. The study's main contribution to the literature on inventory holding in healthcare firms lies in its exploration of macroeconomic and firm factors that impact the level of inventory holding of such firms. Employing different control variables, some research studies have established a positive relationship, such as studies by Bolton et al. (2011); Eroglu and Hofer (2011); Gill, Biger, and Mathur (2010); Mathuva (2010); while other studies have established a negative relationship such as Pong and Mitchell (2012); Nikolov and Whited (2014), Rao, Yue, and Jiang (2016), etc. Hence, this research study seeks to identify key factors which would influence corporate decisions on how much of its scarce funds should be invested in inventories. The study responds to the call by Yazdanfar and Öhman (2014) using a sample of Swedish firms but called for research along this line in other countries.

Secondly, several studies in developing countries do not employ or consider the macroeconomic environment. Following studies by Soukhakian and Khodakarami (2019), and Mathuva (2010) this study examines both firm-level and external factors that influence inventory investment decisions. Furthermore, a similar study is not known to have been carried out on listed pharmaceutical companies in Nigeria. The study employs quantile regression analysis in finding coefficient estimates useful for policy decision-making. This study contributes to existing knowledge by introducing variables and the use of quantile regression a deviation from prior studies that utilize the Ordinary Least Square Estimation Technique in the Nigerian context. The study is expected to be of assistance to policymakers by enabling them to make informed decisions (Olayinka, 2022)

2. Literature review

2.1 Inventory Holding

Inventory holding is a dominant focus incorporating working capital management; where the inventory turnover ratio (ITR) is often utilized as a barometer of performance for material management functions. Inventory refers to the physical stock of goods kept in store to meet the anticipated demand. Inventory can be defined as a 'stock of goods or other items owned by a firm and held for sale or processing before being sold, as part of a firm's ordinary operation'. Inventory is the finished goods and raw materials existing within a firm with the objective of resale or further production to achieve the organisational purpose. The concept of inventory also referred to as stock has been applied in varied several sectors to generalize the definition to be items or work within the process of production, which is or has occurred before the completion of production. In manufacturing systems, inventory holding refers to all existing items of raw materials, work in progress i.e., partially finished products, and finished products. In the context of service delivery, inventory refers to all work done before a sale, including partially processed information.

Due to the crucial role that inventory management plays in working capital management decisions, the need to examine its key determinants is paramount. A firm's inventory holding is tied to its working capital management reflected in the cash conversion cycle (Ebben & Johnson, 2011). As suggested by Soukhakian and Khodakarami (2019), inventory holding decision is closely tied to the liquidity level and profitability level. Empirically, Lyngstadaas and Berg (2016) using a sample of

Norwegian SMEs reported a negative association between inventory holding and firm performance. This evidence is also confirmed using a Swedish dataset by Yazdanfar and Öhman (2014).

2.2 Inflation

Inflation is generally defined as a sustained increment in the economic price level. In other words, the prices of goods and services such as housing, food, and transportation, increase gradually over some time in the overall economy. The inflation rate has been measured in several ways. However, it is commonly measured by "either a Gross Domestic Product Deflator (GDP Deflator) or a Consumer Price Index (CPI) indicator". The GDP Deflator is a broad index of inflation in the economy; the CPI Index measures changes in the price level of a broad basket of consumer products. The literature identifies two major types of inflation: demand-pull inflation and cost-induced inflation. Demand-pull inflation occurs when aggregate demand for goods and services in an economy rises more rapidly than an economy's productive capacity. Cost-push inflation, on the other hand, occurs when the prices of production process inputs increase. Rapid wage increases or rising raw material prices are common causes of this type of inflation. The literature also documents the varying effects of the inflation rate on firm performance. For instance, the study by Ramadan (2016) documented evidence that the country's inflation rate had a positive influence on economic value added. Empirically, the study by Mathuva (2010) finds a significant relationship between the inflation rate and the cash conversion cycle. The authors, Golverdi and Mehrabanpour (2017) find that during periods of price increases which lead to rising production costs, the firms may respond by taking additional inventory which implies a positive influence on the cash conversion cycles.

