

From Supply Chain Frictions to Financial Resilience: Evidence from an Emerging Economy

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Abstract

Supply chains are often seen as a strategic system to boost profitability rather than a cost center, especially in developing countries with problems in logistics, working capital constraints, and frequent market disruptions. This study tests whether supply chain performance proxies capture the profitability of publicly traded cement firms in Bangladesh for the period 2015-2024. The study covers 54 firm-year observations for the years 2016-2024. FGLS model is used as the main estimator, while PCSE and robust OLS are used for validation and to adjust for diagnostic issues. Results show that all lagged proxies of the supply chain have a substantial effect on profitability, indicating that adequate management of receivables, inventory, payables, and working capital can greatly enhance profitability in firms operating within an emerging economy. By situating these results within established theoretical paradigms and rigorous econometric analysis, this study delivers pragmatic guidance for bolstering enduring financial resilience via systematic supply-chain finance strategies.

Keywords: Supply Chain Performance, Developing Countries, Cement Industry, Emerging Economy, Profitability, FGLS

1. Introduction

Management of the supply chain is the strategic control over the movement of information, products, and services, both within and among companies, to generate benefits for the supply chain ecosystem as a whole and for the success of individual businesses (Mentzer et al., 2001). SCM broadens the concept of logistics management to include cross-functional integration, coherence in decision-making, and consistency between procurement, production, distribution, and financial flows of different organizations (Cooper et al., 1997). Empirical evidence shows that better quality implementation of SCM practices and increased integration of supply chains lead to better performance at the organizational and financial levels (Flynn et al., 2010; Li et al., 2006). However, supply chain disruptions have a major negative effect on business operations and firm value (Dyer & Singh, 1998; Hendricks & Singhal, 2005; Williamson, 1998).

The cement industry is an ideal case in examining the effects of supply chain profitability, given its capital-intensive, volume-driven, and efficient material flows and distribution network operations. It is also a sector highly sensitive to credit policies and inventory management practices and working capital constraints (Petersen & Rajan, 1997; Rezina & Khan, 2020; Richards & Laughlin, 1980). Supply chain performance involves critical operational trade-offs. Working capital is considered a strategic asset in emerging economies, especially when external financing options are less available. Such a situation would force firms to maintain a disciplined approach to their operating cash flows (Fazzari & Petersen, 1993; SMITH, 1987). Companies often use supplier and customer credits to manage financing difficulties that emerge from financial frictions (Fisman & Love, 2003; Petersen & Rajan, 1997).

Earlier studies on the cement industry in Bangladesh have mostly focused on the parameters of working capital and major macroeconomic factors that influence profitability, including the return on assets (Quayyum, 2011; Rezina & Khan, 2020). More research should explicitly measure supply-chain performance using different turnover and intensity ratios and apply estimation techniques that can capture cross-sectional correlation due to common shocks at the industry level (Chakku et al., 2019; Hofmann & Kotzab, 2010; Pesaran & M.H., 2004). This study makes a significant contribution because it uses panel data for the years 2015 to 2024 and an estimator that considers the identified cross-sectional dependence. Effective supply chain management can increase profitability by reducing working capital requirements, minimizing stockouts and emergency procurement, and accelerating cash conversion from sales (García-Teruel & Martínez-Solano, 2007; Richards & Laughlin, 1980). The cement industry is particularly relevant due to its strategic role in the development of infrastructure and the direct link between operational effectiveness and financial performance throughout the supply chain (Petersen & Rajan, 1997; Rezina & Khan, 2020).

This study has a number of unique traits compared to other studies that can be considered as significant gaps in the literature. Firstly, not enough evidence has been found on the cement industry of Bangladesh that has applied the Pesaran CD test to check cross-sectional dependence nor used robust models like FGLS or PCSE estimators (Beck & Katz, 1995; Parks, 1967; Pesaran & M.H., 2004). Secondly, previous studies focused on traditional working-capital measures, and not enough evidence was found that has brought in a full supply chain management framework altogether (Asha et al., 2022; Fahim et al., 2024; Helal et al., 2024; Iftekhar et al., 2020; Noha et al., 2023; M. Rahman et al., 2023). Thirdly, not enough studies covered the period from 2015 to 2024, a time that saw major supply chain and macroeconomic disruptions. Fourthly, there's not enough existing research that lays down a theoretical foundation integrating Resource-Based View, Transaction Cost Economics, Relational View, and Cash Conversion Cycle Theory (Barney, 1991; Dyer & Singh, 1998; Richards & Laughlin, 1980; Williamson, 1979).

