






# “Working capital management and profitability: Cash threshold effects in Vietnam’s transportation sector”

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# WORKING CAPITAL MANAGEMENT AND PROFITABILITY: CASH THRESHOLD EFFECTS IN VIETNAM'S TRANSPORTATION SECTOR

## Abstract

This study examines whether the relationship between working capital management and profitability in Vietnam's listed transportation is nonlinear and influenced by a cash-holding threshold. Using panel data from 88 transportation firms listed on HSX, HNX, and UPCOM during the period 2014–2023, and Hansen's (1999) threshold regression, the study identifies the threshold point and estimates the model parameters. The empirical results reveal that before reaching the identification threshold, DSO, DPO, and DSI have a noticeably negative impact on ROA (coefficients being  $-0.004$ ,  $-0.006$ , and  $-0.017$ ,  $p < 0.01$ ), indicating that lengthening collection, payment, or inventory periods harms profitability under lower liquidity conditions. However, once the identified threshold is exceeded, the effects of DSO, DPO, CCC, and OCC are reversed, suggesting that with sufficient liquidity, more lenient working capital policies can actually support profitability. Meanwhile, control variables such as LEV and CASH demonstrate a substantially positive influence on ROA (LEV:  $0.016$ – $0.022$ ; CASH:  $0.0904$ – $0.1512$ ,  $p < 0.01$ ), affirming that prudent debt use and ample liquidity buffers enhance performance, whereas SZ negatively affects ROA ( $-0.0176$  to  $-0.0219$ ,  $p < 0.01$ ). The study proposes some practical recommendations for working capital management to enhance the profitability of transportation firms.

## Keywords

working capital management, profitability, threshold regression, transportation enterprises, cash thresholds

## JEL Classification

G30, G31, G32

## INTRODUCTION

Managing working capital is a fundamental aspect of keeping businesses running smoothly, especially in industries that demand heavy capital investments and deal with complex operations like transportation. Efficient working capital management (WCM) ensures that firms maintain sufficient liquidity to operate while also using resources effectively to support profitability. On the other hand, poor management can cause unnecessary capital lockup or liquidity shortages, which threaten business stability.

In Vietnam, discussions around WCM have gained increasing relevance, especially in the aftermath of COVID-19 disruptions. Transportation companies, in particular, face extended cash conversion cycles due to generous credit terms and large inventory holdings. Current data show that these firms experience an average receivables period of 68 days versus payment terms of 38 days, resulting in a two-month cash conversion cycle. Meanwhile, their return on assets remains modest, averaging just 6.4% from 2014 to 2023 (KPMG Vietnam, 2021).



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These circumstances emphasize how crucial it is for capital-intensive businesses to optimize WCM. However, despite a wealth of research on this subject, the interaction between WCM and profitability in different internal circumstances, such as liquidity, remains unclear. According to preliminary data, the relationship might not be linear and could change depending on firm-specific financial thresholds. In developing markets like Vietnam, closing this knowledge gap is essential for managerial decision-making and scholarly understanding.

Despite a substantial body of global research examining the connection between WCM and firm performance, a notable gap remains in the context of the transportation sector in Vietnam, particularly regarding potential nonlinear effects. Most existing studies assume a linear relationship, overlooking the possibility that firm-specific financial conditions, such as liquidity levels or leverage, may alter how working capital impacts profitability. According to preliminary findings, this relationship may follow a nonlinear pattern and could change depending on firm-specific financial thresholds. In developing markets like Vietnam, closing this knowledge gap is essential for managerial decision-making and scholarly understanding.

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## 1. LITERATURE REVIEW

Working capital management (WCM) remains central to sustaining firm liquidity while aiming to improve profitability. It encompasses the management of short-term assets, such as cash, receivables, and inventory, as well as short-term liabilities, primarily payables. Classical financial theories have long emphasized the tension between holding sufficient working capital to avoid liquidity crises and minimizing working capital to reduce opportunity costs. Excessive working capital may tie up resources unnecessarily, whereas overly tight management can expose firms to operational disruptions. The core of WCM, therefore, lies in maintaining an optimal balance. Empirical research has consistently reinforced the significance of WCM in driving firm performance. Deloof (2003) demonstrated that shortening the receivables period (DSO) and reducing inventory (DSI) enhances profitability, as firms benefit from lower financing costs and improved asset utilization. Supporting this, studies across diverse markets have found that shortening the cash conversion cycle (CCC) typically boosts returns on assets (ROA) (Lazaridis & Tryfonidis, 2006; Garcia-Teruel & Martinez-Solano, 2007). These findings converge on the understanding that efficient WCM directly supports profitability. However, the relationship is not entirely straightforward. Some researchers note that moderately lengthening the working capital cycle can support sales growth by extending credit to customers or holding ample inventory to meet demand spikes. Yet, if the cycle

becomes excessively prolonged, the costs surpass the benefits, eroding net profits. Such observations suggest that WCM's impact is best understood as nonlinear, where profitability increases up to an optimal point but declines beyond it. This view calls for more advanced analytical methods to capture the nuanced effects of WCM.