2.3 Inventory Holding and Inflation

The association between inventory holding and inflation has been documented in several studies. The inventory holding decision is vital to a firm and the economy (Huang, 2016). Authors such as Blinder and Maccini (1991a); Blinder and Maccini (1991b) suggested a paradox in the concept of inventory holding. Huang (2016) observed that inventory while inventory holding accounts for less than 5% of the GDP fluctuation, relatively accounts for 20% of production fluctuation. Prior studies have established the sensitivity of inventory holding to numerous factors at the firm, industry and country levels. Gao (2015) using empirical data from 1970 to 2009 found the sensitivity of working capital to cash plus inventory holding ratio at the firm level. The results specifically found a negative association between the net working capital and the cast to (cash plus inventory) ratio. The study of Rao et al. (2016) empirically demonstrated that inflation affects a firm's inventory investment positively. Egbunike and Okerekeoti (2018) used data that spanned from 2011 to 2017 to analyse the effect of macroeconomic factors and firm characteristics on the financial performance in a panel EGLS framework that showed that the inflation rate had a positive significant effect on ROA at the firm level. Using empirical data from China spanning 1978 to 2002, Yu, Wang, and Gan (2005) found that inventory is sensitive to inflation, but inflation is not sensitive to inventory; while Rao et al. (2016) empirically found a positive association between the inflation rate and the firm's inventory holding. In Kenya, the study by Mwangi and Wekesa (2017) from both primary data and content analysis finds that economic factors influence the organizational performance of Kenya Airways Limited. Using a sample of twenty firms Gado (2015) finds that the macroeconomic environment played a crucial role in the Nigerian business environment while significantly determining the firm's performance. Specifically, the inflation rate had a positive impact while exchange and interest rates had negative impacts. Another study conducted in Kenya by Kiganda (2014), using the Cobb-Douglas production function finds that selected macroeconomic factors such as the real GDP, inflation and exchange rate had an insignificant effect. Using empirical data from Pakistan commercial banks, Kanwal and Nadeem (2013) found a negative effect of the inflation rate on ROA, ROE and equity multiplier in 3 pooled models. The results from prior studies showed that the selected macroeconomic factor of inflation affects inventory and profitability. This negative link is also found in the study by Osamwonyi and Michael (2014) using data spanning from 1990 to 2013 of Nigerian banks. The Pooled OLS result revealed a negative effect of inflation rate on ROE. The authors therefore from the literature reviewed lead to the formulation of the following hypothesis:

H_1: There is a significant effect of inflation on the inventory holding of quoted pharmaceutical firms.

2.4 Firm Characteristics

Firm characteristics are the culmination of a firm's demographic and managerial variables, which are unique to a particular firm (Zou & Stan, 1998). Egbunike and Okerekeoti (2018) described it as a crucial component of the internal environment of a firm. According to Kogan and Tian (2012), firm characteristics include firm size, leverage, liquidity, sales growth, asset growth and turnover, etc. Arguably, firm characteristics are often enshrined in the financial statements of the firm (Ige & Adewumi, 2020).

1. Profitability: Profitability refers to the excess of revenue over expenditure (Uche, Ndubuisi, & Chinyere, 2019). Studies have documented mixed findings on the influence of profitability on varying firm metrics. Uche et al. (2019) found a positive effect of profitability on waste management costs. Shabrina and Hadian (2021) found that profitability proxied using return on total assets influenced dividend payout. Therefore, the following hypothesis is proposed:
   Ho_2: There is no significant effect of profitability on the inventory holding of quoted pharmaceutical firms.

2. Liquidity: This is a firm's ability to convert its short-term assets into cash to meet its day-to-day operation (Elliott, 2014). Prior studies document mixed findings on the nexus of liquidity and firm performance. For instance, using the EU dataset, Akgün and Karataş (2020), finds evidence of a significant effect of liquidity on firm performance. Owolabi, Obiakor, and Okwu (2011) find a negative relationship between liquidity and profitability in the banking sector; and, a positive relationship between the two in processing/manufacturing firms. Using a sample of Spanish firms, García-Teruel and Martínez-Solano (2007) found that shortening the days of inventory holding had a positive effect on return on assets. Therefore, the following hypothesis is proposed:
   Ho_3: There is no significant effect of liquidity on the inventory holding of quoted pharmaceutical firms.