This study, therefore, examines whether and how the proxies of supply-chain performance affect the profitability of the six cement companies listed with the DSE. In that sense, it applies and tests a full-fledged supply chain management framework from the strategic to the operational level. This approach provides both scientifically and practically valuable results. The formulated research objectives are presented below to guide the scope and direction of the study:

- I. To assess how inventory intensity (ISR) affects profitability
- II. To examine how collection efficiency (ARTR) relates to profitability.
- III. To assess how collection period (DSO) affects profitability.
- IV. To examine how payment speed (APTR) affects profitability.
- V. To assess how working-capital position (WCR) relates to profitability.
- VI. To examine how asset utilization (AT) affects profitability.
- VII. To assess how inventory efficiency (ITR) relates to profitability.

2. Literature Review and Hypothesis Development

The theoretical underpinnings that tie supply-chain and working-capital variables to profitability are discussed in this literature review. It also synthesizes empirical evidence from contexts around the globe, emerging markets, and Bangladesh, and develops hypotheses that can be said to match model specification (García-Teruel & Martínez-Solano, 2007; Mentzer et al., 2001). According to the RBV, companies get an edge over their competitors when their assets

are valued, uncommon, unique, and impossible to replace (Barney, 1991; Deloof, 2003). The same applies to supply-chain capabilities in manufacturing in terms of inventory management, receivables collection, and cash-flow conversion, especially under infrastructure and financing constraints as critical strategic resources (Flynn et al., 2010; Li et al., 2006; Richards & Laughlin, 1980). Therefore, inventory turnover, receivables turnover, and asset turnover can be used as measures of how efficiently a firm can transform resources into profitability and hence impact return on assets (Aktas et al., 2015; Nissim & Penman, 2001). According to Transaction Cost Economics, organizational performance depends on minimizing transaction, monitoring, and enforcement costs due to bounded rationality and opportunism (Williamson, 1979). Inefficient coordination in the supply chain presents the organization with additional transaction costs in terms of delays, disputes, and pressures on working capital (Blinder & Maccini, 1991; Eroglu & Hofer, 2011; Fazzari & Petersen, 1993; Fisman & Love, 2003; Petersen & Rajan, 1997).

The relational view further suggests that interfirm relationships create relational rents through collaborative payment terms, credit policies, and information sharing, which would explain the link between profitability and the interrelationships among the supply chain management metrics (Dyer & Singh, 1998; Fazzari & Petersen, 1993; Fisman & Love, 2003; Petersen & Rajan, 1997; Soliman, 2008). According to the Cash Conversion Cycle (CCC) Theory, proper inventory management, receivables, and payables will lead to increased liquidity and profitability, especially for firms under financial constraints (Fazzari & Petersen, 1993; Pesaran & M.H., 2004; Quayyum, 2011; Richards & Laughlin, 1980; SMITH, 1987). The study integrates Resource-Based View (RBV), Transaction Cost Economics, Relational View, and CCC Theory to argue that supply chain performance proxies influence ROA systematically among cement companies listed on the DSE, controlling for firm size and age (Barney, 1991; Dyer & Singh, 1998; Richards & Laughlin, 1980; Williamson, 1979).

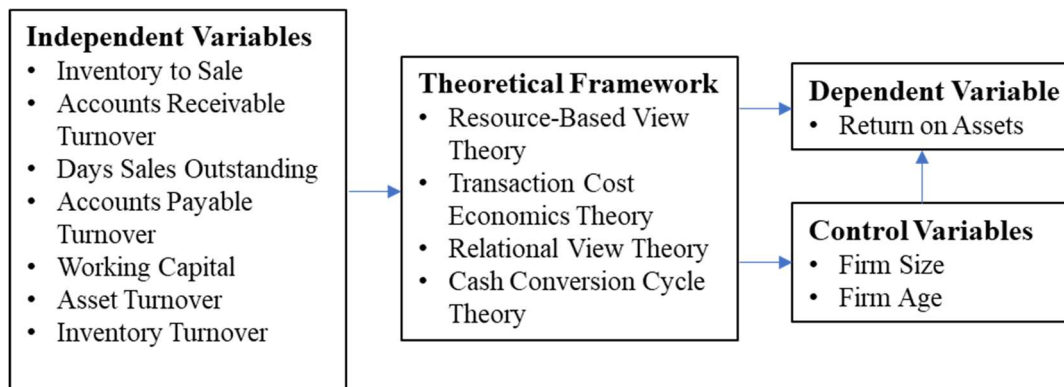


Figure 01. Conceptual Framework

Combining the four theoretical perspectives altogether, the Resource-Based View sees inventory, receivables, payables, and asset-utilization efficiency as valuable and inimitable capabilities (Barney, 1991). Transaction Cost Economics explains how coordination failures within these processes raise transaction costs (Williamson, 1979). The Relational View spots supplier-customer agreements as sources of relational rents (Dyer & Singh, 1998). Cash Conversion Theory sees one set of processes as the mechanism that governs liquidity (Richards & Laughlin, 1980). This study then develops the following hypothesis: Return on Assets for cement companies listed with the Dhaka Stock Exchange (DSE) can be predicted by the shown interrelationships among the supply chain management metrics. The model also includes firm size and firm age as control variables to accommodate structural heterogeneity.