Cash, a fundamental component of working capital, serves as an immediate liquidity buffer. Theories on cash holdings suggest firms maintain cash for transactional needs, precautionary reserves, and as a cheaper alternative to external financing. Cash offers operational resilience, particularly for firms facing volatility or operating in uncertain markets. Nonetheless, excessive cash can lead to inefficiencies and encourage managerial slack—highlighting the classic agency problem. Empirical studies such as Yilmaz and Samour (2024) have observed this nonlinear effect: firm performance improves with higher cash holdings up to a point, but declines if cash exceeds optimal levels. Kayani et al. (2019) further emphasized that effective corporate governance mechanisms can strengthen the positive impact of WCM on firm performance, illustrating how internal governance complements liquidity management in enhancing profitability. Capital structure, commonly proxied by leverage (LEV), also plays a pivotal role in shaping firm outcomes and closely interacts with WCM. According to trade-off theory, moderate debt usage provides tax advantages and compels efficient capital use. Yet, excessive leverage raises interest costs and insolvency risk, diminishing profitability. Empirical

findings consistently note a negative link between high leverage and firm performance, indicating another nonlinear relationship. Notably, cash holdings and capital structure interact in shaping WCM effectiveness. Firms with ample cash can finance working capital needs internally, affording flexibility in policies like extending customer credit. Conversely, highly leveraged firms face liquidity constraints, forcing tighter control over receivables and inventories. This interplay forms the foundation for considering cash as a threshold variable in the WCM-performance relationship. It suggests that the effectiveness of WCM may differ significantly between firms with sufficient liquidity and those under cash pressure.

Growing evidence highlights that many financial relationships are nonlinear, shifting once specific thresholds are crossed. The relationship between debt and firm value or firm size and performance often exhibits such patterns. In WCM research, Anton and Nucu (2021) found that European firms benefit from keeping working capital low, but profitability declines when working capital surpasses optimal levels. Similarly, Hung and Su (2022) applied nonlinear models and confirmed the presence of an optimal WCM level for maximizing firm value. In exploring alternative methodologies, Shrivastava et al. (2017) applied Bayesian regression to study the WCM-profitability link, offering a probabilistic perspective that enhances robustness in empirical analysis. Mun and Jang (2015) provided industry-specific evidence by documenting an inverted U-shaped relationship between WCM and profitability in the hospitality sector, where cash holdings played a critical moderating role. Methodologically, threshold regression offers a robust tool to detect these nonlinearities. Hansen (1999) introduced the technique for panel data, enabling researchers to identify unknown threshold values and assess how variable impacts change across regimes. In WCM studies, threshold regression distinguishes firms based on liquidity or financial structure, allowing for tailored analysis. Nguyen and Dinh (2022), for instance, applied this method in Vietnam and found that CCC impacts profitability differently depending on its level. However, while their focus was on CCC itself as the threshold, this study advances the literature by using cash holdings as the threshold variable, providing fresh insights into how liquidity conditions moderate WCM effectiveness.

In Vietnam, research on WCM and profitability has grown, though much remains at the linear analysis stage. Võ Xuân Vinh (2013) found that key WCM components significantly affect profit margins among SMEs. Trần Mạnh Dũng and Nguyễn Huy Cường (2016) noted that WCM's impact on profitability in UPCoM-listed SMEs was less clear, possibly due to financing constraints typical of smaller firms. More advanced analyses confirm WCM's relevance. Huynh et al. (2025), using data from 441 listed firms between 2010 and 2019 and employing GMM estimation, reported that improving WCM (e.g., shortening the cash cycle) significantly boosts ROA. Their findings also highlight that delaying supplier payments (increasing DPO) can temporarily improve profitability by utilizing free capital. Ahmad et al. (2022) observed that during macroeconomic disruptions like the COVID-19 pandemic, effective WCM becomes increasingly crucial, as firms face intensified liquidity constraints and supply chain interruptions. Across emerging markets, similar patterns emerge. Ukaegbu (2014) documented an inverse relationship between CCC length and profitability in African firms, while Ahmad et al. (2022) observed that shortening receivables and inventory periods benefits firms in Malaysia, Thailand, and Pakistan. Lin and Wang (2021) further revealed that market conditions, like competition intensity, influence how WCM affects performance in China. Singh et al. (2017), through a meta-analysis, confirmed WCM's universal importance but noted that its impact tends to be stronger in developing economies where firms face tighter capital constraints. Similar conclusions were drawn in emerging economies. For instance, Ukaegbu (2014) highlighted that in Africa, firms with shorter cash conversion cycles achieved stronger profitability, emphasizing the importance of efficient WCM under high capital cost environments. Moreover, Enqvist et al. (2014) showed that the influence of WCM on firm profitability intensifies during economic downturns, highlighting the need for context-specific WCM strategies in volatile environments. Nevertheless, a common shortcoming is the prevailing reliance on linear models, which overlook potential threshold effects. Few studies examine whether WCM's impact varies with liquidity conditions – a gap particularly critical

for emerging markets like Vietnam, where firms frequently navigate financial volatility.

Nevertheless, a common shortcoming in prior studies is the prevailing reliance on linear models, which overlook potential threshold effects. Few studies examine whether WCM's impact varies with liquidity conditions – a gap particularly critical for emerging markets like Vietnam, where firms frequently navigate financial volatility. Overall, prior research has yet to explore whether cash holdings shape the WCM-profitability relationship in Vietnam's transportation sector, a gap this study addresses. Methodologically, we apply Hansen's (1999) threshold regression to identify whether cash holdings segment firms into distinct regimes with differing WCM impacts. Empirically, the study focuses on Vietnam's transportation industry – a sector characterized by high capital intensity and low profit margins - using updated data from 2014 to 2023. By isolating the moderating role of cash, our research aims to provide actionable insights for managers and extend the academic conversation on WCM in emerging markets. While previous research primarily focused on CCC as a threshold, this study provides new insights into how liquidity conditions moderate the WCM-profitability relationship in transportation firms in Vietnam.