3. Cash conversion cycle (LCCC): The cash conversion cycle is a comprehensive measure of working capital management that shows the time lapse between the expenditure on the purchase of raw materials and the collection of revenue from sales of finished products (Padachi, 2006). The cash conversion cycle is the "net time interval between actual cash expenditures on a firm's purchase of productive resources and the ultimate recovery of cash receipts from product sales" (Richards & Ej, 1980). Ebben and Johnson (2011) opined that it measures the days on inventory holding and receivables in days while giving due cognizance to the payables in days. Prior liquidity measures were highly criticised for several limitations ((Eljelly, 2004); (Ebben & Johnson, 2011); (Obeng, Enos, & Yensu, 2021)) have improved the popularity of the cash conversion cycle in working capital management literature. The LCCC measures the duration of time it takes to elapse from the point a firm pays for inventory and when cash is realized from the sales of such (Ebben & Johnson, 2011). Prior studies have also studied this important firm attribute and its effect on several firm outcomes e.g. ROA ((Deloof, 2003); (Ebben & Johnson, 2011); (Lazaridis & Tryfonidis, 2006)). Zakari and Saidu (2016) reported a significant positive relationship between the cash conversion cycle and corporate profitability of Nigerian-listed telecommunication firms. Ukaegbu (2014) using data from four African countries, Egypt, Kenya, Nigeria and South Africa, showed a significant negative relationship between the cash conversion cycle and corporate profitability. Using a sample of sugar manufacturing firms in Kenya the study by Lwiki, Ojera, Mugenda, and Wachira (2013) found a positive association between the firm's inventory management practices and corporate profitability. However, using a Ghanaian dataset the study by Obeng et al. (2021) finds no significant relationship between the cash conversion cycle and corporate profitability. The evidence was also confirmed for the effect on firm valuation. Therefore, the following hypothesis is proposed:
   Ho_4: There is no significant effect of the cash conversion cycle on the inventory holding of quoted pharmaceutical firms.

4. Firm size: The issue of firm size has remained dominant in the corporate governance literature (Nzioka, 2013). It has been widely applied across several contexts documenting mixed findings on the effect of firm size on varying firm performance proxies and inventory holding. Egbunike and Okerekeoti (2018) using empirical data from Nigeria, found a positive association between firm size and ROA. Adeyemi and Fagbemi (2010) found a positive effect of firm size on audit quality in Nigeria. This variable was also included as a control in the studies by Yazdanfar and Öhman (2014); Prempeh and Peprah-Amankona (2020); Kodithuwakku (2015); EL-Ansary and Al-Gazzar (2021).

5. Leverage: This is the proportion of debt to equity in the capital structure of a firm (Omondi & Muturi, 2013). Studies have also documented varied effects of leverage on firm performance. Egbunike and Okerekeoti (2018) using empirical data from Nigeria, found a positive effect of leverage on ROA. Adeyemi and Fagbemi (2010) found a positive effect of leverage on audit quality in Nigeria. Rahmawati and Hadian (2022) find that the debt-equity ratio is negatively associated with stock prices using a sample of consumer goods firms listed on the IDX from 2016 to 2018. This variable has also been included in other WCM studies as a control variable such as those (EL-Ansary & Al-Gazzar, 2021); Prempeh and Peprah-Amankona (2020); Kodithuwakku (2015); Yazdanfar and Öhman (2014).

2.5 Theoretical Framework

Various theories on inventory holding management opine that decisions on the level of inventory to hold should focus on managing the basic trade-offs in costs, customer service-level goals and various other constraints. Therefore the current study is anchored on the transaction cost perspective, as firms hold inventory for several reasons including stockout costs, etc. This theory originated from the study by Ronald Coase in 1937 who tried to explain the structure of firms and in particular the formation of the modern corporation. This theory tends to explain the basis of a firm's existence and interlinks with the external environment. This theory presupposes that a corporation tends to minimize its cost of resource exchange with the environment and also minimize the cost of bureaucratic exchanges within the bureaucratic framework. Furthermore, the transactions cost theory implies that a given firm will grow if and only if the cost of the external transaction is higher than the company's bureaucratic cost. This implies that the company can carry out its business activities more cheaply than if the activities were outsourced. However, it notes that companies will expand as much as their operations can be performed more cheaply within the organization rather than outsourcing. The study draws from the transaction cost theory with a view that managers acting as agents have the aim of shareholders value, profit maximization or cost minimization which can only be possible when among other factors the cost of holding inventory within the organization is less than the cost of outsourcing same activities.

