

OPERATING WORKING CAPITAL, FIRM PROFITABILITY, AND CRISIS MODERATION: EVIDENCE FROM LISTED FIRMS IN AN EMERGING EUROPEAN MARKET

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Abstract

This study examines the relationship between operating working capital (OWC) and firm profitability under conditions of economic instability, with particular attention to the moderating role of crisis periods. Anchored in the trade-off perspective and financial resilience literature, the analysis investigates whether the profitability implications of OWC intensify during periods of economic stress and whether this relationship varies across industry structures. Using a balanced panel of 25 firms listed on the Bucharest Stock Exchange across four sectors over the period 2013–2024 (300 firm-year observations), the study analyses the association between OWC, asset turnover (AT), firm size, and profitability measured by return on assets (ROA). The period 2020–2021 is treated as an exogenous crisis episode. Linear mixed-effects models are employed to capture firm-level heterogeneity and temporal variation in performance. The results indicate that the direct OWC–profitability association is negative across all specifications, but statistically significant only in the full model ($p = 0.033$) and not robust to more parsimonious specifications ($p = 0.187$), indicating that this effect should not be interpreted as uniformly strong in isolation. The interaction between OWC and the crisis period is negative and statistically significant: the total marginal effect of OWC on ROA intensifies from -0.065 in non-crisis periods to -0.165 during crisis conditions, equivalent to an additional profitability reduction of approximately 2.7 percentage points at the sample mean OWC. Industry group interactions do not reach statistical significance, a result attributable at least in part to the limited representation of project-based firms in the sample rather than definitive evidence of sectoral homogeneity. By contrast, asset turnover emerges as the dominant and robust profitability determinant across all specifications, with a standardized coefficient 2.7 times larger in magnitude than that of OWC. These findings indicate that the profitability implications of working capital are context-dependent, becoming economically meaningful primarily under macroeconomic stress, with relevant implications for financial management in emerging capital markets.

Keywords: Operating working capital; Firm profitability; Crisis conditions; Financial resilience; Mixed-effects models

JEL: M41; G32; G01.

1. Introduction

In recent years, firms have faced heightened economic uncertainty driven by crises, disruptions, and geopolitical tensions, reinforcing the importance of working capital management as a component of short-term financial policy relevant to both firm performance and resilience under adverse conditions (Cowling et al., 2025). A growing body of literature examines how firms adjust financial policies in response to economic shocks, particularly following the global financial crisis and during the COVID-19 pandemic, with responses varying according to firm characteristics, financing constraints, and institutional environments (Zeitun et al., 2017; Demirgüç-Kunt et al., 2020; Zimon & Tarighi, 2021).

COVID-19 affected economies through financial market disruptions, sharp drops in consumption, and negative spillovers across sectors. At the firm level, payment delays and longer receivable and payable periods worsened working capital conditions (Liu et al., 2020; Shen et al., 2020; PwC, 2021), reinforcing the importance of efficient short-term financial management for sustaining performance under stress (Chang et al., 2019; Salehi et al., 2019). These dynamics are particularly pronounced in emerging capital markets, where firms face tighter financing constraints,

shallower credit markets, and greater macroeconomic exposure than their counterparts in developed economies (Demirgüç-Kunt et al., 2020; Alfaro et al., 2019). The Bucharest Stock Exchange (BVB) represents a relevant context for examining these mechanisms, given Romania's classification as a frontier-to-emerging market characterised by relatively thin liquidity, concentrated ownership, and heightened sensitivity to external shocks. Firm profitability in such settings depends not only on short-term liquidity management, but also on asset utilisation efficiency and firm size, which shape the capacity to sustain performance across different economic environments (Nguyen, 2026; Aguade et al., 2022; Žiković et al., 2025; Gupta, 2025).

Recent research highlights the role of working capital management in strengthening firm-level resilience, as it directly affects liquidity and shapes firms' responses to disruption (Kiymaz et al., 2024; Banerjee et al., 2024). At the same time, the OWC–profitability relationship may change during crisis periods, as downturns generate tighter financing constraints, greater supply-chain risks, and heightened uncertainty (Huynh, 2025). Evidence further suggests this relationship may be non-linear, with excessive investment in short-term assets reducing efficiency and constraining profitability, with effects varying across firms and operating environments (Silva et al., 2026; Altaf & Shah, 2018; Afrifa & Padachi, 2016; Dalci et al., 2019). However, existing studies have predominantly examined these relationships in developed market contexts or have focused on single crisis episodes without jointly accounting for industry heterogeneity (Enqvist et al., 2014; Zanolli et al., 2024). Evidence from emerging European markets remains limited, and the simultaneous moderation of the OWC–profitability relationship by both crisis conditions and sectoral structure has not been tested within a unified panel framework — a gap that is particularly relevant given the structural financing frictions faced by emerging market firms.

Against this background, this study examines the relationship between OWC and firm profitability, measured by return on assets (ROA), using a panel of listed firms from the BVB over the period 2013–2024. The analysis is informed by the trade-off framework and incorporates interaction terms to test whether the OWC–profitability relationship differs across industry settings and during the COVID-19 crisis. The sample period begins in 2013, following the stabilisation of Romanian capital markets after the global financial crisis, providing a pre-crisis baseline that strengthens the internal validity of the crisis moderation analysis.