Based on the theoretical framework and empirical evidence, this study proposes the following hypotheses:

- H1: *There is a nonlinear relationship between working capital management and firm profitability in transportation firms.*
- H2: *Cash holdings act as a threshold variable that moderates the relationship between working capital components and profitability.*
- H3: *The impact of specific WCM components (e.g., DSO, DSI, CCC) on profitability differs significantly between firms above and below the cash threshold.*
- H4: *Cash holdings positively influence firm profitability, and this effect is more pronounced in firms with higher liquidity.*

## 2. METHODOLOGY

The research sample consisted of transportation companies listed on the Ho Chi Minh City (HOSE), Hanoi (HNX) stock exchanges, and the UPCoM market. Data were collected for the period 2014–2023 from the FiinPro database. The firms selected for the sample have financial statements audited with unqualified opinions, ensuring data reliability. The final sample includes 88 listed transportation firms in Vietnam from 2014 through 2023.

After data collection, we carried out two important preprocessing steps to ensure data quality before analysis: handling missing values and dealing with outliers. Missing data can severely affect analytical results and forecasting models. Therefore, handling missing values is crucial for data quality and the accuracy of the model and results. In treating outliers, we focused on observations with values exceedingly high or low compared to the majority of the data. Such extreme values can skew the research findings. Controlling for outliers in the dataset helps improve the accuracy of our model estimates.

To analyze the relationship between WCM and the profitability of listed transportation firms, we conduct descriptive statistical analysis, correlation matrix analysis, and regression estimation. We also perform a panel unit root test for stationarity, test for threshold effects, and then estimate a threshold regression model. The study employs the threshold regression approach to examine whether a threshold value exists at which the relationship between WCM and firm profitability changes significantly. Based on the literature review, the following research model is proposed:

$$\begin{aligned}
 ROA = & \beta_0 + \beta_1 DSO_{i,t} + \beta_2 DPO_{i,t} \\
 & + \beta_3 DSI_{i,t} + \beta_4 OCC_{i,t} + \beta_5 CCC_{i,t} \\
 & + \beta_6 LEV_{i,t} + \beta_7 CASH_{i,t} + \beta_8 QR_{i,t} \\
 & + \beta_9 GR_{i,t} + \beta_{10} SZ_{i,t} + \varepsilon_i,
 \end{aligned} \tag{1}$$

where the model variables are described in Table 1.

**Table 1.** Variable description and measurement

Variable Name	Symbol	Calculation (Formula)
Profitability	ROA	Net profit after tax / Average total assets
	DSO	(Accounts receivable / Revenue) × 365
	DPO	(Accounts payable to suppliers / Cost of goods sold) × 365
Working Capital Management	DSI	(Inventory / Cost of goods sold) × 365
	OCC	DSO + DSI
	CCC	DSO + DSI – DPO
Leverage	LEV	Total liabilities / Total assets
Cash	CASH	(Cash + Short-term financial investments) / Total assets
Liquidity	QR	(Current assets – Inventory) / Current liabilities
Revenue Growth	GR	(Current year revenue – Previous year revenue) / Previous year revenue
Size	SZ	Logarit(Total assets)

### 3. RESULTS

Table 2 presents the descriptive statistics of the variables in the research model. The sample consists of 88 transportation firms over 2014–2023, with a total of 968 firm-year observations. The descriptive statistics include the mean, standard deviation, minimum, and maximum values for each variable.

**Table 2.** Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	968	0.064	0.079	-0.231	0.372
DSO	968	67.692	43.716	1.263	267.132
DPO	968	37.608	29.775	0	161.031
DSI	968	9.152	10.409	0	56.463
OCC	968	78.089	46.094	2.212	283.357
CCC	968	38.926	44.891	-152.595	238.751
LEV	968	0.5	0.7	0.005	10.374
CASH	968	0.219	0.185	0	0.86
QR	968	2.868	3.802	0.02	44.24
GR	968	0.261	4.148	-1	127.458
SZ	968	26.912	1.363	23.74	31.841

The average ROA stands at 6.4%, underscoring the capital-intensive nature of the transportation industry in Vietnam. High fixed asset investments – in vehicles, warehouses, or logistics infrastructure – contribute to significant depreciation, limiting returns. Notably, ROA fluctuates widely between -23.1% and 37.2%, highlighting industry volatility. Some firms enjoy healthy profits, yet many face losses, reflecting operational risks and fierce market competition. This dispersion implies opportunities for better financial management, particularly in leveraging working.