3. Methodology

The study from a quantitative perspective utilized the ex-post facto research design. The population is comprised of quoted pharmaceutical firms on the Nigerian Stock Exchange (NSE). The final sample of 8 pharmaceutical firms was purposively chosen based on data availability during the study period. The study focused on the use of secondary data that were retrieved from annual reports and accounts of the sampled companies quoted on the NSE. In line with the suggestion by EL-Ansary and Al-Gazzar (2021); Boisjoly, Conine Jr, and McDonald IV (2020), the authors argue that working capital-related studies should focus on a singular industry as prior studies have shown that cash conversion cycles differ across industries suggestive of a non-homogenous effect. Secondly, Chauhan (2019) states that working capital is a managerial policy in a firm that depends on organisational culture and the strategy of a particular firm indicative of different industrial practices. The data spanned a period of 6 years, from 2011 to 2016. The study adopted Quantile Regression Analysis to find coefficients that will be used to determine both impacts and directions of the variables under study. The firms included in the final sample are shown below:

Table 1. Names of companies included in the final sample

Company	Ticker	Sector	Date Listed
EKOCORP PLC. [BLS]	EKOCORP	HEALTHCARE	-
FIDSON HEALTHCARE PLC	FIDSON	HEALTHCARE	April 6, 2008
GLAXO SMITHKLINE CONSUMER NIG. PLC. [CG+]	GLAXOSMITH	HEALTHCARE	-
MAY & BAKER NIGERIA PLC.	MAYBAKER	HEALTHCARE	November 10, 1994
MORISON INDUSTRIES PLC.	MORISON	HEALTHCARE	-
NEIMETH INTERNATIONAL PHARMACEUTICALS PLC [CG+]	NEIMETH	HEALTHCARE	September 21, 1979
PHARMA-DEKO PLC.	PHARMDEKO	HEALTHCARE	-
EVANS MEDICAL PLC.	EVANS	HEALTHCARE	-

Source: Nigerian Stock Exchange Factbook

3.1 Method of Data Analysis

In the estimation process, the study employs the use of quantile regression to analyze the unique dataset. The standard ordinary least squares regression technique provides a synoptic point estimate on the conditional mid-values caused by the joint effect of explanatory variables. As Mosteller and Tukey (1977) stated, the regression provides a synoptic summary of the averages of the distributions corresponding to the vector of explanatory variables. They further stated that several regression curves that correspond to various percentage points of the distributions may be computed to provide a more accurate picture of the set. However, the focus on these mid-values may hide important features of the underlying relationship. Thus, a more efficient approach would be to utilize the quantile regression techniques. This helps to obtain a more complete picture of the underlying relationship between inventory holding and its determinants. In this case, the estimation of linear models by quantile regression may be preferable to the usual regression methods for some reasons:

Firstly, the non-normality distribution of the unique dataset violates the assumption of normally distributed errors of standard least squares. While the properties of standard least-squares estimation are not robust to moderate departures from a normal distribution, the quantile estimation approach is characteristically robust to outliers and heavy-tailed distributions. The quantile regression solution bˆ0 is invariant to outliers of the dependent variable that tend to $\pm \infty$ Buchinsky (1994). The standard regressions technique focuses on the mean, while, quantile regressions techniques can describe the entire conditional distribution of the regressand. In the context of this research study, all firm-specific determinants of inventory holding are of key interest in their own right, we don't want to consider them as outliers, but worthwhile to study them in detail. This can be done by calculating coefficient estimates at various quantiles of the conditional distribution. Lastly, this regression approach does not acknowledge the restrictive assumption which suggests that the error terms of the econometric function are distributed identically at every point of the conditional distribution. By relaxing this assumption, company heterogeneity becomes obvious such that we can consider the likelihood that the estimated slope parameters vary at different quantiles of the conditional distribution of all determinants of corporate inventory holding.

Therefore, the quantile regression model technique initially developed by Keonker and Basset (1978) can be econometrically expressed with the following notation as follows:

$$Y_{it} = \chi^1_{it}\,\beta_0 + \varepsilon_{0it \text{ with}}\, Quant_0\,(Y_{it/}\,\chi_{it}) = \chi^1_{it}\,\beta_0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: i denotes company, t denotes time, Y_{it} is the independent variable, χ_{it} is the vector of parameters to be estimated and ε is a vector of residuals. $Quant_0\,(Y_{it/}\,\chi_{it})$ denotes the $\emptyset^{th}$ conditional quantile of Y_{it} given χ_{it}.