The novelty of the study resides in combining the analysis of operating working capital, crisis moderation, and sectoral structure within a unified panel-data framework applied to BVB-listed firms — a setting underexplored in the literature. The study contributes to the literature in three main ways. First, it contributes context-sensitive evidence on the OWC–profitability relationship from an emerging European capital market, a setting underrepresented in the working capital literature. Second, it examines whether this relationship becomes more adverse during crisis periods, using COVID-19 as an exogenous shock relevant to firm-level financial resilience. Third, it shows that the profitability implications of working capital are context-dependent and become more restrictive under conditions of economic stress.

The empirical results indicate that the direct association between OWC and profitability is negative and statistically significant in the full specification, though sensitive to model complexity. However, the interaction between OWC and the crisis period is negative and statistically significant, indicating that the adverse profitability implications of operating working capital intensify during periods of economic disruption. By contrast, asset turnover emerges as the most robust and economically significant determinant of profitability across all estimated models, underscoring the importance of operational efficiency relative to short-term liquidity management.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 presents research hypotheses, methodology, and empirical model. Section 4 reports and discusses the empirical results. Section 5 concludes the study, while also outlining its limitations and directions for future research.

2. Literature review

Recent economic instability, particularly during the COVID-19 pandemic, has intensified interest in how financial structure decisions shape firm performance (Baker et al., 2020; Bai et al., 2021). The pandemic generated liquidity shortages, financing constraints, and operational disruptions (De Vito & Gómez, 2020; Ding et al., 2021; Balugani et al., 2020), while responses remained heterogeneous across sectors and institutional contexts (Lago-Peñas et al., 2022; George et al., 2021). Understanding how firms navigate these pressures requires engaging with both long-term capital structure theory and short-term financial policy.

Capital structure decisions determine how firms finance operations through debt and equity, with classical literature explaining them via trade-off and pecking order theories (Modigliani & Miller, 1963; Miller, 1977; Myers, 2001). Trade-off theory weighs tax advantages of debt against financial distress costs, with larger firms and those with stable earnings relying more on external financing (Voutsinas & Werner, 2025). Extensions suggest threshold effects: benefits rise to a point, then costs dominate (Lindset et al., 2024). Financially constrained firms often prioritise flexibility over strict optimisation, and financial behaviour varies with firm size, asset structure, and institutional context (Pecina et al., 2024; Jaworski & Czerwonka, 2023; Qerimi et al., 2024). Empirically, firms adjust their capital structure dynamically rather than maintaining a fixed optimum (Muñoz Mendoza et al., 2023; Carvalho et al., 2023; Stulz, 2008), with excessive rigidity reducing firm value (Frank & Goyal, 2008; Michalkova et al., 2021; Nworie et al., 2023). While this study does not address leverage decisions directly, the trade-off framework provides a conceptual basis for interpreting the balance between liquidity and profitability in short-term financial policy.

This balancing logic extends naturally to working capital management, which directly shapes the liquidity–profitability trade-off (Kiymaz et al., 2024; Huynh et al., 2025). Working capital reflects the firm's capacity to meet short-term obligations through the management of inventories, receivables, and payables (Jaworski, 2024; Silva & Silva, 2026). Empirical evidence consistently reports a negative relationship between profitability and the cash conversion cycle: longer holding periods and slower receivables collection reduce efficiency and lock up resources (Lazaridis & Tryfonidis, 2006; Anojan et al., 2010; Padachi, 2006). Managerial approaches range from aggressive policies — lower current assets, higher returns but greater liquidity risk — to conservative policies prioritising stability at the cost of idle assets (Nazir & Afza, 2009; Panda & Nanda, 2018; Al-Mawsheki, 2022; Baños-Caballero et al., 2013). During economic disruptions, the profitability impact of OWC depends on how efficiently firms manage its components under stress (Ahmad et al., 2022; Enqvist et al., 2014), with better coordination improving cash flow and ineffective management locking capital in non-productive assets (Aktas et al., 2015). Recent evidence emphasises that performance depends less on the absolute level of working capital than on its efficient adjustment over time (Yeboah & Kjaerland, 2024; Bünyamin & Güneysu, 2023). Evidence from Central and Eastern European settings further suggests that the OWC–profitability relationship is more sensitive to financing constraints and institutional conditions than in developed markets (Zimon & Tarighi, 2021; Zanolli et al., 2024), motivating this study's focus on firms listed on the Bucharest Stock Exchange.

Beyond working capital policy, firm profitability is also shaped by structural characteristics that condition the broader operational environment. Asset efficiency, proxied by asset turnover, reflects how effectively firms generate revenue from their asset base and is generally associated with stronger performance (Lazaridis & Tryfonidis, 2006; Ahmad et al., 2023; Žiković et al., 2025). Higher turnover reduces idle resources, accelerates capital circulation, and supports both liquidity and profitability (Aktas et al., 2015). Firm size similarly shapes profitability: larger firms benefit from broader resource endowments, stronger market positions, and better financing access, aiding shock absorption (Alfaro et al., 2019; Zhu & Liu, 2024; Moise, 2023), though size can also introduce bureaucratic rigidity and slower adaptation (Raguseo et al., 2020). Smaller firms are more flexible but more exposed to financing constraints (Steinker et al., 2016). In this study, both variables serve

as structural controls conditioning the environment within which working capital management operates.