Regarding working capital management, the average collection period (DSO) is 67.7 days, with a maximum of up to 267 days. This indicates that

transport firms take a long time to collect payments from customers – a common feature in B2B contracts or international shipping. In contrast, the average payment period (DPO) is only 37.6 days, shorter than DSO, which creates pressure on cash flows as firms must pay suppliers (for fuel, maintenance, etc.) relatively quickly. The average inventory holding period (DSI) is 9.2 days, which is low and expected for the sector (as transportation companies generally do not hold much inventory), though the maximum of 56.5 days likely corresponds to specific sub-sectors. In transportation firms, DSI is typically low because the business is not inventory-intensive (the main inventory items are fuel or spare parts). As a result, the average operating cycle (OCC = DSO + DSI) is 78.1 days, while the cash conversion cycle (CCC) averages 38.9 days, with values ranging from -152.6 to 238.8 days. A negative CCC indicates some companies effectively delay payments to improve cash flow, whereas a very high positive CCC signals serious liquidity management issues. On average, a 38.9-day CCC, with such a wide range (-152.6 to 238.8), shows that some firms improve liquidity by postponing payments, while others face disadvantageously long cash cycles.

Examining control variables, financial leverage (LEV) averages 50%, yet extremes reach up to 1037% (ratio of 10.374). Such heavy debt burdens, especially in a volatile environment of fluctuating fuel prices and interest rates, pose serious risks for transport firms. Cash holdings (CASH) display substantial variation, from 0% to 86% of total assets, signifying diverse liquidity management strategies. The quick ratio (QR) also spans a broad range: although the average is 2.87, some firms operate with levels as low as 0.02, signaling potential insolvency risks.

Revenue growth (GR) shows notable dispersion: the mean is 26.1%, but extreme cases reach over 12,745%, likely reflecting one-off expansions or recovery from prior contractions. Finally, firm size (SZ), measured by the logarithm of assets, averages 26.91, with limited variation, suggesting a sample dominated by medium to large enterprises.

Overall, these descriptive statistics reveal marked differences across Vietnam's transportation firms in terms of profitability, liquidity, and working capital efficiency. While some firms balance receivables, payables, and inventory effectively, others endure extended collection cycles and high leverage, undermining their financial performance.

Table 3 provides the matrix of Pearson correlation coefficients among the variables. The correlation matrix helps identify the relationships between profitability (ROA) and the independent and control variables. In this case, we examine the relationship between ROA and the independent WCM variables (collection period, inventory period, payment period, cash cycle) as well as control variables (leverage, cash holdings, quick ratio, revenue growth, and firm size).

The correlation matrix highlights several notable relationships. ROA is weakly negative with DSO (-0.030), DPO (-0.140), and DSI (-0.105), suggesting that longer receivables, payables, and inventory cycles are generally linked to reduced profitability – a logical outcome for transportation firms, where efficient cash flow management is crucial. Interestingly, ROA has a slight positive correlation with CCC (0.110), possibly reflecting that in certain contexts, extending the cash cycle might accompany higher sales volumes or customer re-

attention strategies, though this requires further regression analysis. Among control variables, leverage (LEV) shows a moderately strong negative correlation with ROA (-0.329), indicating that debt-heavy firms tend to achieve lower profitability. In contrast, CASH (0.385) and QR (0.159) correlate positively with ROA, reinforcing the role of liquidity in sustaining firm performance, particularly under volatile operating conditions.

The matrix also reveals high correlations within WCM measures. As expected, DSO strongly correlates with OCC (0.940), given that OCC is composed of DSO and DSI. CCC similarly shows robust correlation with OCC (0.678), while DPO inversely correlates with CCC (-0.226), emphasizing its role in shortening the cash cycle. These mechanical interdependencies are natural but warrant attention in regression analysis to mitigate multicollinearity concerns.

Additional insights include a negative relationship between CASH and LEV (-0.309), suggesting that firms carrying higher debt loads tend to hold less cash, potentially due to debt covenants or substitutive financing behavior. The positive correlation between CASH and QR (0.514) is expected, as cash forms a core part of quick assets.

Overall, while the matrix shows interlinkages among WCM components, none of the correlations are so high as to preclude their simultaneous inclusion in regression models. Recognizing these relationships provides a sound basis for interpreting the subsequent econometric analysis.

Before estimating the regression model, a panel stationarity test was performed to ensure the

**Table 3.** Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) ROA	1.000										
(2) DSO	-0.030	1.000									
(3) DPO	-0.140	0.337	1.000								
(4) DSI	-0.105	-0.015	0.066	1.000							
(5) OCC	-0.044	0.940	0.338	0.184	1.000						
(6) CCC	0.110	0.656	-0.226	0.170	0.678	1.000					
(7) LEV	-0.329	0.072	0.173	0.080	0.084	-0.238	1.000				
(8) CASH	0.385	0.037	-0.127	-0.121	-0.001	0.131	-0.309	1.000			
(9) QR	0.159	0.150	-0.166	-0.048	0.131	0.279	-0.296	0.514	1.000		
(10) GR	-0.005	0.120	0.106	-0.023	0.106	0.036	0.015	-0.042	-0.013	1.000	
(11) SZ	-0.013	0.241	0.264	0.239	0.268	0.099	0.081	0.014	-0.072	0.046	1.000

variables do not contain unit roots that could bias the results. The Harris–Tzavalis test for panel unit roots on the balanced panel data was applied. Table 4 shows the stationarity test results, reporting the test statistic for each variable in level and (if needed) first difference form.

**Table 4.** Stationarity test

Variable	Statistic
<b>Variable (in level)</b>	
ROA	0.3521***
ROE	0.2659***
DSO	0.2790***
DPO	0.2196***
DSI	0.2773***
OCC	0.2363***
CCC	0.2507***
LEV	1.0901
CASH	0.5908***
QR	0.2897***
GR	-0.1026***
SZ	0.7315
<b>Variable (in difference)</b>	
D.LEV	-0.0147***
D.SZ	-0.1240***

Note: \*\*\*  $p < 0.01$ .

