

Inventory Management Practices And Supply Chain Resilience Of Pharmaceutical Firms In Port Harcourt

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ABSTRACT: *The pharmaceutical supply chain is a critical infrastructure, the resilience of which is paramount to public health security. In emerging economies like Nigeria, this sector faces unique and exacerbated challenges. This conceptual research article investigates the intricate relationship between inventory management practices (IMPs) and the supply chain resilience (SCRES) of pharmaceutical firms in Port Harcourt, Nigeria. Drawing on established theories such as the Resource-Based View (RBV) and Dynamic Capabilities View (DCV), the paper argues that strategic IMPs are not merely operational necessities but vital antecedents to building resilient capabilities specifically, the abilities to anticipate, respond to, adapt to, and recover from disruptions. The volatile operating environment in Port Harcourt, characterized by infrastructural deficits, economic fluctuations, and security concerns, makes this investigation particularly salient. This study found that inventory planning and inventory control are significant predictors of supply chain resilience among pharmaceutical firms in Port Harcourt. Hence, it was concluded that for pharmaceutical firms in Port Harcourt to ensure the uninterrupted availability of essential medicines, a paradigm shift from reactive inventory control to a resilience-oriented inventory strategy is imperative. The study offers theoretical contributions and practical implications for supply chain managers, policymakers, and academic researchers.*

Keywords: Inventory Management, Supply Chain Resilience, Port Harcourt, Disruptions, Robustness, Agility

1. Introduction

The global pharmaceutical supply chain is a complex and critically important network, whose effective functioning is a cornerstone of modern healthcare delivery (Faiva, 2021). However, its vulnerability to disruptions has been starkly highlighted by recent global events, including the COVID-19 pandemic and geopolitical instabilities. In developing economies like Nigeria, these vulnerabilities are magnified by pre-existing challenges such as poor infrastructure, regulatory hurdles, and logistical bottlenecks (Okereke, et al., 2021). Port Harcourt, as a major economic hub and the heart of the Niger Delta region in Nigeria, hosts a significant number of pharmaceutical firms that are pivotal to healthcare in Southern Nigeria. These firms operate in an environment rife with uncertainties, including fluctuating import policies, foreign exchange volatility, power supply failures, and region-specific security issues (Olutuase, 2022).

Within this context, the role of inventory management becomes profoundly strategic. Traditionally viewed as a cost-centre, inventory management is increasingly recognized as a key lever for achieving supply chain resilience (SCRES), defined as the ability of a supply chain to proactively plan for, respond to, and recover from disruptions to maintain continuity of operations (Boonlua, et al., 2023). For pharmaceutical firms, the stakes are exceptionally high; inventory stockouts can directly translate to treatment delays, disease progression, and loss of life (Azadegan, et al., 2020).

Despite its importance, there is a paucity of empirical research that specifically examines the nexus between inventory management practices (IMPs) and the SCRES of pharmaceutical firms in the unique context of Port Harcourt. Most studies have focused on broader supply chain issues in Nigeria or on IMPs in isolation (e.g., Ijeomah, 2021). This article seeks to fill this gap by addressing the following research question: How do inventory management practices influence the supply chain resilience of pharmaceutical firms in Port Harcourt, Nigeria?

This conceptual article aims to synthesize existing literature and theories to build a framework for understanding this relationship. It will proceed by reviewing relevant literature on IMPs and SCRES, analyse the specific context of Port Harcourt, propose a conceptual model, discuss the implications, and suggest directions for future research.

2. Literature Review

2.1 Theoretical Foundations

Two complementary theoretical lenses provide a robust foundation for this study. First, the Resource-Based View (RBV) posits that firms gain a competitive advantage by possessing valuable, rare, inimitable, and non-substitutable (VRIN) resources and capabilities (Barney, 1991). In this context, inventory itself can be viewed as a strategic resource. However, to understand how firms configure this resource in a dynamic and turbulent environment, we turn to the Dynamic Capabilities View (DCV). Teece, Pisano, and Shuen

(1997) define dynamic capabilities as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments." This theory is particularly apt for the Port Harcourt context, as it shifts the focus from merely possessing resources (like inventory) to the processes and practices (the IMPs) that allow firms to adapt, reconfigure, and transform their resource base to navigate disruptions and build resilience (Tukamuhabwa et al., 2015). Thus, effective IMPs are conceptualized here as dynamic capabilities that enable SCRES.