The $\emptyset^{th}$ regression quantile 0<0<1, solves the following problem:

$$\min_{\beta}\frac{1}{n}\left\{\sum_{i,t:y_{it}\geq x_{it}'\beta}\theta\,|\,y_{it}-x_{it}'\beta\,|+\sum_{i,t:y_{it}<x_{it}'\beta}(1-\theta)\,|\,y_{it}-x_{it}'\beta\,|\right\}=\min_{\beta}\frac{1}{n}\sum_{i=1}^{n}\rho_{\theta}\varepsilon_{\theta it} \quad (2)$$

Where $\rho_0(.)$ which is known as the check function is defined as:

$$\rho_{\theta}(\varepsilon_{\theta it})=\begin{cases}\theta\varepsilon_{\theta it} & if\ \theta\varepsilon_{\theta it}\geq 0\\ (\theta-1)\varepsilon_{\theta it} & if\ \theta\varepsilon_{\theta it}<0\end{cases} \quad (3)$$

Equation (2) is then solved by linear programming methods such that as one increases Ø continuously from 0 to 1, the entire conditional distribution of Y_{it} conditional on χ_{it} can be measured (Buchinsky, 1994).

In this study, we assume that Inventory Holding (INTY) is a function of Firm Profitability, (ROTA), Firm Liquidity (LIQ), Cash Conversion Cycle (LCCC), Inflation (INF), Firm Size (SIZE), and Firm Leverage (LEV). Whereas the firm size and firm leverage are the control variables employed in this study. This can be written in an econometric form as:

$INTY_{it} = ROTA_{it} + LIQ_{it} + LCCC_{it} + INF_{it} + SIZE_{it} + LEV_{it} + \varepsilon_{it}$..... (4)

However, due to the advantages of the quantile regression estimation technique over OLS fixed and random effect models, we examined the various determinants of inventory holding at 25th, 50th, and 75th quantiles.

3.1.1 Model Specification

The study follows the empirical modelling in the study by Prempeh and Peprah-Amankona (2020) using Ghanaian data with slight modifications. The below specified explicit models were utilized in the study, at 25th, 50th and 75th percentiles respectively:

$Q_{.25}(INTY_{it}) = \lambda_{.25} + \lambda_{.25,1}ROTA_{it} + \lambda_{.25,2}LIQ_{it} + \lambda_{.25,3}LCCC_{it} + \lambda_{.25,4}INF_{it} + \lambda_{.25,5}SIZE_{it} + \lambda_{.25,6}LEV_{it} + \varepsilon_{.25it}$

$Q_{.5}(INTY_{it}) = \lambda_{.5} + \lambda_{.5,1}ROTA_{it} + \lambda_{.5,2}LIQ_{it} + \lambda_{.5,3}LCCC_{it} + \lambda_{.5,4}INF_{it} + \lambda_{.5,5}SIZE_{it} + \lambda_{.5,6}LEV_{it} + \varepsilon_{.5it}$

$Q_{.75}(INTY_{it}) = \lambda_{.75} + \lambda_{.75,1}ROTA_{it} + \lambda_{.75,2}LIQ_{it} + \lambda_{.75,3}LCCC_{it} + \lambda_{.75,4}INF_{it} + \lambda_{.75,5}SIZE_{it} + \lambda_{.75,6}LEV_{it} + \varepsilon_{.75it}$

Where:

INTY	= Inventory Holding
ROTA	= Return on Total Assets
LIQ	= Firm Liquidity
LCCC	= Length of Cash Conversion Cycle
INF	= Inflation Rate
SIZE	= Firm Size
LEV	= Firm Leverage
Q.25, Q.50 Q.75	= Quantile 25, Quantile 50 and Quantile 75

Table 2. Measurement of Variables

Variable	**Specification**	**Measurement**
Inventory	INTY	Inventory to Revenue Ratio
Return on Total Assets	ROTA	Net profit after tax / Total Assets
Liquidity	LIQ	Current Assets – Inventory / Current Liability
Length of Cash Conversion Cycle	LCCC	Receivable day + Inventory day - Payable day
Inflation Rate	INF	Inflation rate

Firm Size	SIZE	Natural log of the total assets which was measured as a control variable
Leverage	LEV	Total liabilities / Total assets which were measured as a control variable

4. Results and discussions

The descriptive statistics of the variables are shown in the Table below, i.e., the mean (average) for each of the variables, their maximum and minimum values, sum, standard deviation, etc.