The Harris–Tzavalis test on the balanced panel indicates that all variables are stationary, satisfying at least first-difference stationarity. Variables such as ROA, ROE, DSO, DPO, DSI, OCC, CCC, CASH, QR, and GR are stationary in levels (the test statistics are significant, rejecting the null of a unit root at the 1% level). LEV and SZ are not stationary in levels (their statistics are not significant), but they achieve stationarity in first difference ( $\Delta$ LEV and  $\Delta$ SZ are significant at 1%). No variable needed to be dropped, confirming that the dataset is suitable for panel regression without spurious regression concerns.

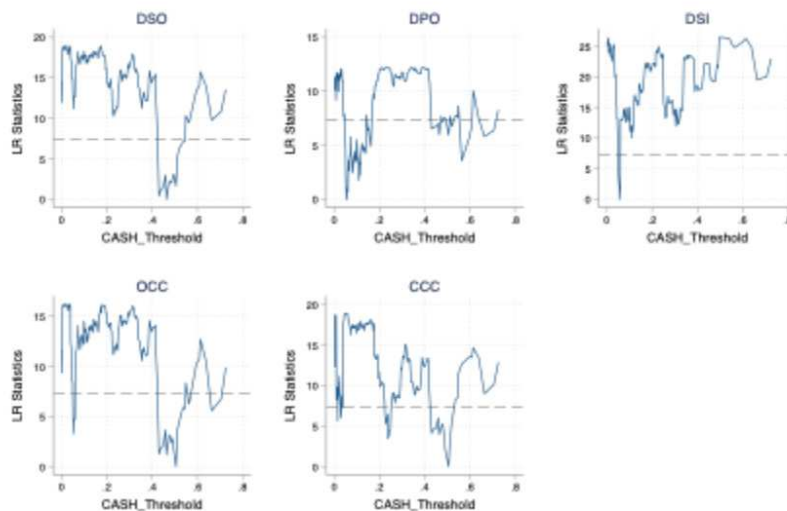
**Table 5.** Threshold test results

Model with	No.Thre	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
DSO	Single	2.851	0.003	19.056	0.033	14.519	17.657	30.532
	Double	2.828	0.003	7.612	0.287	11.690	15.348	22.423
DPO	Single	2.822	0.003	12.297	0.073	11.009	12.913	19.269
	Double	2.795	0.003	9.357	0.207	12.252	14.447	22.441
DSI	Single	2.833	0.003	26.664	0.007	16.879	19.514	25.487
	Double	2.797	0.003	12.364	0.100	11.421	15.408	24.216
OCC	Single	2.862	0.003	16.318	0.047	14.068	16.311	22.004
	Double	2.827	0.003	11.959	0.107	12.088	16.119	29.119
CCC	Single	2.838	0.003	19.005	0.020	12.841	16.462	23.523
	Double	2.804	0.003	11.503	0.180	14.205	18.667	23.995

Next, the study examines the presence of threshold effects in the model. Table 5 reports the results of threshold effect tests for the WCM variables. Specifically, the existence of a threshold (single or double) for each WCM factor was tested using the threshold model. The table shows, for each model specification with a given variable, the Residual Sum of Squares (RSS) under no threshold, the Mean Squared Error (MSE), the F-statistic for threshold existence, its bootstrap p-value (Prob), and the critical values at 10%, 5%, and 1% significance levels.

The threshold test results for the WCM variables (DSO, DPO, DSI, OCC, CCC) indicate the existence of a significant single threshold effect in the panel data model for most of these variables. Specifically, the models with DSO, DSI, OCC, and CCC each show a statistically significant single threshold (Prob < 0.05), as their F-statistics (19.056, 26.664, 16.318, and 19.005, respectively) exceed the 5% critical values (Crit5) and have p-values below 0.05. By contrast, DPO's model yields an F-statistic of 12.297 with  $p = 0.073$ , which does not meet the 5% significance level (it is marginal at the 10% level), suggesting no clear threshold effect for DPO. None of the variables exhibits a significant double threshold (all double threshold p-values > 0.1). Therefore, a single-threshold model is appropriate for analyzing these variables: there is evidence of one meaningful threshold split and no evidence of a second threshold.

The estimated threshold values ( $\gamma$ ) for each single-threshold model are summarized in Table 6, along with their 95% confidence intervals. Figure 1 provides a visual illustration of the first threshold value identification, where steep drops in the likelihood ratio (LR) statistics indicate the potential threshold location.



**Figure 1.** Confidence interval construction for the first threshold value

And this is a novel finding in the study: cash is both a threshold-determining variable ( $\gamma$ ) and a variable with a coefficient that varies with the threshold. And the variation of variables in the models is shown in Table 6.