Turning to the evidence, previous studies that have been conducted on supply chain management (SCM) integration have shown that well-managed supply chains lead to better results for the organization (Flynn et al., 2010; Li et al., 2006). Research that has focused on disruptions has found that failures in the supply chain are very damaging to profitability metrics (Dyer & Singh, 1998; Hendricks & Singhal, 2005; Williamson, 1998). There is a significant body of evidence that relates working capital efficiency to profitability. Deloof (2003) finds that the managers of Belgian

firms can increase profitability by cutting down on the time needed to turn inventories and receivables into cash. García-Teruel & Martínez-Solano (2007) provide supporting evidence for Spanish small and medium-sized businesses. Baños-Caballero et al. (2014) show that working capital investment and performance have an inverted U relationship, whereas Aktas et al. (2015) show that improvements in working capital create value in line with enhancement in efficiency.

Inventory related evidences are rather complex. Low carrying costs can be achieved through lean inventory practices, but the risk of stockouts becomes very high with excessively lean inventories. The industry context is especially important, and in the cement sector, this is most significant as, due to logistical disruptions and variability in demand, inventory positioning becomes a very important part of strategic planning (Eroglu & Hofer, 2011). Studies on supply chain management (SCM) and firm-level profitability in Bangladesh have been extended in sectors like cement, ready-made garments (RMG), fast-moving consumer goods, and manufacturing. Despite this extension of the literature, three main gaps remain. Firstly, most studies have used basic regression or ratio analysis without panel diagnostics. Secondly, they have used perceptual survey data without the involvement of financial statement analysis. Thirdly, they have ignored cross-sectional dependence, although most firms are subject to common macroeconomic and sectoral shocks (Pesaran & M.H., 2004). The paper will try to fill in these gaps by using Pesaran CD-based diagnostics and FGLS estimation in a broad multi-proxy framework of supply chain performance (Parks, 1967).

In the Bangladeshi cement industry, Quayyum (2011) studied WCM and liquidity for four companies listed on the DSE from 2005 to 2009, and documented statistically substantial evidence of a relationship between CCC and profitability. In their study, Hoque et al. (2015) proved a negative relationship between DSO and ROA, without checking for cross-sectional dependence. S. M. K. Rahman & Ahmed (2021) found that working capital components affect profitability, even though their analysis was based on ratio analysis only. Rezina & Khan (2020) determined the factors of ROA without considering multi-dimensional SCM proxies. Another study checked the relationships of ROA and ROE with receivables, payables, and inventory management but did not use Pesaran CD testing (Hoque et al., 2015).

Apart from the cement industry, Khan & Emon (2025) found using the PLS-SEM approach that digital supply chain practices play a significant role as a mediator to examine the link between SCM strategies and organizational performance in Bangladesh's manufacturing sector. Emon et al. (2024) proved that supplier relationship management enhances cost and efficiency outcomes at the perceptual level. More so, Meah et al. (2021) also found that working capital management efficiency contributes to profitability. Their study did not specifically focus on the cement sector or conduct tests for cross-sectional dependence. The literature summary is shown below,

Table 01. Literature Summary

Research Gaps	Gaps Identified	Supporting Evidence	Reference(s)
Vendor management & price transmission	No panel evidence links vendor management or price transmission to ROA/ROE in DSE-listed firms; no financial statement analysis or panel econometrics.	Vendor management improves cost reduction and customer satisfaction; supplier survey shows suppliers drove 40% of price hikes.	(Asha et al., 2022; M. Rahman et al., 2023)
Perishable SCM & circular economy	No panel or econometric test of profitability; no longitudinal DSE data, ROA model, or financial performance framework.	Interview-based perishable-goods study proposes a revised SC system; circular economy work maps barriers and enablers only.	(Iftekhhar et al., 2020; Noha et al., 2023)
Disruption, last-mile, silk & lead time	No quantitative panel evidence links disruptions, last-mile efficiency, silk gaps, or lead-time cuts to profitability/ROA.	Studies are descriptive or qualitative, covering resilience, delivery	(Islam et al., 2025; Jawad et al., 2024)

		feasibility, silk demand-supply imbalance, and efficiency recommendations.	
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(Author's own findings)

2.1. Hypothesis Development

The hypotheses are formulated to empirically test the relationships and are outlined below:

H1: Inventory-to-sales is significantly associated with firms' profitability.