These structural and operational characteristics are closely tied to the concept of financial resilience — a firm's ability to withstand and recover from adverse conditions while maintaining performance (Zimon & Tarighi, 2021). Firms with strong liquidity and flexible structures better absorb shocks (Ding et al., 2021; Albuquerque et al., 2020), though resilience also depends on the stability of financial systems and institutions (Cavallaro & Villani, 2024). Resilience is unevenly distributed: larger and listed firms benefit from broader funding access (Demirgüç-Kunt et al., 2020; Shojaee & Mirzaei, 2024; Stulz, 2008), while smaller firms are more agile but more vulnerable. Resilience-oriented strategies include optimising working capital, diversifying financing, and maintaining operational flexibility (Zimon & Tarighi, 2021; Cavallaro & Villani, 2024). To illustrate how these elements interact, Figure 1 summarises the conceptual framework linking financial decisions, resilience, and firm performance under economic shocks — showing how macroeconomic disturbances disrupt cash flows and financing access, how firms respond through internal decisions on asset allocation and working capital policy informed by trade-off and pecking-order perspectives, and how these decisions translate into strategic responses that shape the capacity to absorb shocks and maintain operational stability.

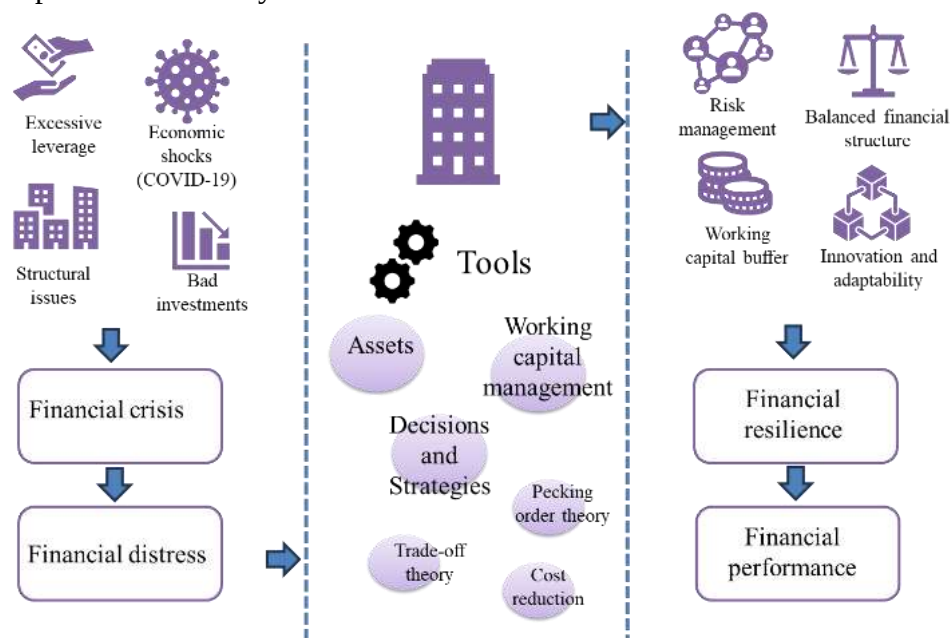


Figure 1. Conceptual framework linking working capital policy, financial resilience, and firm performance under economic shocks.

Taken together, the literature points to three dimensions relevant to this study. First, a consistent negative association between OWC and profitability, driven by the opportunity cost of resources tied up in inventories and receivables (Lazaridis & Tryfonidis, 2006; Padachi, 2006; Altaf & Shah, 2018). Second, this relationship varies across economic conditions, with crisis periods amplifying the adverse effects of high working capital (Ahmad et al., 2022; Enqvist et al., 2014; Zimon & Tarighi, 2021). Third, asset efficiency and firm size represent structural determinants complementing short-term financial policy (Aktas et al., 2015; Žiković et al., 2025). These dimensions motivate the hypotheses developed in Section 3, with financial resilience serving as a conceptual lens rather than a directly measured outcome.

3. Methodology

This section outlines the methodological framework employed to investigate the relationship between operating working capital and firm profitability, with particular attention to the moderating role of crisis conditions. The empirical design seeks to assess whether the profitability implications

of OWC are stable over time or become more restrictive under adverse macroeconomic circumstances.

The study investigates how short-term financial policy relates to firm profitability and how this relationship evolves under economic instability, focusing on operating working capital as a proxy for short-term financial policy alongside asset utilisation efficiency and firm size as additional firm-level determinants. Working capital management is treated not only as a liquidity-related decision, but also as a strategic element relevant to firm-level financial resilience. Particular attention is given to the COVID-19 period (2020–2021), treated as an exogenous shock, and to whether the profitability effect of OWC differs across industry structures given their heterogeneous operating cycles and financing requirements. These objectives are captured in three hypotheses: *H1, that operating working capital is negatively associated with firm profitability, after controlling for asset utilization efficiency, firm size, industry group, and crisis conditions; H2, that this negative association becomes stronger during periods of economic disruption, reflecting the amplifying role of financing constraints and supply-chain stress on the opportunity cost of capital tied up in working capital; and H3, that asset turnover and firm size are positively associated with firm profitability across all specifications.*

H1 is grounded in evidence that higher investment in inventories and receivables reduces profitability through the opportunity cost of tied-up capital (Lazaridis & Tryfonidis, 2006; Padachi, 2006; Altaf & Shah, 2018); H2 draws on the crisis moderation literature suggesting that financing constraints and supply-chain disruptions amplify these adverse effects (Ahmad et al., 2022; Enqvist et al., 2014; Zimon & Tarighi, 2021). The analysis additionally tests, through interaction terms, whether the crisis-moderation effect on the OWC–profitability relationship differs across industry groups, given their heterogeneous operating cycles and working capital requirements; this is treated as an exploratory extension of H2 rather than a separate hypothesis, in light of the unequal industry representation in the sample. H3 is supported by evidence that asset turnover and firm size are robust structural determinants of profitability across market settings (Aktas et al., 2015; Žiković et al., 2025; Anton & Nucu, 2021).