**Table 6.** Estimated threshold values and confidence intervals

Model with	Threshold	95% Confidence Interval	
		Lower	Upper
DSO	0.464	0.440	0.472
DPO	0.053	0.048	0.054
DSI	0.055	0.051	0.056
OCC	0.505	0.458	0.512
CCC	0.505	0.458	0.512

In Table 6, the threshold values are reported in fraction-of-year units (since the WCM duration variables were measured in days and then divided by 365 in the model). Converting these to days: the threshold for DSO is approximately 0.464 of a year, or about 169 days; for DPO, about 0.053 of a year (~19 days); for DSI ~20 days; for OCC ~0.505 of a year (~185 days); and for CCC ~185 days. The 95% confidence intervals for these threshold estimates are relatively tight, indicating precise estimation (for example, DSO's threshold is between 0.440 and 0.472, i.e. ~161–172 days). Figure 1 illustrates the confidence interval construction for the first threshold: segments where the LR statistic dips sharply correspond to the threshold estimate and its confidence region.

The threshold test results provide strong evidence of nonlinear (piecewise) relationships between the WCM variables and profitability. These results confirm Hypothesis 1, which posits a nonlinear relationship between working capital management and firm performance. In particular, DSO, DSI, OCC, and CCC each have a significant single threshold, implying that their impact on ROA differs in two distinct regimes (below and above the threshold). Only DPO does not show a statistically significant threshold effect in our sample. Because each WCM variable satisfies the condition of a single threshold without a second threshold, a single-threshold model is deemed appropriate for further analysis of these variables. Furthermore, the identification of clear threshold values based on cash holdings supports Hypothesis 2, validating the moderating role of liquidity in shaping the WCM-profitability relationship.

Having established the presence of threshold effects, this study proceeds to estimate the threshold regression model for ROA. In the threshold model, the cash ratio is used as the threshold variable that splits the sample into low-liquidity and high-liquidity regimes (based on the threshold estimate for CASH). Within each regime, the effects of the WCM variables and controls on ROA are estimated. Table 7 reports the estimation results of the threshold regression model. The table presents the coefficients for each explanatory variable in the two regimes (Regime 0 for firms below the

**Table 7.** Threshold regression estimation results for ROA

Variables	(1)	(2)	(3)	(4)	(5)
	ROA	ROA	ROA	ROA	ROA
0b._cat#c.DSO	0.0000 (0.000)				
1._cat#c.DSO	-0.004*** (0.000)				
0b._cat#c.DPO		-0.006*** (0.000)			
1._cat#c.DPO		-0.008* (0.000)			
0b._cat#c.DSI			-0.017*** (0.000)		
1._cat#c.DSI			0.003 (0.000)		
0b._cat#c.OCC				0.0000 (0.000)	
1._cat#c.OCC				-0.003*** (0.000)	
0b._cat#c.CCC					0.002*** (0.000)
1._cat#c.CCC					-0.003*** (0.000)
LEV	0.0180*** (0.005)	0.0221*** (0.005)	0.0160*** (0.005)	0.0177*** (0.005)	0.0188*** (0.005)
CASH	0.1512*** (0.021)	0.0997*** (0.019)	0.0904*** (0.019)	0.1470*** (0.020)	0.1445*** (0.019)
QR	-0.0011 (0.001)	-0.0014* (0.001)	-0.0011 (0.001)	-0.0011 (0.001)	-0.0014* (0.001)
GR	0.0002 (0.000)	0.0005 (0.000)	0.0001 (0.000)	0.0002 (0.000)	0.0001 (0.000)
SZ	-0.0214*** (0.004)	-0.0176*** (0.004)	-0.0189*** (0.004)	-0.0219*** (0.004)	-0.0214*** (0.004)
Constant	0.6043*** (0.109)	0.5188*** (0.110)	0.5511*** (0.110)	0.6143*** (0.109)	0.5970*** (0.108)
Observations	968	968	968	968	968
Number of ID	88	88	88	88	88

Note: \*\*\* p < 0.01; \*\*p < 0.05; \* p < 0.1. Standard errors are in parentheses.

cash threshold, and Regime 1 for firms above the threshold), along with standard errors and significance levels.

Table 7 reports the regression outcomes for two distinct regimes, determined by the cash holdings threshold. Specifically, Regime 0 captures firms below the cash threshold (low liquidity), and Regime 1 represents firms above it (high liquidity). This structure allows for an examination of how working capital management (WCM) impacts firm profitability (ROA) under differing liquidity conditions in Vietnam's transportation sector. The models consistently reveal that the effects of WCM variables on profitability vary significantly

across these regimes, reflecting the sector's operational realities.

### 3.1. Days Sales Outstanding (DSO)

In firms with limited cash (Regime 0), DSO shows no significant impact on ROA (coefficient = 0.0000). However, in high-cash firms (Regime 1), DSO is negatively significant (coefficient = -0.004, p < 0.01). This suggests that when liquidity is abundant, prolonged collection periods diminish profitability. For transportation companies, particularly those managing contracts with large clients or engaging in international logistics, extended receivables cycles can delay critical pay-

ments for fuel and maintenance, straining operational efficiency. Although high-cash firms might afford longer credit terms, the data indicate that doing so erodes returns. This outcome aligns with Vietnamese practice, where aggressive credit policies boost sales but elevate bad debt risk, ultimately harming shareholder value.

### 3.2. Days Payable Outstanding (DPO)

DPO exerts a negative influence on ROA in both regimes:  $-0.006$  ( $p < 0.01$ ) for low-cash firms and  $-0.008$  ( $p < 0.10$ ) for high-cash firms. The slightly stronger effect in high-cash firms implies that extending supplier payments does not yield benefits, regardless of liquidity level. For the transportation sector, this reflects dependence on suppliers for fuel and spare parts, where delayed payments may incur penalties or jeopardize supply reliability.