The high intensity of inventory leads to high holding costs and risk of obsolescence, while low inventory leads to stockouts and disruption of operations (Eroglu & Hofer, 2011). In the cement supply chain, companies often hold higher inventory levels to ease logistics bottlenecks and fluctuating demand, which can either steady profits or reduce ROA because of rising carrying costs. Hence, a strong relationship is assumed between the inventory-to-sales ratio and profitability.

H2: Accounts receivable turnover is significantly associated with firms' profitability.

Accounts receivable turnover (ARTR) measures how quickly credit sales are converted into cash, where higher turnover usually means better liquidity and profitability (Deloof, 2003). The trade credit theories link receivables policies to customer relationships, financing decisions, and default risk, all of which affect firm performance (Fisman & Love, 2003; Petersen & Rajan, 1997). This link is especially important in emerging economies where financing constraints are common (Fazzari & Petersen, 1993; SMITH, 1987). As a result, ARTR is expected to have a strong correlation with profitability.

H3: Day's sales outstanding is significantly associated with firms' profitability.

The average collection period captures how many days, on average, credit sales stay outstanding before collection (Richards & Laughlin, 1980). Extended periods of collection immobilize funds in receivables, increase liquidity risk, and raise the costs of financing. This can be explained through the financing-constraint approach, which argues that poorly managed working capital can block investment opportunities (Deloof, 2003; Fazzari & Petersen, 1993). In light of the above discussion, DSO and ROA are predicted to have a negative association.

H4: Accounts payable turnover is significantly associated with firms' profitability.

The accounts payable turnover (APTR) captures the speed at which a firm settles its bills with trade suppliers. Trade credit poses an advantage in terms of liquidity, but if payment periods are extended, it may cause damage to the relationships with suppliers and increase the risk of disruptions in operations (García-Teruel & Martínez-Solano, 2007; Nissim & Penman, 2001; Wetzel & Hofmann, 2019). This relationship has received mixed empirical support, suggesting that the trade-off between the benefits of liquidity and costs of operations may be specific to the context (Baños-Caballero et al., 2014; Fisman & Love, 2003). In line with the importance of continuous supply of raw materials in the cement industry, it is hypothesized that APTR will be significantly related to profitability.

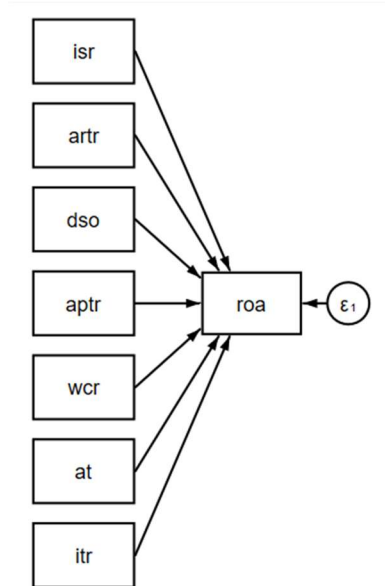


Figure 02. Structural Equation Model

H5: Working capital is significantly associated with firms' profitability.

The working capital ratio (WCR) shows the firm's liquidity and its ability to continue its operations (Baños-Caballero et al., 2014). Proper investment in working capital ensures smooth operations and stock availability, while overinvestment will reduce returns due to the opportunity cost. For cement companies working with demand fluctuation and facing logistics problems, the most appropriate management of working capital will reduce disruptions as well as reduce the need for expensive short-term financing (Deloof, 2003). Hence, WCR is expected to have a significant correlation with profitability.

H6: Asset turnover is significantly associated with firms' profitability.

Asset turnover (AT) captures how effectively a company generates sales from its asset base, making it a core building block in decomposing profitability (Soliman, 2008). Higher turnover usually implies higher operating efficiency, but turnover and profit margins may act as substitutes for each other, especially in cement markets with intense competition and high transportation costs (Aktas et al., 2015). A significant association between AT and ROA is, therefore, assumed.

H7: Inventory turnover is significantly associated with firms' profitability.

Inventory turnover (ITR) indicates how efficiently the goods are turned into sales within the cash conversion cycle (Richards & Laughlin, 1980). Higher turnover is associated with better inventory management, lower holding costs, and increased profits. The problem arises if inventory is reduced too far and the risk of stockout occurs, disrupting operations (Deloof, 2003; Eroglu & Hofer, 2011). Therefore, ITR would be expected to relate significantly to profitability.

3. Research Methodology and Econometrics

3.1. Selection of Samples and Data Sources

The sample consists of six out of the seven DSE-listed cement companies, selected to maximize firm representation and ensure data availability from 2015 to 2024. The data were sourced from the firms' audited reports.