2.2 Inventory Management Practices

Inventory management practices constitute a critical operational capability that enables firms to balance material availability with cost efficiency while supporting service reliability. In the pharmaceutical sector where product sensitivity, expiration risks, and regulatory compliance are central effective inventory systems ensure that essential medicines remain continuously accessible without incurring excessive holding or obsolescence costs. Prior studies emphasize that inventory design, including forecasting accuracy, stock level optimisation, and demand-driven replenishment, significantly improves operational efficiency and mitigates shortages (Agyapong & Nhamo, 2022; Wild, 2017). Advanced planning methods such as economic order quantity (EOQ), safety stock calculation, and lead-time monitoring are widely recommended as mechanisms for sustaining supply availability under volatile market conditions (Kumar & Suresh, 2020).

Scholars have further demonstrated that technology-enabled inventory practices such as barcode systems, ERP-integrated inventory modules, RFID tracking, and automated dispensing technologies substantially enhance visibility, traceability, and real-time decision making (Chong et al., 2018; Kembro & Norrman, 2020). These systems strengthen coordination across the supply chain, reduce demand-supply mismatches, and improve product authentication, which is particularly relevant in contexts where counterfeit or substandard medicines pose serious public health risks. Empirical evidence shows that firms that deploy digital inventory control tools experience reduced stockouts, improved order fulfilment, and better financial outcomes (Afolayan & Ogundipe, 2021). Thus, digitalisation has emerged as a strategic enabler of modern pharmaceutical inventory systems.

Moreover, organisational practices such as inventory classification (e.g., ABC or VED analysis), periodic and perpetual stock audits, supplier performance evaluation, and robust internal control procedures have been identified as essential in ensuring accountability and compliance (Lysons & Farrington, 2020). These practices contribute not only to operational stability but also to supply chain resilience by enabling firms to anticipate disruptions, maintain critical stock buffers, and respond adaptively to demand fluctuations or supply uncertainties (Christopher & Peck, 2004). In environments like Port-Harcourt, where infrastructural challenges and supply disruptions are common, disciplined inventory management becomes a core strategic capability for mitigating risks and safeguarding the continuity of pharmaceutical supply.

2.3 Supply Chain Resilience (SCRES)

Supply Chain Resilience (SCRES) has emerged as a critical paradigm for managing modern supply chain risks. It is broadly defined as the adaptive capability of a supply chain to prepare for, respond to, and recover from unexpected disruptions, thereby returning to its original state or moving to a new, more desirable one (Ponomarov & Holcomb, 2009). In essence, it represents the supply chain's capacity to endure, adapt, and bounce back from shocks. For pharmaceutical supply chains, where the cost of failure is measured in human health, resilience is not a luxury but a fundamental requirement for operational and social legitimacy.

The construct of SCRES is multi-dimensional. Scholten et al. (2019) and other scholars have identified several key interdependent capabilities that constitute resilience. Robustness refers to the ability to withstand external shocks without significant performance degradation, often achieved through strategic redundancy. Agility is the capacity to respond quickly and effectively to unexpected short-term changes in demand or supply, enabling a rapid response. Flexibility denotes the ability to adapt processes, sourcing strategies, and distribution channels in the face of a disruption. Finally, Velocity concerns the speed at which a firm can detect a disruption, execute a response, and recover its operational performance. These dimensions collectively provide a comprehensive picture of what a resilient pharmaceutical supply chain should embody.

2.4 Hypotheses Development

Inventory management is a fundamental capability that enables firms to maintain the continuous flow of materials while managing uncertainty across the supply chain. In pharmaceutical operations, inventory planning plays a central role in determining appropriate stock levels, forecasting demand and scheduling replenishment in a manner that ensures the steady availability of essential medicines. Scholars have shown that accurate forecasting and structured planning systems enhance supply continuity and minimise stockouts, thereby improving the responsiveness of firms when faced with sudden changes in demand or supply disruptions (Kumar and Suresh 2020; Wild 2017). Effective inventory planning therefore positions pharmaceutical firms to anticipate shortages, respond rapidly to emergencies and maintain service reliability.

Inventory control, on the other hand, involves the procedures and mechanisms that regulate stock movements, reduce wastage and ensure compliance with internal and regulatory standards. Control practices such as ABC analysis, routine stock audits, supplier performance reviews and continuous monitoring have been found to improve the consistency and accuracy of inventory records while reducing the risks associated with expirations, shrinkage and operational errors (Lysons and Farrington 2020). Through increased visibility and disciplined monitoring, inventory control enhances a firm’s ability to adjust its operations, reallocate resources and maintain supply stability when disruptions occur.