The empirical analysis is based on a balanced panel of 25 firms listed on the Bucharest Stock Exchange, observed over 2013–2024, yielding 300 firm-year observations across four sectors: manufacturing, utilities, construction, and real estate. For analytical purposes, these are grouped into two broader categories: capital-intensive industries (manufacturing and utilities) and project-based industries (construction and real estate), the latter typically involving longer operating cycles and greater reliance on working capital financing. Financial data were sourced from official disclosures on the Bucharest Stock Exchange platform, with 2012 included solely to construct lagged values for the first observation year. Firms were selected on the basis of continuous listing and data availability throughout the full period. It should be noted that the two industry groups are unequally represented — 18 firms in capital-intensive and 7 in project-based industries — which reflects the composition of the BVB listing and is acknowledged as a potential constraint on the precision of industry-level interaction effects.

The dependent variable is return on assets (ROA), defined as net income divided by total assets, a widely used profitability measure that enables comparisons across firms of different sizes and sectors. The main explanatory variable is operating working capital (OWC), scaled by total assets as $OWC = (\text{Inventories} + \text{Receivables} - \text{Trade Payables}) / \text{Total Assets}$, capturing resource commitment to operating activities in line with recent empirical work (Ahmad et al., 2022; Lyngstadaas, 2020; Tarighi et al., 2024). Asset turnover ($AT = \text{Sales} / \text{Total Assets}$) is included to capture operational efficiency, with higher values associated with stronger profitability (Huynh, 2025). Firm size, measured as the natural logarithm of total assets, controls for differences in organisational scale, economies of scale, and financing access (Anton & Nucu, 2021; Dalci et al., 2019). A group dummy (1 for project-based, 0 for capital-intensive industries) and a crisis dummy (1 for 2020–2021, 0 otherwise) capture structural and macroeconomic differences shaping the OWC–

profitability relationship. The empirical framework is summarised in Figure 2, which illustrates the relationship between the key variables, the dependent variable, and the moderating factors.

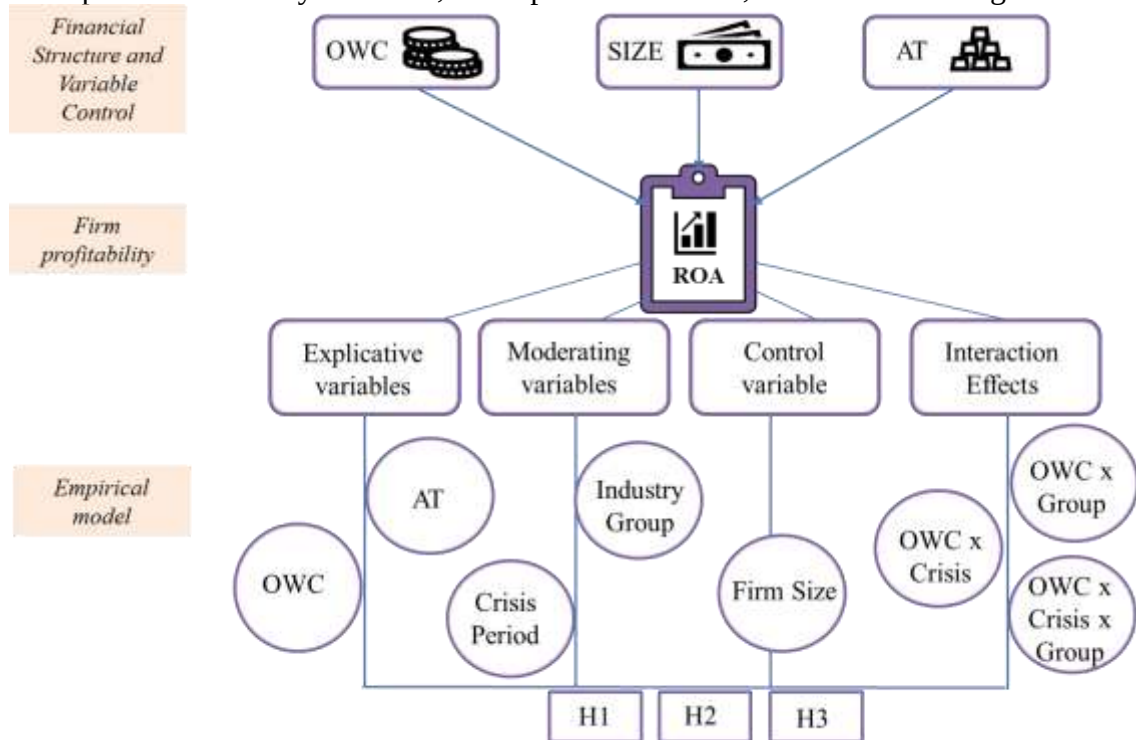


Figure 2. Structure of the empirical model and variables.