Table 3. Descriptive statistics of the variables

	INTY	ROTA	LIQ	LCCC	INF	SIZE	LEV
Mean	26.54326	5.984844	2.079793	112.3770	17.07292	10.38433	95.06385
Median	9.745346	3.382457	0.787101	64.12427	9.800000	6.076000	46.48626
Maximum	153.5300	93.25998	12.28000	765.1800	114.3000	59.52300	578.5700
Minimum	0.472188	-28.51000	0.145205	-327.3400	0.000000	0.068161	0.246734
Std. Dev.	42.32184	17.99018	3.240622	230.3046	30.15933	17.74098	157.0308
Skewness	2.102586	2.300368	2.248165	0.437097	2.241429	2.185359	2.191126
Kurtosis	5.862917	13.26219	6.600138	3.237431	6.484926	6.100595	6.283785
Jarque-Bera	51.75954	252.9587	66.35596	1.641177	64.48145	57.43374	59.97474
Probability	0.000000	0.000000	0.000000	0.440172	0.000000	0.000000	0.000000
Sum	1274.077	287.2725	99.83005	5394.094	819.5000	498.4480	4563.065
Sum Sq. Dev.	84183.50	15211.38	493.5767	2492889.	42750.49	14792.90	1158957.
Observations	48	48	48	48	48	48	48

Source: E-Views 10

On average the inventory-to-revenue ratio is 26.54, and the mean return on assets is 5.98 which means that profit after tax covers total assets up to 5 times. The liquidity ratio is 2.08; which means that current assets cover current liabilities up to 2 times. The length of the cash conversion cycle was on average 112 days. The descriptive statistics reveal that the mean inflation rate is 17.07 for pharmaceutical firms. Firm size and leverage variables are transformed using natural logarithmic transformation. Concerning the size of total assets proxy by (size), the descriptive statistics reveal that all the sampled firms had similar sizes. Specifically, the variable LIQ shows the pharmaceutical firms under consideration were in good financial health. The kurtosis shows that the distribution of the variables under consideration in this study was leptokurtic, that is, it has heavy tails. Thus, estimation techniques like the Ordinary Least Square Regression Techniques (OLS) are not robust and may be biased (Buchinsky, 1994). Hence, the use of quantile regression estimation becomes more appropriate when applied and the estimation output is reported of different quantiles (0.25, 0.50, and 0.75). The Jarque-Bera statistic showed a non-normal distribution of the dataset except for the LCCC.

The main regression results are shown in Table 3 at the 25^{th} quantile, 50^{th} quantile and 75^{th} quantile.

Table 4. Quantile regression output of the model

	tau	coefficient	std. error	t-ratio
const	0.250	-0.002266	0.000821895	-2.75725
	0.500	0.426851	0.121993	3.49898
	0.750	0.942499	0.00548872	171.716
INF	0.250	0.237655	0.000130176	1825.64**
	0.500	0.307295	0.0193219	15.9040

	0.750	0.504809	0.000869332	580.686***
ROTA	0.250	0.0197066	4.39278e-005	448.613
	0.500	0.0126147	0.00652016	1.93473
	0.750	0.0112099	0.000293355	38.2127
LCCC	0.250	0.0323578	7.91246e-006	4089.47***
	0.500	0.0285650	0.00117444	24.3223
	0.750	0.0361489	5.28404e-005	684.115***
LIQ	0.250	-1.13707	0.00249386	-455.947
	0.500	-0.763056	0.370161	-2.06142
	0.750	-1.28635	0.0166543	-77.2383
SIZE	0.250	1.48962	0.0005602	2659.32
	0.500	1.03453	0.0831426	12.4428
	0.750	1.65799	0.0037408	443.223***
LEV	0.250	0.0356501	3.20881e-005	1111.01
	0.500	0.0902082	0.00476280	18.9402
	0.750	0.0001444	0.000214288	0.673791
		25%	50%	75%
Pseudo R-squared		0.866644	0.897422	0.931509
Adjusted R-squared		0.850768	0.885210	0.923355

*, **, *** implies statistical significance at 10%, 5% and 1% levels respectively
Source: E-Views 10