### 3.3. Days Inventory Outstanding (DSI)

DSI significantly reduces profitability in low-cash firms (coefficient =  $-0.017$ ,  $p < 0.01$ ), whereas its effect is negligible and slightly positive in high-cash firms (coefficient =  $0.003$ , not significant). Transportation firms typically hold minimal inventory (primarily spare parts and fuel). For liquidity-constrained firms, holding inventory longer ties up vital resources, leading to higher carrying costs. However, firms with ample cash can absorb inventory costs without harming ROA. The switch in sign between regimes illustrates the buffering role of liquidity.

### 3.4. Operating Cash Cycle (OCC)

OCC is non-significant in low-cash firms but negatively significant in high-cash firms ( $-0.003$ ,  $p < 0.01$ ). For liquidity-constrained firms, OCC is likely kept tight out of necessity, limiting its observable impact. In contrast, high-cash firms that extend their operating cycles see diminished returns, reinforcing that ample liquidity does not justify lax working capital discipline.

### 3.5. Cash Conversion Cycle (CCC)

CCC presents an interesting contrast. For low-cash firms, CCC is positively significant ( $0.002$ ,  $p < 0.01$ ), indicating that modestly extending the

cycle might facilitate higher sales or operational flexibility. This counterintuitive result suggests that in cash-constrained environments, managers may strategically extend CCC to support revenue generation, accepting liquidity risks for potential gains. Conversely, in high-cash firms, CCC is negatively significant ( $-0.003$ ,  $p < 0.05$ ), consistent with expectations that prolonged cash cycles in well-funded firms reflect inefficiency.

### 3.6. Cash Holdings (CASH)

A distinctive result arises from the role of cash itself. CASH acts both as a threshold variable and as an explanatory factor. Its coefficient is positive and highly significant in both regimes:  $0.0904$  for low-cash firms and a markedly higher  $0.1512$  for high-cash firms. This indicates that maintaining adequate cash reserves strongly enhances profitability, with the effect intensifying once firms surpass the optimal liquidity threshold. This reinforces the critical importance of cash for operational resilience, particularly in sectors like transportation where financial buffers mitigate risks of fuel price volatility and payment delays.

These results collectively support Hypothesis 3, as the effects of individual WCM components (DSO, DSI, CCC) differ substantially between the two cash regimes. The sign reversals and variations in statistical significance between low- and high-cash firms confirm that liquidity conditions alter the impact of working capital decisions on profitability.

Furthermore, the consistent and significantly positive coefficient of CASH in both regimes—with a stronger magnitude in high-cash firms—validates Hypothesis 4, suggesting that maintaining higher levels of liquidity enhances firm performance more substantially when a firm has already surpassed its optimal cash threshold.

## 3.7. Control variables analysis

### 3.7.1. Leverage (LEV)

LEV exhibits a positive and significant relationship with ROA in both regimes ( $0.016$  for low-cash and  $0.022$  for high-cash, both  $p < 0.01$ ). This suggests that moderate debt levels improve profitability, likely through tax shields and discipline mech-

anisms. The stronger effect in high-cash firms indicates that these companies can harness leverage more effectively, as their liquidity cushions reduce financial distress risks.

### 3.7.2. Quick Ratio (QR)

QR shows a small positive coefficient in both regimes but lacks statistical significance. This suggests that short-term liquidity, aside from cash itself, does not substantially influence profitability once other factors are accounted for.

### 3.7.3. Revenue Growth (GR)

GR has positive yet insignificant coefficients across both regimes. This implies that revenue expansion alone does not directly enhance short-term profitability (ROA), likely because growth in the transportation sector often involves upfront investments and increased operating costs, which may offset immediate financial gains.

### 3.7.4. Firm Size (SZ)

SZ has a consistently negative and significant effect on ROA ( $-0.0176$  in low-cash and  $-0.0219$  in high-cash, both  $p < 0.01$ ). Larger firms tend to experience lower asset returns, potentially due to scale-related inefficiencies or excessive asset bases that dilute profitability. The slightly greater negative impact in high-cash firms suggests that liquidity alone cannot counteract the profitability drag associated with size.

## 4. DISCUSSION

This paper analyzed a threshold regression on panel data to examine the relationship between working capital management and profitability (ROA) of listed transportation companies on the stock market. The study considered the effects of WCM-related factors (including DSO, DPO, DSI, OCC, and CCC), along with control variables (financial leverage – LEV, cash holdings – CASH, quick ratio – QR, revenue growth – GR, and firm size – SZ), on ROA. Using 968 observations from 88 transportation firms listed on HSX, HNX, and UPCoM during 2014–2023, the analysis yielded notable results and important recommendations to improve financial performance.