3.2. Variable Description

The measurement details of the variables are as given below.

Table 02. Variable Descriptions

Variables	Acronyms	Definition & approach	Research Sources
Dependent Variable			
ROA	Return on assets (profitability)	Profitability studies generally use ROA for performance in panel settings: $\frac{\text{Net Income}}{\text{Total Assets}}$	(Rezina & Khan, 2020)
Independent Variables			
ISR	Inventory to sales ratio (inventory intensity)	Studies of the inventory-performance link commonly use inventory scaled by sales as a key efficiency proxy: $\frac{\text{Inventory}}{\text{Sales}}$	(Eroglu & Hofer, 2011)
ARTR	Accounts receivable turnover ratio (collection efficiency)	Working-capital research uses receivables turnover/collection metrics to study profitability: $\frac{\text{Sales}}{\text{Accounts Receivable}}$	(Deloof, 2003)
DSO	Days' sales outstanding (collection time)	The CCC framework centers on the collection period as a key component: $\frac{365}{\text{Accounts Receivable Turnover}}$	(Richards & Laughlin, 1980)
APTR	Accounts payable turnover ratio (payment speed)	Trade credit and CCC literature treats payables as a core working-capital component:	(Richards & Laughlin, 1980)

		$\frac{COGS}{Accounts Payable}$	
WCR	Working capital ratio (net WC relative to sales)	Working-capital performance research often operationalizes working-capital investment levels relative to activity scale: $\frac{Current Assets - Current Liabilities}{Sales}$	(Baños-Caballero et al., 2014)
AT	Asset turnover (asset utilization)	Financial statement analysis decomposes profitability through turnover and margin components: $\frac{Sales}{Total Assets}$	(Soliman, 2008)
ITR	Inventory turnover (inventory efficiency)	Inventory turnover is a standard CCC/inventory efficiency measure in empirical WCM research: $\frac{COGS}{Inventory}$	(Quayyum, 2011)
Control Variables			
Size	Firm size	Profitability determinants commonly include size as a control in panel models: $\ln(total assets)$	(Rezina & Khan, 2020)
Age	Firm age	Firm age is used in performance studies; aging can be linked to rigidity/inertia. $Years since establishment$	(Majumdar, 1997)

(Author's own findings)

3.3. Econometric Model

We estimate the following panel model:

$$ROA_{it} = \beta_0 + \beta_1 ISR_{i,t-1} + \beta_2 ARTR_{i,t-1} + \beta_3 DSO_{i,t-1} + \beta_4 APTR_{i,t-1} + \beta_5 WCR_{i,t-1} + \beta_6 AT_{i,t-1} + \beta_7 ITR_{i,t-1} + \beta_8 Size_{i,t-1} + \beta_9 Age_{i,t-1} + \varepsilon_{it} \dots \dots \dots (i)$$

To account for temporal effects, the model includes all explanatory and control variables with a one-year lag relative to the dependent variable. The resulting balanced panel contains 54 firm-year observations covering 2016 to 2024. This lag structure helps to mitigate potential threats to causal inference, including simultaneity and endogeneity between profitability and supply chain efficiency decisions, omitted time-varying firm characteristics, and reverse causality in which current profitability may influence inventory, receivables, and payables policies (Bai et al., 2020). In this model, *(i)* identifies the individual firm across the cross-section and *(t)* refers to its corresponding time period. The intercept is denoted as β_0 , while β_1 through β_9 quantify the impact of explanatory variables on profitability. Furthermore, ε_{it} captures random shocks that are not explained by the regressors.

Table 03. Diagnostic Tests for Model Assumptions (Lagged-Regressor Model)

Diagnostic	Test statistic	Interpretation
Shapiro-Wilk residual normality	$W = 0.9823$	Fail to reject normality (no evidence that residuals are non-normal)
Breusch-Pagan/Cook-Weisberg heteroskedasticity	$\chi^2(1) = 3.30$	Fail to reject constant variance at 5% ($p = 0.069$)
Wooldridge/Drukker serial autocorrelation test	$F(1,5) = 2.545$	Fail to reject no AR (1), $p = 0.172$ (supports "no autocorrelation")
Pesaran CD cross-sectional dependence	$CD = 3.324^{***}$	Rejecting independence (cross-sectional dependence present) motivates correlated-panel inference.