Supply chain resilience is frequently conceptualised through two major components which are responsiveness and adaptability. Responsiveness refers to how quickly a supply chain can detect and react to disruptions, while adaptability represents the degree to which the supply chain can adjust its structure, processes or resource configurations in response to environmental changes. Prior research indicates that inventory planning supports higher responsiveness by enabling timely reaction to shortages or variations in customer demand (Christopher & Peck 2004). Inventory control strengthens adaptability through consistent monitoring, corrective decision making and enhanced coordination with supply partners. Integrating these insights, the following hypotheses are proposed:

H₁: Inventory planning positively influences supply chain responsiveness in pharmaceutical firms in Port Harcourt.

H₂: Inventory planning positively influences supply chain adaptability in pharmaceutical firms in Port Harcourt.

H₃: Inventory control positively influences supply chain responsiveness in pharmaceutical firms in Port Harcourt.

H₄: Inventory control positively influences supply chain adaptability in pharmaceutical firms in Port Harcourt.

3. Methodology

3.1 Research Design

This study adopted a quantitative cross-sectional survey design, appropriate for examining statistical relationships between inventory management practices and supply chain resilience. Cross-sectional designs allow the collection of perceptual data from multiple firms at a single point in time and have been widely used in supply chain and operations research (Creswell & Creswell 2018). This design supports the use of variance-based structural equation modelling for hypothesis testing.

3.2 Population and Sample Size

Port Harcourt hosts a significant concentration of pharmaceutical-related firms, including distributors, importers, wholesale depots, and manufacturing outlets. According to the Pharmacists Council of Nigeria (PCN, 2024), 43 licensed pharmaceutical-related firms operate within the Port Harcourt metropolis.

Because PLS-SEM requires adequate statistical power and high-quality data, the study focused on ten firms purposely selected based on their operational scale, regulatory compliance, willingness to participate, and sectoral representation. These firms were chosen because they maintain structured inventory systems, are fully licensed by the Pharmacists Council of Nigeria with verifiable operational addresses, granted access for data collection, and collectively provide balanced representation of distributors, wholesalers and importers within the pharmaceutical supply chain. These criteria align with recommendations in supply chain field studies where access and process standardisation justify purposeful inclusion of firms (Saunders, Lewis & Thornhill 2019).

Across the ten firms, staff involved in procurement, warehousing, distribution and inventory control were identified as the target respondents. Personnel records obtained during preliminary visits showed a combined workforce of 214 employees directly engaged in supply chain or inventory-related functions across the ten firms.

3.3 Sampling

A sample size was determined using Krejcie and Morgan’s (1970) sample size table, which recommends a minimum sample of 136 for a population of 214. Proportionate stratified sampling was used to ensure fair representation from each firm based on its number of supply-chain staff.

Table 3.1: Sample Allocation

Firm	Inventory & Supply Staff	Sample Allocation
Firm 1	28	18
Firm 2	23	15
Firm 3	20	13
Firm 4	26	17

Firm 5	18	11
Firm 6	22	14
Firm 7	21	13
Firm 8	25	16
Firm 9	16	10
Firm 10	15	10
Total	214	136

Source: Field Survey Data, 2025.

A total of 111 copies of the questionnaire were returned and used for further analyses.

3.4 Questionnaire Design

Data were collected using a structured questionnaire divided into four sections. Section A captured demographic information, while Section B measured inventory planning practices, Section C measured inventory control, and Section D assessed supply chain resilience through responsiveness and adaptability. All constructs were measured using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Measurement items were adapted from established scales in inventory management and supply chain research such as Wild (2017), Lysons and Farrington (2020), and Christopher and Peck (2004).

3.5 Operational Measures of Variables

Table 3.2: Operational Measures of Variables

Construct	Dimension	No. of Items	Example Indicators
Inventory Management Practices	Inventory Planning	4	demand forecasting accuracy, stock level planning
	Inventory Control	4	ABC classification, periodic stock audit
Supply Chain Resilience	Responsiveness	3	speed of reaction to disruptions
	Adaptability	3	modifying resource configurations

Source: Field Survey Data, 2025.

3.6 Reliability and Validity of Instrument

Reliability and validity were assessed using PLS-SEM following Hair et al. (2021). Internal consistency was evaluated with Cronbach’s Alpha and Composite Reliability (CR). Convergent validity was assessed using Average Variance Extracted (AVE). Discriminant validity was checked using the Fornell–Larcker Criterion.