The empirical analysis is conducted within a panel-data framework estimated through linear mixed-effects models, which exploit both the cross-sectional and time-series dimensions of the dataset while accounting for unobserved firm-level heterogeneity through random firm-level intercepts and fixed effects for explanatory variables (Bell et al., 2019). A fixed-effects estimator was considered but rejected on the grounds that it would absorb the time-invariant industry group variable, precluding the estimation of sector-level effects central to the research design. The mixed-effects specification with random firm-level intercepts was therefore adopted as the appropriate estimator for this panel structure, in line with recommendations for small balanced panels where group-level variation is of theoretical interest (Bell et al., 2019; McNeish & Kelley, 2019). Year fixed effects are also included to absorb common macroeconomic influences. The baseline specification is:

$$ROA_{it} = \beta_0 + \beta_1 OWC_{i,t-1} + \beta_2 AT_{i,t-1} + \beta_3 SIZE_{i,t-1} + \beta_4 (OWC_{i,t-1} \times Group_i) + \beta_5 (OWC_{i,t-1} \times Crisis_t) + \beta_6 (OWC_{i,t-1} \times Crisis_t \times Group_i) + \gamma_t + \mu_i + \varepsilon_{it}$$

where γ_t represents year fixed effects, μ_i denotes firm-specific random effects, and ε_{it} is the idiosyncratic error term. In this specification, β_1 captures the baseline association between OWC and ROA for capital-intensive firms during non-crisis periods; β_4 captures the differential effect across industry groups in non-crisis conditions; β_5 reflects the additional moderating effect of crisis conditions; and β_6 tests whether crisis-related moderation differs between the two industry groups. A reduced specification focusing solely on the $OWC \times Crisis$ interaction is also estimated as a more parsimonious robustness check.

All continuous variables are winsorised at the 5th and 95th percentiles to mitigate the influence of extreme observations (Leone et al., 2019; Burcă and Batrancea, 2024), and lagged values of all explanatory variables are used to reduce simultaneity and reverse causality concerns (Bellemare et al., 2017; Leszczensky & Wolbring, 2022). Models were estimated using restricted maximum likelihood (REML) with Satterthwaite degrees of freedom approximation, and model fit was assessed using AIC and BIC. All analyses were conducted in SPSS. The next section presents the results,

beginning with descriptive statistics and preliminary diagnostics before turning to the mixed-effects regression estimates.

4. Results

This section presents empirical findings on the relationships among operating working capital, asset utilisation efficiency, firm size, and profitability, beginning with descriptive statistics and preliminary diagnostics before turning to the mixed-effects regression estimates.

Table 1 reports descriptive statistics for the main variables used in the analysis, providing an initial characterisation of the sample in terms of central tendency and dispersion.

Table 1. Descriptive statistics of financial structure.

Variable	N	Minimum	Maximum	Mean	Std. Deviation
ROA	300	-0.0736	0.2892	0.0479	0.0649
OWC	300	0.0107	0.5640	0.2648	0.1747
AT	300	0.0839	1.1309	0.5194	0.2929
Size	300	16.000	23.000	19.1933	1.9635
Crisis	300	0	1	0.1667	0.3733
Group dummy	300	0	1	0.2800	0.4498

The sample firms recorded a mean ROA of 0.0479, indicating average profitability of approximately 4.8% of total assets, with a standard deviation of 0.0649 and a coefficient of variation of approximately 135%, reflecting substantial cross-firm heterogeneity that reinforces the appropriateness of the mixed-effects specification. The mean OWC of 0.2648 indicates that approximately 26% of total assets are tied up in net operating working capital, with considerable dispersion across firms ($SD = 0.1747$), ranging from a minimum of 0.0107 to a maximum of 0.5640. The average asset turnover of 0.5194 suggests moderate asset utilisation efficiency, while firm size ranges from 16 to 23 on the logarithmic scale, indicating a relatively homogeneous sample of medium-to-large listed firms. The crisis dummy captures two years of disruption (2020–2021), representing approximately 17% of the total firm-year observations, while the group dummy indicates that 28% of firm-year observations correspond to project-based industries. Overall, the variables display sufficient variation across both firms and years to support the subsequent econometric analysis.

To assess the direction and strength of bivariate relationships among the main variables, Table 2 reports the Pearson correlation matrix prior to the regression estimation.

Table 2. Correlation matrix.

Variable	ROA	OWC	AT	Size
ROA	1			
OWC	-0.169**	1		
AT	0.367**	0.203**	1	
Size	0.219**	-0.270**	-0.281**	1

The above table reports Pearson correlation coefficients between the main variables. * $p < 0.05$; ** $p < 0.01$.

Crisis and Group dummy variables are excluded from the correlation matrix, as Pearson correlation coefficients are less informative for binary indicators; their associations with the dependent variable are captured through the regression interaction structure.

The correlation matrix reveals that ROA is negatively associated with OWC ($r = -0.169$, $p < 0.01$) and positively associated with both asset turnover ($r = 0.367$, $p < 0.01$) and firm size ($r = 0.219$, $p < 0.01$), consistent with the expected direction of the regression coefficients. The stronger correlation between AT and ROA relative to OWC and ROA provides an early indication that operational efficiency may be a more dominant profitability driver than short-term liquidity management. Correlations among the explanatory variables remain moderate, with no pairwise coefficient exceeding 0.30 in absolute value, suggesting that multicollinearity is unlikely to distort the regression estimates. These associations are nonetheless preliminary and should be interpreted as descriptive rather than causal.

Before proceeding to the regression models, Table 3 reports variance inflation factors to formally assess the extent of multicollinearity among the explanatory variables and interaction terms included in the full specification.

Table 3. Multicollinearity diagnostics.