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

In the one-year-lagged specification, the Shapiro-Wilk, Breusch-Pagan/Cook-Weisberg, and Wooldridge/Drukker tests indicate that the residuals are normally distributed, homoscedastic, and free from first-order serial autocorrelation (Breusch & Pagan, 1979; Drukker, 2003; Shapiro & Wilk, 1965). However, the Pesaran CD test shows a highly significant result ($p=0.001$), affirming that firm outcomes share co-movement either due to common macroeconomic conditions, industry demand cycles, or input cost shocks (Rezina & Khan, 2020). In line with prior studies (Pesaran & M.H., 2004), this result indicates that the FGLS model with contemporaneous cross-sectional correlation should be used rather than pooled OLS inference. As a robustness check, we also reported the PCSE model, which adjusts standard errors for panel serial autocorrelation and cross-sectional dependence (Beck & Katz, 1995). PCSE stands for reliable inference when there is contemporaneous correlation, and for additional transparency, we also include Pooled OLS with White-type robust corrections (Pesaran & M.H., 2004; Wetzell & Hofmann, 2019; White, 1980).

4. Results and Discussion

4.1. Descriptive Statistics

Table 4 summarizes descriptive data pertaining to the lag variables. The mean one-year-lagged return on assets (ROA) amounts to 0.0463, or 4.63%, with a minimum of -0.0391 and a maximum of 0.1638, revealing considerable variability among firms and across years. The average lagged DSO, meanwhile, stands at 56.52, and the average lagged ARTR at 10.57, pointing to considerable variation across firms in how efficiently receivables are collected.

Table 04. Descriptive Statistics

Variables	N	Mean	SD	Median	Min	Max
ROA	54	0.0463	0.0497	0.0369	-0.0391	0.1638
ISR	54	0.1170	0.0356	0.1161	0.0493	0.2382
ARTR	54	10.5717	11.5400	6.0359	3.3924	56.2987
DSO	54	56.5201	26.7360	60.5226	6.4833	107.5941

APTR	54	11.6788	11.6406	7.8414	1.8034	56.4717
WCR	54	-0.0271	0.3005	-0.0043	-0.6764	0.7991
AT	54	0.7776	0.3273	0.7339	0.2417	1.9097
ITR	54	7.8542	2.7770	7.5813	4.1977	17.2322
Size	54	23.3195	0.5327	23.2849	22.1798	24.3144
Age	54	23.5000	4.3902	24.0000	14.0000	32.0000

(Author's own findings)

The average working capital ratio is negative, at -0.0271, showing that net working capital relative to sales is marginally negative in this sample, which lines up with how most businesses tend to use current liabilities and trade credit in their day-to-day operations.

4.2. Correlation Matrix and Multicollinearity

Table 5 shows the pairwise correlation coefficients, with asterisks indicating significance at the 5% level. When lagged regressors are used, ROA possesses a statistically significant and favorable correlation with both ARTR and WCR, and a significant and negative association with DSO and ITR. The correlation with lagged Age is still negative, but it loses statistical significance when a one-year lag is considered; this is in contrast to the contemporaneous specification.

Table 05: Correlation Matrix and Multicollinearity

Var.	ROA	ISR	ARTR	DSO	APTR	WCR	AT	ITR	Size	Age	VIF
ROA	1.0000										
ISR	0.0590	1.0000									5.57
ARTR	0.3644*	0.0642	1.0000								2.85
DSO	-0.3982*	0.0126	-0.7678*	1.0000							3.30
APTR	-0.2381	-0.2335	-0.3257*	0.3606*	1.0000						1.25
WCR	0.3734*	0.0519	0.1394	-0.2154	-0.0016	1.0000					1.41
AT	-0.0165	-0.0811	0.4259*	-0.4419*	-0.1437	0.2340	1.0000				2.42
ITR	-0.2956*	-0.8556*	-0.2240	0.2127	0.2661	-0.2287	0.0768	1.0000			5.80
Size	0.1822	-0.2169	0.2950*	-0.3529*	-0.0869	0.0384	-0.3218*	-0.0208	1.0000		2.15
Age	-0.2184	0.0208	0.0434	0.0913	-0.0389	-0.4053*	-0.1974	0.0638	-0.0614	1.0000	1.32
Mean VIF											2.90

Note: * p<0.05; ** p<0.01; *** p<0.001.

Lagged ARTR and lagged DSO have a significant negative correlation of -0.7678. This is mechanically consistent since DSO is inversely related to receivables turnover. The VIFs are used to judge the influence of collinearity on

regression inference. The mean VIF is 2.90; the maximum VIF of 5.80 indicates no severe multicollinearity (O'Brien, 2007).

4.3. Regression Analysis Using Panel Data and Findings

Inference methods that explicitly adjust for contemporaneous correlation are preferred since cross-sectional dependence has been identified (Pesaran & M.H., 2004). We have therefore used the FGLS model, which accommodates cross-sectional correlation as the primary estimator (Bai et al., 2020; Parks, 1967).