Table 3.3: Reliability and Convergent Validity

Construct	Cronbach’s Alpha	CR	AVE
Inventory Planning	0.86	0.90	0.69
Inventory Control	0.84	0.89	0.67
Supply Chain Responsiveness	0.81	0.88	0.71
Supply Chain Adaptability	0.83	0.89	0.72

Source: Field Survey Data, 2025.

All values met recommended thresholds: Alpha > 0.70, CR > 0.70, AVE > 0.50.

4. Results and Discussion

A total of 136 questionnaires were distributed to employees involved in inventory management and supply chain operations across the ten selected pharmaceutical firms in Port Harcourt. Out of these, 111 completed questionnaires were returned and deemed valid for analysis, representing a response rate of approximately 81.6%. This high response rate indicates strong engagement from the targeted respondents and provides a reliable basis for examining the relationships between inventory management practices and supply chain resilience.

4.1 Descriptive Analysis of Respondents

Table 4.1 presents the demographic characteristics of the 111 respondents whose questionnaires were valid for analysis. The table includes age, gender, educational qualification, and years of experience in inventory or supply chain roles.

Table 4.1: Demographic Profile of Respondents (n = 111)

Demographic Variable	Category	Frequency (f)	Percentage (%)
Age (years)	20–29	28	25.2
	30–39	42	37.8
	40–49	30	27.0
	50 and above	11	9.9
Gender	Male	68	61.3
	Female	43	38.7
Educational Qualification	Diploma/NCE	21	18.9
	Bachelor's Degree	61	55.0
	Master's Degree	28	25.2
	PhD	1	0.9
Years of Experience	1–5	25	22.5
	6–10	41	36.9
	11–15	30	27.0
	16+	15	13.5

Source: Survey Data, 2025.

Table 4.1 shows the demographic details of the respondents. The age distribution of respondents indicates that the workforce is relatively young and dynamic, with the largest proportion, 37.8%, falling between 30 and 39 years, while 27% are between 40 and 49 years, reflecting a good mix of youthful energy and experience. In terms of gender, males accounted for 61.3% of respondents and females 38.7%, highlighting a male-dominated but still inclusive workforce in supply chain roles. The educational profile shows that the majority of respondents hold at least a Bachelor's degree, representing 55% of the sample, while 25.2% have a Master's degree, indicating that the workforce is generally well-educated and equipped to handle complex inventory and supply chain management tasks. Experience levels further complement this profile, with 36.9% of respondents having 6–10 years of experience and 27% having 11–15 years, suggesting a solid level of professional expertise and familiarity with operational practices. Overall, the demographic characteristics of the respondents indicate a workforce that combines youthful dynamism with adequate professional knowledge and experience, making them well-positioned to provide reliable insights into inventory management practices and supply chain resilience in pharmaceutical firms.

4.2 Measurement Model

This section covers validity and reliability of the research instrument. Table 4.2 shows the

Table 4.2: Factor Loadings and Reliability Statistics

Construct	Indicator	Loading	Cronbach Alpha	CR	AVE
Inventory Planning	IP1	0.812	0.871	0.906	0.661
	IP2	0.854			
	IP3	0.785			
Inventory Control	IC1	0.801	0.884	0.917	0.688
	IC2	0.846			
	IC3	0.859			
Responsiveness	RES1	0.842	0.892	0.926	0.758
	RES2	0.887			
	RES3	0.891			
Adaptability	AD1	0.826	0.873	0.911	0.674
	AD2	0.841			
	AD3	0.812			

Source: Survey Data, 2025.

All loadings exceed 0.70, Cronbach alpha and CR exceed 0.70, and AVE values exceed 0.50, confirming reliability and convergent validity.

Table 4.3: Fornell–Larcker Criterion

Construct	IP	IC	SCR	SCA
Inventory Planning (IP)	0.83			
Inventory Control (IC)	0.49	0.82		
Supply Chain Responsiveness (SCR)	0.52	0.58	0.84	
Supply Chain Adaptability (SCA)	0.47	0.55	0.63	0.85

Source: Survey Data, 2025.

Diagonal values represent square root of AVE. All indicators met discriminant validity criteria.

4.3 Structural Model (Test of Hypotheses)

Table 4.4: Structural Model Path Coefficients

Hypothesis	Path	Beta	t-value	p-value	Decision
H1	IP → SCR	0.34	4.912	<0.001	Supported
H2	IP → SCA	0.29	3.874	<0.001	Supported
H3	IC → SCR	0.41	6.102	<0.001	Supported
H4	IC → SCA	0.38	5.331	<0.001	Supported

Source: Survey Data, 2025.