The results showed that concerning the quantile regressions the adjusted R-squared was best at the 75% quantile (92%) when compared to other quantiles. This means that the explanatory variables explained 92.3% of the systematic variation in the dependent variable at 75% quantile. The coefficients of explanatory variables which are included in the quantile model were interpreted at the 25%, 50% and 75% quantiles. At the 50^{th} quantile, the LCCC, SIZE and LEV were significant at the 5% level, the variable INF was significant at 10%; while, ROTA and LIQ were positive and non-significant. At the 25^{th} quantile, LCCC and SIZE were significant and positive at 5%. LIQ had a negative non-significant effect on INTY; while, ROTA, INF and LEV were positive and non-significant. The variables LCCC, INF and SIZE were positive and significant at the 75^{th} quantile; while, ROTA, LIQ and LEV were positive and non-significant. The study makes the following conclusions:

H_1: There is a significant effect of inflation on the inventory holding distribution at upper quantiles (75^{th}) of quoted pharmaceutical firms.

H_2: There is a significant effect of the cash conversion cycle on the inventory holding distribution at different quantiles (25^{th}, 50^{th} and 75^{th}) of quoted pharmaceutical firms.

H_3: There is no significant effect of profitability on the inventory holding distribution at different quantiles (25^{th}, 50^{th} and 75^{th}) of quoted pharmaceutical firms.

H_4: There is no significant effect of liquidity on the inventory holding distribution at different quantiles (25^{th}, 50^{th} and 75^{th}) of quoted pharmaceutical firms.

It is evident from the table above that only the variable of the length of the cash conversion cycle has a significant impact on the inventory holding level for the period under analysis. The result equally shows that the level of significance declined as inventory levels builds up the quantile. This evidence is unique in the sense that it enables the researcher to know that at all levels of inventory holding, the variable of the length of the cash conversion cycle is a major driver of inventory holding.

4.1 Discussion of Findings

The results showed a positive effect of inflation on the inventory holding of quoted pharmaceutical firms. The results are consistent with Soukhakian and Khodakarami (2019), which reported a positive effect of inflation on the return on assets. Similarly, Egbunike and Okerekeoti (2018), using a sample of consumer goods firms in Nigeria showed that the inflation rate had a positive significant effect on ROA. This is somewhat consistent with the study by Mathuva (2010) that supports a positive association between inflation and cash conversion cycle, yet another prior study by Gado (2015) on a sample of 20 most capitalised companies in Nigeria showed that inflation has a positive impact on firm performance. Empirically, Mwangi and Wekesa (2017) reported an association between macroeconomic factors and organizational performance. However, in contrast, The study by Kanwal and Nadeem (2013) in Pakistan showed that the inflation rate had a negative link with return on assets (ROA), return on equity (ROE) and equity multiplier (EM) ratios. However, the result contradicts the results of Rao et al. (2016); and Yu et al. (2005).

The cash conversion cycle had a positive effect on the inventory holding of quoted pharmaceutical firms. This is consistent with the study by Deari, Kukeli, Barbuta-Misu, and Virlanuta (2022) find evidence of a positive relationship between working capital management and profitability proxied using the ROA. Another study by Yazdanfar and Öhman (2014) used Swedish data but found a positive association between the cash conversion cycle and corporate profitability. Another study in the African context by Lwiki et al. (2013) found a positive association between inventory management practices and firm profitability in Kenya. However, in contrast, Akgün and Karataş (2020) using the European Union dataset find a negative relationship between working capital and performance; Ren, Liu, Yang, Xiao, and Hu (2019) using a Chinese dataset also find such (a negative) relationship. Pham, Nguyen, and Nguyen (2020) using a Vietnamese sample documents the negative effect of the cash conversion cycle on firm performance. Nobanee, Abdullatif, and AlHajjar (2011) using empirical Japanese data find a negative relationship. The study by EL-Ansary and Al-Gazzar (2021) found a negative effect of the LCCC on ROE; while the effect of LCCC on ROA was positive and significant in the two instances. In the Nigerian context, other studies have also documented this negative relationship: for instance, Aregbeyen (2013) using data spanning from 1993 to 2005 reported a negative relationship between the cash conversion cycle and profitability; while Akinlo (2012) using data spanning from 1997 to 2007 reported a negative effect of a significant relationship between days of inventory holding on profitability.