Table 06. Regression Results FGLS Model

Variable	FGLS (Z-Statistics)
ISR	-0.502*** (-3.20)
ARTR	0.00148*** (3.06)
DSO	-0.000450*** (-2.85)
APTR	-0.000813*** (-3.81)
WCR	0.0307** (2.47)
AT	-0.0676*** (-4.95)
ITR	-0.00559*** (-2.85)
Size	-0.0307*** (-4.41)
Age	-0.00231*** (-2.79)
Constant	0.985*** (4.96)
Wald chi-square	100.14

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The lagged Inventory-to-Sales Ratio (ISR) is significantly negative ($p = 0.001$). That is, a one-unit increase in lagged ISR is associated with a decrease in ROA of about 50.2 percentage points. This result indicates that cement firms with relatively large inventories compared to sales will experience much lower subsequent profitability, a finding consistent with the holding-cost and obsolescence-risk mechanisms underlying Hypothesis 1 (Eroglu & Hofer, 2011).

The lagged ARTR is statistically significant ($p = 0.002$) and positive, thereby supporting the perspective of receivables efficiency. Firms that promptly convert receivables into cash tend to have improved profitability, as documented in studies of supply chain profitability (Deloof, 2003). More precisely, a one-unit increase in lagged ARTR is associated with an approximate improvement of 0.148 percentage points in ROA.

Conversely, lagged DSO is negative and statistically significant ($p = 0.004$). In line with the theory of CCC, long collection periods tend to immobilize funds, heighten pressures on financing, and reduce profitability (Eroglu & Hofer, 2011). Each additional day of outstanding receivables is linked to a 0.045 percentage point decline in ROA.

The positive and statistically significant association ($p = 0.013$) between lagged WCR and ROA means that a one-unit change in the lagged WCR results in an improvement of about 3.07 percentage points in ROA. This, therefore, confirms the general belief that good net working capital positions help in stabilizing operations and thus reducing liquidity worries (Baños-Caballero et al., 2014; SMITH, 1987).

In contrast, lagged asset turnover (AT) is negative and highly significant ($p < 0.001$). A one-unit increase in lagged AT relates to a decrease of about 6.76 percentage points in ROA. In terms of DuPont analysis, high turnover may reduce profitability if it is attained through a decrease in margins or an increase in distribution expenses, especially in the case of sectors driven by commodities with heavy logistical activities (Soliman, 2008).

The Lagged Accounts Payable Turnover Ratio (APTR) is substantial ($p < 0.001$) and negative. A standard deviation rise in lagged APTR is related to a 0.95 percentage point decrease in ROA. Firms in cement that quicken the settlement of obligations to suppliers and, therefore, do not rely much on payables as interest-free financing sources tend to have lower subsequent profitability. This finding supports the view of supply chain finance on trade credit as a liquidity buffer (García-Teruel & Martínez-Solano, 2007; Wetzell & Hofmann, 2019).

In the same way, lagged Inventory Turnover Ratio (ITR) is substantial ($p = 0.004$) and negative. A standard deviation rise in ITR corresponds to a decline of roughly 1.55 percentage points in ROA. The above finding lends support to a margin-turnover trade-off. Quick turnover of inventory will require either price discounts or the use of fast and expensive logistics, squeezing profit margins despite operating efficiency (Eroglu & Hofer, 2011; Soliman, 2008).

When firm size is measured with a one-period lag, it possesses a statistically significant inverse relationship with ROA ($p = 0.001$). Specifically, a one-unit increase in firm size is associated with an approximate 3.07-percentage-point decrease in ROA. This could be due to factors like capital intensity, the competitive environment, and cost structure. This result is in line with earlier studies that show industry factors have a big effect on how firm size and profitability relate to each other (Barney, 1991; Goddard et al., 2005).

The relationship is statistically significant at the 1% level and negative ($p = 0.005$) for Lagged Firm Age. That is, one more year added to a firm's age is linked to a 0.231 percentage point drop in ROA. This result aligns with the corporate inertia theory, according to which older firms are less likely to make changes (Majumdar, 1997; Williamson, 1979).

4.4. Robustness Analysis

Reporting both FGLS, PCSE, and Robust OLS would further enhance the credibility of inferences drawn under conditions of cross-sectional dependence (Beck & Katz, 1995; Pesaran & M.H., 2004).

Table 07. Regression Results Using PCSE and Robust-OLS Model

Variable	PCSE (Z-Statistics)	Robust-OLS (T-Statistics)
ISR	-0.676** (-2.08)	-0.676** (-2.35)
ARTR	0.00138** (2.05)	0.00138* (1.69)
DSO	-0.000415 (-1.49)	-0.000415 (-1.18)
APTR	-0.000570* (-1.83)	-0.000570* (-1.73)
WCR	0.0378 (1.62)	0.0378* (1.72)
AT	-0.0697*** (-3.21)	-0.0697*** (-2.82)
ITR	-0.00800* (-1.95)	-0.00800** (-2.19)
Size	-0.0274** (-2.16)	-0.0274* (-1.85)
Age	-0.00207* (-1.76)	-0.00207 (-1.51)
Constant	0.943*** (2.66)	0.943** (2.47)
R-square	0.4431	0.4431
Wald χ^2	57.20	
F-statistic		3.57
Observations	54	54

Note: * p<0.10, ** p<0.05, *** p<0.01.