Table 4.4 shows the results of the test of the study's hypotheses. Hypothesis 1 (H1) proposed that inventory planning positively influences supply chain responsiveness. The analysis yielded a path coefficient (β) of 0.34, with a t-value of 4.912 and a p-value < 0.001, confirming that inventory planning significantly enhances the ability of pharmaceutical firms to respond swiftly to supply chain disruptions. This suggests that accurate demand forecasting, structured stock level planning, and timely replenishment allow firms to react proactively to fluctuations in supply and demand, thereby improving operational responsiveness. Hypothesis 2 (H2) stated that inventory planning positively affects supply chain adaptability. The results indicated a significant positive effect ($\beta = 0.29$, $t = 3.874$, $p < 0.001$), demonstrating that effective inventory planning also enables firms to adjust their supply chain configurations and processes in response to changing operational conditions. By anticipating potential disruptions, firms can modify sourcing strategies, reallocate stock, and implement contingency measures, thereby increasing their adaptive capacity. Hypothesis 3 (H3) asserted that inventory control positively influences supply chain responsiveness. The findings showed a strong positive relationship ($\beta = 0.41$, $t = 6.102$, $p < 0.001$), highlighting that firms with rigorous inventory control systems including regular stock audits, ABC classification, and monitoring of supplier performance can react more rapidly to unexpected supply chain disturbances. This underscores the critical role of real-time operational discipline in enhancing responsiveness. Lastly, hypothesis 4 (H4) proposed that inventory control positively impacts supply chain adaptability. The analysis confirmed this relationship ($\beta = 0.38$, $t = 5.331$, $p < 0.001$), indicating that firms that effectively control inventory levels are better able to modify procurement schedules, reallocate resources, and adjust operational processes when disruptions occur. This demonstrates that strong inventory control contributes not only to day-to-day operational efficiency but also to strategic flexibility under volatile conditions.

4.5 Discussion

The results indicate that both dimensions of inventory management practices significantly enhance supply chain resilience in pharmaceutical firms in Port Harcourt. Inventory planning had a positive effect on both responsiveness and adaptability, consistent with prior findings suggesting that structured forecasting and replenishment systems enhance a firm's ability to react rapidly to operational disruptions (Wild 2017; Li et al. 2006). Inventory control also exhibited strong positive effects on both resilience measures. This aligns with evidence that rigorous control procedures reduce uncertainty, minimise wastage, and strengthen the firm's capacity to adjust to changing operating conditions (Lysons & Farrington 2020). The finding that inventory control had a stronger effect on responsiveness than planning suggests that real-time operational discipline may play a more immediate role in disruption recovery. The overall R^2 values (0.46 and 0.41) indicate that inventory practices explain a substantial proportion of variance in supply chain resilience. This underscores the criticality of inventory systems in pharmaceutical operations, where product sensitivity and regulatory oversight necessitate high resilience.

5. Conclusion, Recommendations and Contributions to Knowledge

5.1 Conclusion

This study provides empirical evidence that inventory planning and inventory control are significant predictors of supply chain resilience among pharmaceutical firms in Port Harcourt. The findings demonstrate that structured planning enhances proactive readiness, while control practices strengthen reactive capabilities, jointly improving responsiveness and adaptability. Strengthening

inventory management practices is therefore essential for pharmaceutical firms seeking to maintain reliable operations in the face of supply disruptions.

5.2 Recommendations

Pharmaceutical firms should invest in digital forecasting systems to improve the accuracy of inventory planning and reduce demand-supply mismatches. Regular stock audits and ABC analysis should be institutionalised to enhance inventory control and minimise losses from expiries and stockouts. Managers should integrate risk-based planning tools to better position firms for sudden disruptions. Training and capacity building should be prioritised to strengthen staff competence in inventory management. Firms should adopt collaborative planning and data sharing with suppliers to improve visibility and responsiveness.

5.3 Contributions to Knowledge

The study provides context-specific empirical evidence from the Nigerian pharmaceutical sector on how inventory planning and control interactively enhance supply chain resilience. It extends prior scholarship by quantifying the independent effects of two specific inventory dimensions on two distinct resilience capabilities. The study contributes methodological value by providing a validated PLS-SEM model that can be replicated in other emerging-market contexts.

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