The threshold regression results from the five models show that the relationship between the independent variables and ROA differs significantly with respect to working capital factors and financial characteristics of transportation firms – an industry heavily reliant on WCM. Specifically, the interaction terms indicate: DSO (average collection period) has an opposite (negative) effect on profitability in the above-threshold regime, with a coefficient of  $-0.004$ . This finding supports the recommendation that transport firms should reduce receivables days to enhance profitability, in line with Boțoc and Anton (2017). Similarly, DPO (average payment period) exhibits a negative impact on profitability in both the below- and above-threshold regimes (coefficients  $-0.006$  and  $-0.008$ , respectively). This consistently negative effect of DPO across both regimes reinforces findings by Boisjoly et al. (2020), which indicated that while deferring payments can ease short-term liquidity constraints, it ultimately undermines profitability. DSI (average inventory period) has a significantly negative impact on profitability before the threshold (coefficient  $-0.017$ ). that align with Boțoc and Anton (2017) and Huynh et al. (2025), and further reflect the specific characteristics of transportation enterprises, where inventory is not a major asset component.; OCC (operating cycle) is negatively related to profitability in the above-threshold regime (coefficient  $-0.003$ ). This finding echoes Yazdanfar and Öhman (2014), who stressed the importance of maintaining efficient cash cycles in capital-intensive sectors like transportation. Filbeck and Krueger (2005) emphasized that WCM effectiveness varies considerably across industries, reinforcing the importance of sector-specific approaches, particularly in capital-intensive sectors such as transportation. And CCC (cash conversion cycle) has a positive effect on profitability before the threshold (coefficient  $0.002$ ), but reverses to a negative effect after the threshold (coefficient  $-0.003$ ). The regime-dependent impact of CCC underlines how liquidity levels shape WCM effectiveness, corroborating findings by Huynh et al. (2025), Singhania et al. (2014), Tran et al. (2017), Şen and Oruc (2009), and Soda et al. (2022), and also aligning with Baños-Caballero et al. (2014), who documented an inverted U-shaped relationship between WCM and firm performance in UK firms.

In addition, the control variables, such as LEV (financial leverage) and CASH (cash ratio), both have a positive relationship with profitability and are statistically significant at the 1% level in all models. This indicates that transportation firms' use of financial leverage and increased liquidity contribute to improving ROA. Conversely, SZ (firm size) has a negative impact on profitability, implying that larger companies may face lower profit rates. QR (quick ratio) and GR (growth) do not show clear effects. Overall, the findings underscore the importance of WCM and financial structure in enhancing ROA for transportation companies. This finding aligns with Myers (1977), who highlighted the beneficial role of leverage in capital-intensive industries such as transportation, where borrowing supports fleet expansion and network development. Interestingly, this outcome resonates with Kim et al. (1998), who argued that excess liquidity, while providing security, can dilute returns if idle resources are not efficiently deployed. This finding aligns with Lee (2009), who noted that large transport firms bear heavy fixed costs, including maintenance and infrastructure, which weigh on overall returns.

The findings of the current study have several implications for establishing appropriate working capital management policies in transportation enterprises. A company's cash conversion cycle depends on its receivable period, inventory period, and payable period. The cash cycle lengthens when inventory and receivables periods are extended, and it shortens when the firm can delay payables. The longer the cash conversion cycle, the more financing the company needs; a long cash cycle may indicate the firm is having trouble collecting receivables or managing inventory. Therefore, transportation business managers should devise suitable WCM policies to boost firm profitability.

In particular, **Customer credit policy:** Transportation company managers should tailor credit policies to each customer segment and closely monitor accounts receivable. Tight control of receivables and prompt collection will shorten the DSO, which, especially for liquidity-constrained firms, contributes to higher profitability. **Supplier payment terms:** Managers should carefully select suppliers and negotiate payment terms that align with the company's cash flow. By optimally extending payables (without incurring penalties or straining supplier relationships), firms can effectively shorten the cash conversion cycle and relieve pressure on cash flows. **Inventory management:** For transport companies that hold inventories such as fuel or spare parts, it is crucial to find an optimal balance between holding costs and stock-out costs. Maintaining too much inventory ties up funds and lowers ROA, while too little risks operational disruptions. An optimal inventory policy will support continuous operations without unnecessary liquidity drain. **Leverage utilization:** Transportation firms can consider using debt financing to invest in vehicles or technology that improve operational efficiency and profitability, but they must keep leverage at manageable levels to avoid excessive financial risk. Moderate debt can improve returns (through tax benefits and disciplined use of capital), whereas over-leveraging can harm profitability and increase vulnerability. **Cash reserve management:** Transportation companies should maintain a sufficient cash buffer to ensure liquidity, especially since this industry requires continuous operating expenditures. Adequate cash reserves enable firms to withstand shocks and also provide flexibility in WCM decisions. However, excess cash beyond a reasonable reserve can be inefficient, so firms should aim for an optimal cash ratio that safeguards operations but also allows funds to be invested productively.

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## CONCLUSION

This study aimed to examine whether the relationship between working capital management (WCM) and firm profitability is influenced by cash holdings, using panel data from listed transportation firms in Vietnam. The regression results provide robust evidence of the moderating role of cash holdings in the WCM-profitability relationship. Specifically, the influence of key WCM variables such as DSO, DSI, OCC, and CCC varies significantly between low- and high-liquidity regimes. In liquidity-constrained firms, extending the cash cycle can, under certain conditions, support profitability, reflecting strategic trade-offs. However, for firms with ample liquidity, prolonging any component of the cash cycle typically erodes returns, emphasizing the need for continuous working capital discipline even when cash buffers are available.

Moreover, the consistent positive contribution of cash holdings across both regimes highlights the strategic importance of liquidity for operational stability and profitability. This reinforces the practical message to transport sector managers: while access to cash enables flexibility, maintaining tight control over working capital processes remains essential to maximizing firm performance.

## AUTHOR CONTRIBUTIONS

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