In both PCSE and Robust OLS, the lagged Inventory-to-Sales Ratio (ISR) continues to be statistically significant and negative in both robustness checks ($p = 0.037$ and $p = 0.023$), thus cementing its position as one of the most robust

indicators of supply chain performance together with the Average Turnover Ratio (AT). The lagged Average Receivables Turnover Ratio (ARTR) is positive and significant under PCSE ($p = 0.040$) and marginally significant under OLS. The lagged Average Payables Turnover Ratio (APTR) and the Inventory Turnover Ratio (ITR) show marginal significance at the 10% level under PCSE; ITR is significant at the 5% level under OLS ($p = 0.034$). The lagged AT is still negative and highly significant under both PCSE and OLS ($p = 0.001$ and $p = 0.007$). Lagged firm size is also significant under PCSE ($p = 0.031$) and marginally significant under Robust OLS ($p = 0.071$). The lagged Working Capital Ratio (WCR) and Days Sales Outstanding (DSO) exhibit the same sign across all estimators. This proves that these relationships are not just artifacts of FGLS.

5. Generalizability and Recommendations

5.1. Generalizability and Broader Implications

Interpret the results with respect to the cement sector, a six-firm panel, and the period-specific common shocks, which exhibit cross-sectional dependence. However, the importance of receivables efficiency and working capital position is in line with the evidence across countries. Cross-sectional dependence points to common macroeconomic and industry effects; it underlines the importance of supply chain resilience and financing flexibility in determining performance during common shocks.

5.2. Policy Recommendations

The study recommends that managers in the cement industry should give top priority to supply chain finance and management as the main drivers of profitability. Receivables management, which includes credit assessment, timely collections, and the right incentives for early payments, should be viewed in light of the principles of the Relational View (Dyer & Singh, 1998). Inventory management should relate to the variability of demand and lead time so that holding costs are minimized without compromising profit margins since high turnover does not necessarily lead to increased profitability (Eroglu & Hofer, 2011; Soliman, 2008). Payables should be managed strategically through the negotiation of sustainable payment terms that provide financing benefits while upholding strong supplier relationships (García-Teruel & Martínez-Solano, 2007). Also, the maintenance of a modest positive working capital reserve can provide an added cushion against fluctuations in demand and costs in the cement sector (Baños-Caballero et al., 2014). Managers should also consider the turnover ratios in line with the profit margins using the DuPont system and review from time to time the old standing operational policies to ensure organizational flexibility, especially in large firms (Hannan & Freeman, 1984; Majumdar, 1997; Soliman, 2008).

6. Conclusion

This paper uses panel data from 2015 to 2024 for six listed cement companies, where all Supply chain performance proxies are substantially related to firms' profitability. The preferred FGLS model, which captures identified cross-sectional dependence, shows that higher lagged Accounts Receivable Turnover Ratio (ARTR) is associated with increased ROA. Conversely, higher lagged Days Sales Outstanding (DSO), Inventory Turnover Ratio (ITR), Accounts Payable Turnover Ratio (APTR), and Inventory Stock Ratio (ISR) are each related to lower ROA. In addition to this, lagged Working Capital Ratio (WCR) has a positive relationship with ROA, while lagged Asset Turnover (AT), firm size, and age have negative relationships, meaning that each proxy and control variable is statistically significant once the lag structure is imposed. The results for ISR, ARTR, AT, and firm size are stable with the PCSE and Robust OLS model as robustness checks. APTR, ITR, WCR, and DSO, however, show more sensitive directional significance with the choice of estimator. This is the main lesson for managers. The profit of cement companies in a developing country can be made better by financial engineering of SCM. This has to be done by making receivables better, having disciplined inventory and payables management, and working out good working capital structures that can give stability to operations with the least amount of excess idle capital. As a result, managers should focus on receivables, inventory,

and payables, the components of working capital, and the financial supply chain while structuring working capital and integrating financial supply chains, rather than just allowing the asset scale to increase over time to achieve long-term profitability within the context of an emerging economy.

7. Recommendations for Future Research

Further studies should include macroeconomic controls to capture common shocks, including inflation, GDP growth, exchange rates, and fuel costs. The sample period and the range of sectors examined should also be extended to evaluate the generalizability of the findings further.

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