Variable	VIF
OWC	1.218
AT	1.122
Size	1.240
OWC x Group	1.369
OWC x Crisis	1.365
OWC x Crisis x Group	1.511

All VIF values remain well below the conventional threshold of 5, with the highest value recorded for $OWC \times Crisis \times Group$ (1.511), confirming that multicollinearity does not pose a significant concern in the estimated models. The main regressors — OWC (VIF = 1.218), AT (VIF = 1.122), and Size (VIF = 1.240) — display near-unity values, indicating negligible linear dependence among the core predictors. The interaction terms display marginally higher VIF values than the main regressors, as expected given their construction from the constituent variables: $OWC \times Group$ (VIF = 1.369), $OWC \times Crisis$ (VIF = 1.365), and $OWC \times Crisis \times Group$ (VIF = 1.511), yet all remain within a range that does not compromise coefficient stability or interpretability. Taken together, these diagnostics confirm that the dataset is adequate for the econometric investigation, and the analysis proceeds to the full mixed-effects specification.

4.1. Impact of OWC during crisis period – full specification model

Table 4 presents the results of the full mixed-effects specification, which includes interaction terms between OWC, crisis conditions, and industry group, allowing for the simultaneous assessment of direct and moderated effects of working capital on profitability.

Table 4. Mixed-effects regression results – Crisis model.

Variable	Coefficient	Std. Error	t	p-value
OWC(t-1)	-0.065	0.030	-2.155	0.033
AT(t-1)	0.097	0.016	5.776	0.000
Size(t-1)	0.010	0.003	2.787	0.008
OWC x Group	0.070	0.040	1.810	0.073
OWC x Crisis	-0.100	0.045	-2.208	0.028
OWC x Crisis x Group	0.087	0.056	1.555	0.121

In the presence of interaction terms, the OWC coefficient ($\beta_1 = -0.065$, $p = 0.033$) represents the marginal effect of OWC on ROA exclusively for capital-intensive firms during non-crisis periods and should not be interpreted as a general direct effect applicable across the full sample. For this subgroup, the negative association between operating working capital and profitability is statistically significant, consistent with the opportunity cost mechanism underlying H1.

The interaction term $OWC \times Crisis$ is negative and statistically significant ($\beta_5 = -0.100$, $p = 0.028$), indicating that the adverse profitability implications of higher working capital intensify meaningfully during periods of economic disruption. For capital-intensive firms, the total marginal effect of OWC during crisis periods is given by $\beta_1 + \beta_5 = -0.065 + (-0.100) = -0.165$. At the sample mean of OWC (0.265), this implies that crisis conditions are associated with an additional reduction in ROA of approximately 2.7 percentage points relative to non-crisis periods — equivalent to more than half of the sample mean ROA of 4.8%. This magnitude underscores the economic significance of the crisis moderation effect beyond its statistical significance.

Asset turnover exerts a strong positive effect on profitability ($\beta = 0.097$, $p < 0.001$). Standardised coefficients were computed post-estimation by multiplying each unstandardised coefficient by the ratio of the standard deviation of the respective predictor to the standard deviation of ROA. The standardised coefficient of AT ($\beta^* = 0.44$) is approximately 2.7 times larger in magnitude than that of OWC ($\beta^* = -0.16$), confirming that operational efficiency is the dominant

determinant of profitability in this sample. A one standard deviation increase in AT (0.293 units) is associated with an increase in ROA of approximately 2.8 percentage points, compared to a decrease of approximately 1.1 percentage points for a one standard deviation increase in OWC (0.175 units). Firm size also carries a positive and statistically significant effect ($\beta = 0.010$, $p = 0.008$), indicating that structural scale advantages represent a more stable profitability driver than short-term liquidity management in isolation. The $OWC \times Group$ interaction is marginally significant ($p = 0.073$), while the triple interaction $OWC \times Crisis \times Group$ does not reach statistical significance ($p = 0.121$), suggesting that the available data do not provide sufficient power to establish systematic industry-level differences in the OWC–profitability relationship.

To facilitate interpretation of the interaction structure, Table 5 decomposes the total marginal effect of OWC on ROA across all combinations of industry group and crisis condition implied by the full model coefficients.

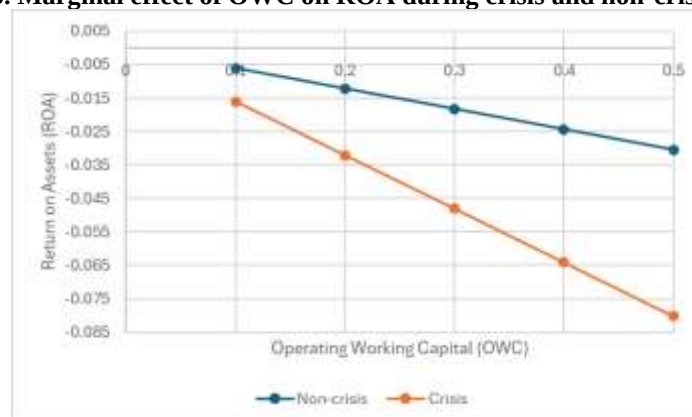
Table 5. Total marginal effect of OWC on ROA by industry group and crisis period.

Industry group	Non-crisis	Crisis	Difference
Capital-intensive	-0.065	-0.165	-0.100
Project-based	+0.005	-0.008	-0.013

The decomposition confirms that the crisis moderation effect is concentrated in the capital-intensive group, where the total marginal effect of OWC shifts from -0.065 in non-crisis periods to -0.165 during the crisis, implying an additional profitability reduction of approximately 2.7 percentage points. For project-based firms, the estimated non-crisis effect is marginally positive ($+0.005$), while the crisis effect turns slightly negative (-0.008), though both figures are derived from coefficients that do not individually reach statistical significance ($OWC \times Group$: $p = 0.073$; $OWC \times Crisis \times Group$: $p = 0.121$) and should therefore be interpreted with caution. The absence of statistically significant industry interactions should not be interpreted as definitive evidence of homogeneity across sectors. Rather, this result reflects, at least in part, the limited number of project-based firms in the sample ($n = 7$), which substantially constrains the statistical power available to detect industry-level interaction effects; even economically meaningful differences may not reach conventional significance thresholds under such conditions.