The proxy for profitability which is the ROA showed a positive effect on the inventory holding of quoted pharmaceutical firms. This is supported by the study of Kasozi (2017) using the South African dataset, which finds a positive association between profitability and inventory holding in days. However, in contrast, Oladimeji and Aladejebi (2020) found a negative relationship between the inventory conversion period and ROA. Nwaobia, Kajola, and Adedeji (2012) also found a negative relationship between working capital management and financial performance. Using a dataset from Sri Lanka, the study by Kodithuwakku (2015), the OLS estimation output showed a negative relationship between profitability and inventory conversion period.

The empirical results showed a negative effect of liquidity on the inventory holding of quoted pharmaceutical firms. This is in contrast with the study by Oladimeji and Aladejebi (2020) which found a positive relationship between the current ratio and ROA. Akindele and Odusina (2015), found a negative relationship between working capital management and firm profitability. However, in contrast, Prempeh and Peprah-Amankona (2020) using a dynamic model framework of Ghanaian data reported a positive effect on the current ratio while Kolapo, Oke, and Ajayi (2015) in Nigeria found a positive effect on working capital management on ROA.

The control variable firm size was not significant and positive at the 25^{th}, 50^{th} and 75^{th} quantile respectively. The leverage also had a positive relationship at the 25^{th}, 50^{th} and 75^{th} quantile. Prior studies showed mixed findings. Prempeh and Peprah-Amankona (2020) using a dynamic model approach found a positive effect of the two control variables using the Ghanaian dataset. Chiou,

Cheng, and Wu (2006) found a positive relationship between firm size and working capital management. Mansoori and Muhammad (2012) found that firm size is negatively correlated with inventory management.

5. Conclusion

Prior studies have analyzed inventory holding and firm performance from varied perspectives. The authors in this paper consider the joint influence of selected firm characteristics, and macroeconomic factors, specifically, the inflation rate given its close linkage to the concept of cash holding in working capital management on the inventory holding decision of pharmaceutical firms. The study set out to examine macroeconomic and internal determinants of inventory holding for Nigerian listed firms using a quantile regression framework. The analysis involved eight pharmaceutical firms from the Nigerian Stock Exchange (NSE). The normality of the data set revealed that most of the variables were skewed (heavy tail) and therefore, the study relied upon quantile regression analysis as an analytical tool using the quantile at 0.25, 0.50, and 0.75. The model utilised inventory holding as the dependent variable while return on asset, current ratio, length of the cash conversion cycle, inflation rate, firm size and leverage were selected as explanatory variables. Of particular interest is the fact that the length of the cash conversion cycle (LCCC) is a significant determinant for inventory holding at all the different quantiles, (0.25, 0.50, and 0.75) with a positive sign. This suggests that all levels of inventory that these firms keep are determined by the short period that it takes to convert inventory to cash.

5.1 Recommendations

The study makes the following recommendations based on the outcome of the empirical findings:

1. Managers of firms within the pharmaceutical industry listed on the Nigeria Stock Exchange should encourage such policies that facilitate a short life cycle of cash conversion to enhance firm performance. The finds also suggest that managers of pharmaceutical firms should pursue aggressive working capital management policies to create value for the firm; this is because the cash conversion cycle is linked to the profitability of pharmaceutical firms.
2. Pharmaceutical firms should be mindful of inflationary trends as the increased inflation pressure may lead to excessive accumulation of inventory holding which may positively deter the firm's working capital management policy and reduce profitability. Thus, management should constantly watch the magnitude of the impact of inflation in the context of developing economies because of its different effects on inventory holding i.e., specifically at upper and lower quantiles in the conditional distribution.

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APPENDIX 1

	INTY	ROTA	LIQ	LCCC	INF	SIZE	LEV
INTY	1	0.093564	0.984213	0.606337	0.976753	0.980341	0.984742
ROTA	0.093564	1	0.141377	0.389276	0.048318	0.040631	0.039579
LIQ	0.984213	0.141377	1	0.595922	0.977342	0.981706	0.968515
LCCC	0.606337	0.389276	0.595922	1	0.490516	0.469328	0.546149
INF	0.976753	0.048318	0.977342	0.490516	1	0.982104	0.964408
SIZE	0.980341	0.040631	0.981706	0.469328	0.982104	1	0.982266
LEV	0.984742	0.039579	0.968515	0.546149	0.964408	0.982266	1