Figure 3 provides a visual complement to the regression results, plotting the estimated marginal effect of OWC on ROA separately for crisis and non-crisis periods to illustrate the shift in the OWC–profitability relationship under economic stress.

Figure 3. Marginal effect of OWC on ROA during crisis and non-crisis periods.



The pronounced negative slope in crisis years visually confirms the earlier finding that the profitability cost of high working capital is greater during economic stress, with the crisis slope shifting from -0.065 to -0.165 relative to the non-crisis baseline. The steeper negative slope in crisis years relative to the non-crisis baseline visually confirms that the profitability cost of high working capital is greater during periods of economic stress. This shift in slope is consistent with the crisis

moderation effect estimated in the regression model, where the $OWC \times Crisis$ interaction term captures a uniform additional reduction in ROA across all levels of working capital commitment. Taken together, Figure 3 and the regression estimates consistently support the conclusion that crisis conditions represent a meaningful moderator of the OWC–profitability relationship, particularly for capital-intensive firms.

4.2. Robustness analysis – Crisis specification

To assess whether the crisis moderation finding holds under a more parsimonious specification, Table 6 presents a reduced mixed-effects model retaining only the $OWC \times Crisis$ interaction, which provides a cleaner and more direct test of H2 while serving as a robustness check for the main findings.

Table 6. Mixed-effects regression results – reduced crisis model.

Variable	Coefficient	Std. Error	t	p-value
OWC (t-1)	-0.0391	0.0295	-1.325	0.187
AT (t-1)	0.0992	0.0172	5.761	0.000
Size (t-1)	0.0121	0.0041	2.933	0.006
Crisis	-0.0306	0.0188	-1.627	0.115
OWC x Crisis	-0.0766	0.0444	-1.724	0.086

In this specification, the OWC coefficient remains negative (-0.039) but is not statistically significant ($p = 0.187$), confirming that the direct effect of working capital on profitability is sensitive to model specification and should not be treated as a robust finding in isolation. The $OWC \times Crisis$ interaction remains negative (-0.077) and marginally significant ($p = 0.086$); while weaker than in the full model, the sign and approximate magnitude are consistent across both specifications — -0.100 in the full model and -0.077 in the reduced model — providing directional evidence of robustness, though statistical significance is not maintained at conventional thresholds in the reduced specification ($p = 0.086$), a result attributable in part to the reduced degrees of freedom and the redistribution of cross-sectional variation following the omission of industry interaction terms. The stability of the direction and order of magnitude across specifications, rather than the significance level alone, constitutes the key evidence of robustness reported here. The attenuation of both coefficients relative to the full model is expected, as the omission of industry interaction terms redistributes part of the cross-sectional variation back onto the main OWC term, which in the full model absorbs variation specific to capital-intensive firms in non-crisis conditions. The stability of the sign and approximate magnitude of $OWC \times Crisis$ across both specifications provides the key evidence of robustness, as the direction and order of magnitude of the crisis moderation effect remain consistent regardless of model complexity.

The control variables remain highly stable across specifications. Asset turnover continues to exert a strong positive and highly significant effect on ROA ($\beta = 0.099$, $p < 0.001$), and firm size remains positive and statistically significant ($\beta = 0.012$, $p = 0.006$). The near-identical coefficients across both models — 0.097 versus 0.099 for AT, and 0.010 versus 0.012 for Size — strengthen confidence in the conclusion that operational efficiency and firm size are robust and dominant determinants of profitability in the sample analysed, independently of the interaction structure imposed on the OWC term.

Taken together, the empirical findings offer differentiated support for the three hypotheses. H1 receives support at the conventional significance level in the full model ($p = 0.033$) but not in the reduced specification ($p = 0.187$), indicating that the direct effect of OWC on profitability, while consistently negative, is sensitive to model complexity and should not be treated as a uniformly robust finding. H2 receives clearer empirical support through the significant $OWC \times Crisis$ interaction in the full model ($p = 0.028$), corroborated in direction and magnitude by the reduced specification ($p = 0.086$), with the crisis period amplifying the adverse working capital effect for capital-intensive firms to a magnitude exceeding half of mean sample ROA. Separately, the exploratory analysis of whether this crisis-moderation effect differs across industry groups — tested

through the $OWC \times \text{Group}$ and $OWC \times \text{Crisis} \times \text{Group}$ interaction terms — does not yield statistically significant results. This outcome is attributable at least in part to the limited number of project-based firms in the sample ($n = 7$), which constrains the statistical power available to detect industry-level differences, and should not be interpreted as definitive evidence of sectoral homogeneity. H3 is robustly confirmed across all specifications, with asset turnover emerging as the dominant profitability driver and a standardised effect approximately 2.7 times larger than that of OWC, and firm size as a consistently significant structural control. These findings provide the empirical basis for the managerial and policy implications discussed in the concluding section.

5. Conclusions

This study examined the relationship between short-term financial policy and firm profitability, with particular attention to the role of operating working capital, asset utilisation efficiency, and firm size under conditions of economic instability. Using a balanced panel of 25 firms listed on the Bucharest Stock Exchange over the period 2013–2024, the empirical analysis employed mixed-effects models to assess both the direct effect of OWC on profitability and its variation during crisis conditions.

The findings reveal a differentiated pattern across the estimated models. The OWC coefficient is negative in all specifications, indicating that higher operating working capital is associated with lower profitability. In the full model, this relationship is statistically significant ($p = 0.033$), while in the reduced specification it does not reach conventional significance ($p = 0.187$), indicating that the direct effect is sensitive to model complexity. The study therefore does not support a uniformly robust direct effect of OWC on profitability across all specifications, but points to a context-dependent adverse association that becomes economically meaningful under specific conditions. By contrast, asset turnover emerges as the most robust profitability determinant across all specifications, with a standardised coefficient approximately 2.7 times larger in magnitude than that of OWC. Firm size also shows a consistently positive and statistically significant association. Taken together, these results underscore that operational efficiency, and firm-specific structural characteristics are more stable drivers of profitability than short-term liquidity management considered in isolation.

The central contribution of the study lies in demonstrating that the profitability implications of OWC are conditional on the macroeconomic environment. The interaction between OWC and the crisis period is negative and statistically significant in the full model ($p = 0.028$) and remains negative and marginally significant in the reduced specification ($p = 0.086$), providing consistent evidence that the adverse effect of working capital on profitability intensifies during periods of economic disruption. The total marginal effect of OWC on ROA for capital-intensive firms intensifies from -0.065 in non-crisis periods to -0.165 during crisis conditions. At the sample mean OWC of 26.5% of total assets, this implies an additional profitability reduction of approximately 2.7 percentage points — a magnitude exceeding half of the sample mean ROA of 4.8%. This result highlights that the profitability cost of maintaining high working capital is not merely statistical but economically substantial under macroeconomic stress. In contrast, the analysis does not provide evidence that the OWC–profitability relationship differs systematically across industry groups, a result that should be read in light of the limited representation of project-based firms in the sample rather than as definitive evidence of sectoral homogeneity.

From a managerial perspective, the findings support a dual-focus financial strategy that combines prudent working capital management with a sustained emphasis on operational efficiency. Firms should monitor working capital positions carefully and adjust them to changing macroeconomic conditions, particularly during crisis episodes when the trade-off between liquidity preservation and profitability becomes more acute. Managerial efforts directed at improving asset utilisation — through inventory optimisation, faster receivables conversion, or better deployment of fixed assets — are likely to generate more reliable and stable profitability gains than adjustments to working capital levels alone. This dual focus is especially important during periods of external stress,

when the liquidity cost of excess working capital rises precisely at the moment when profitability margins are already under pressure. From a policy perspective, the results offer tentative insights relevant to emerging capital markets, where firms operate under tighter financing constraints and greater macroeconomic exposure. While the limited sample scope — 25 listed firms from a single exchange — constrains the direct generalisability of these findings to broader policy settings, the evidence suggests that institutional frameworks governing emerging capital markets may benefit from encouraging context-sensitive working capital oversight, particularly during periods of macroeconomic stress, rather than promoting uniform balance-sheet conservatism. Strengthening the timeliness and quality of financial reporting would further support firm-level liquidity monitoring in such environments.

Overall, the study contributes to the literature by refining the understanding of how operating working capital relates to firm profitability under crisis conditions. Rather than supporting a uniformly strong direct effect of OWC across all specifications, the empirical evidence points to a more context-dependent relationship in which the adverse profitability implications of working capital become pronounced primarily under conditions of macroeconomic stress. This implies that short-term financial policies should be evaluated not only in terms of liquidity provision, but also in relation to the broader economic environment in which firms operate.

Despite these contributions, several limitations should be acknowledged. First, the specification assumes a linear relationship, whereas prior evidence suggests the OWC–profitability relationship may involve an optimal threshold not formally identified here; future work using quadratic or spline specifications would strengthen the empirical basis for the managerial guidance proposed. Second, the sample is limited to 25 listed firms from a single exchange, with an unequal industry distribution — 18 capital-intensive and 7 project-based firms — which constrains the precision of sector-level interaction estimates. A formal Hausman-type specification test was not conducted; future work should consider applying the Mundlak correction as a more robust alternative. Third, the crisis period was modelled as an exogenous disruption without formal parallel-trends validation, and the empirical framework does not incorporate broader macro-financial controls. Fourth, residual endogeneity cannot be fully excluded despite the use of lagged variables, as firms with persistently lower profitability may adjust working capital policies differently; future research should address this through instrumental variable approaches or Arellano–Bond GMM estimators. Fifth, the selection criterion of continuous listing throughout the full sample period introduces a potential survivorship bias, as firms delisted due to financial distress or poor performance — which may systematically differ in their working capital profiles — are excluded from the analysis. This implies that the estimated negative effect of OWC on profitability may be conservative, and future research should consider sampling frameworks that incorporate delisted firms to assess the robustness of the findings to this selection constraint. These limitations open several directions for future research. Nonlinear specifications would allow a more precise identification of optimal working capital thresholds, while alternative working capital measures and broader cross-country samples would improve generalisability. A particularly promising direction is the replication of this framework on larger panels of Central and Eastern European listed firms, which would allow cross-country comparisons controlling for institutional heterogeneity in financing conditions and governance structures, and would clarify whether the crisis-moderation effect documented here is specific to the Romanian market or reflects a broader pattern in emerging European capital markets.

6. References

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