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WORKING CAPITAL AND PERFORMANCE: EUROPE'S CHALLENGE TO CRISES

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Abstract. This paper explores the relationship between working capital management (WCM) strategies and business performance during the COVID-19 crisis. Data from 1,067 non-financial European firms from 33 countries distributed across 6 economic sectors in the period from 2015 to 2021, feed Ordinary Least Squares model (OLS), robust and quantile pooled regression. COVID-19 crisis seems to have negatively influenced only median-low-range performance firms in Europe, showing that crisis coming from productive capacity hibernation do not impact nor impose tough slow recovery, transversal to all firms, as occurred on other financial crises. As for WCM, only median-top-range performance firms had significant statistical evidence for negative impact, that become positive for median-range performance firms during COVID-19. For Eurozone firms, there was an additional positive influence of the WCM on performance during COVID-19. Median-range performance firms seems to benefit from conservative WCM strategies mitigating firms' performance negative effect raised by COVID-19 crisis. Relation between COVID-19 and WCM seems to be sensitive to different levels of firms' performance and to different business' economic sector. Contrary to knowledge on WCM, performance and financial crises in Europe, for COVID-19 alike crises, performance benefits from higher cash conversion cycles and thus encourage conservative WCM strategies. Liquidity should not be pushed by adopting aggressive WCM strategies.

Keywords: working capital, performance, WCM strategies, Europe, Eurozone, COVID-19.

JEL Classification: G30, G31 G01.

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1. Introduction

Working capital management (WCM) is essential to performance and value, following firm's financial policies and strategies (Chang, 2018; Deloof, 2003; García-Teruel & Martínez-Solano, 2007; Tarkom & Ujah, 2023) to finance working capital (Baños-Caballero et al., 2016), ranging from more conservative to more aggressive strategies (Altaf & Ahmad, 2019; Farhan et al., 2021; Tarkom & Ujah, 2023).

Working capital is associated with liquidity and sustainability – greater risk generates greater firms' return (Farhan et al., 2021). Thus, risk/performance trade-off can be established assuming different behaviour across firms. WCM role in shaping, measuring and balance this trade off, for sure contribute to firm financial equilibrium and long-term financial sustainability – possible with efficient WCM (Panda & Nanda, 2018; Nwude et al., 2021). While the

level of risk, materialized by the WCM, ensures the short-term ability to pay, the performance subsidizes firm's long-term operations. The performance can be explained by other variables (Chang, 2018), such as: (i) corporate governance (Vieira et al., 2019); (ii) development status (Enqvist et al., 2014; Wang et al., 2020); (iii) financial constraints (Altaf & Ahmad, 2019; Baños-Caballero et al., 2014, 2016; García-Teruel & Martínez-Solano, 2008; Laghari & Chengang, 2019); (iv) financial crisis (Akbar et al., 2021; Enqvist et al., 2014); and (v) changes in macroeconomic environments (García-Teruel & Martínez-Solano, 2007; Vieira et al., 2019; Wang et al., 2020). Thus, the business environment can influence the WCM strategy to be adopted by firms (Farhan et al., 2021).

Regarding the influence of WCM on performance in crisis periods, Akbar et al. (2021) used three temporal groups as proxies: before, during and after the 2008 financial crisis (subprime); Chang (2018) used the period of banking and exchange rate crisis perceived in each country; and Enqvist et al. (2014) used the GDP trend: upper limit, for non-crisis period and lower limit for crisis/financial struggles period. From literature it appears that financial crises result from lack of credit and/or financial resources, as was 2008 financial crisis case due to macroeconomic contingencies. When looking for evidence on the impact of WCM on performance in periods of crisis, the literature points to the benefits of aggressive WCM strategies, following the example of Chang (2018) and Enqvist et al. (2014), although recently, and circumscribed to the 2008 financial crisis and Pakistan and Chine firms, Akbar et al. (2021) and Liu et al. (2024), respectively, points to the benefits of conservative WCM strategies. In light of contingency theory, Liu et al. (2024) point out that the changing and/or uncertain environment is affected by several factors that are different between organizations and, therefore, there is no standard management model.

In research carried out with Indian manufacturing firms for the period from 2011 to 2017, Farhan et al. (2021) states that well-formulated WCM policies mitigate liquidity and insolvency risk and that conservative WCM strategy mitigates adverse risks and the associated costs and induces the company to perform better. The literature does not clearly explain how financial crises impact the WCM and what is the relationship with firms' performance. The business environment and macroeconomic volatilities are factors that affect the adoption of WCM policies (Farhan et al., 2021; García-Teruel & Martínez-Solano, 2007; Vieira et al., 2019; Wang et al., 2020) and therefore additional research is welcome.

This research uses COVID-19 period 2020–2021 as financial crisis proxy, considering goods and services supply and demand well known effects coming from across countries' economies lockdown waves. The different nature and characteristics compared to previous crises came essentially from a compulsory productive capacity hibernation in many economic sectors, that remained mostly intact waiting for recovery after lockdowns.

COVID-19 consequent financial crisis, itself different, more complex and wider, with different effects between countries across the world, impacting differently all economic sectors and firms, bring opportunity to better understand the contribution of WCM and its effect on firms' performance in such adverse environment. For Ahmad et al. (2022) and Liu et al. (2024), WCM and performance were more affected by COVID-19 than by the 2008 crisis. In such, WCM efficiency matters as it can mitigate financial constrains (Enqvist et al., 2014), liquidity and insolvency risk (Akbar et al., 2021; Enqvist et al., 2014; Farhan et al., 2021; Tarkom & Ujah, 2023), playing WCM dynamics an important role replying to macroeconomic environment (Akbar et al., 2021; Farhan et al., 2021), even when operations resize is needed (Zeidan & Shapir, 2017).

This paper fulfils the gap related to identifying and understanding the WCM policies adopted by firms from different countries and sectors of economic activity as a result of the COVID-19 financial crisis, as well as their relationship at different levels of performance.

Therefore, based on the above, the following research questions arise: What is the effect of COVID-19 and WCM on the performance of European non-financial firms?

The path followed was on the influence of WCM on the performance of European non-financial firms during the COVID-19 financial crisis trough: (i) influence analysis of COVID-19 on the WCM; (ii) influence analysis of WCM on the European firms' performance, for different performance levels and for different economic sectors; and (iii) influence analysis of WCM on the Eurozone firms' performance. Research was set up upon 5 research questions: H1: The financial crisis generated by COVID-19 had a negative and significant impact on the European firms' performance – that according to Zahra (2021), the COVID-19 crisis could disrupt business and put its economic and financial condition at risk (Backes et al., 2020), expecting a significant and negative relationship with performance is expected; H2: The relationship between WCM and the European firms' performance is negative and statistically significant – As most research suggests negative relationship between WCM and performance (Aktas et al., 2015; Berg, 2016; Chang, 2018; Deloof, 2003; Enqvist et al., 2014; Garcia-Teruel & Martínez-Solano, 2007; Pais & Gama, 2015; Wang et al., 2020); H3: WCM has a negative and statistically significant relationship with the European firms' performance in COVID-19 financial crisis; H4: The WCM presents a negative and statistically significant relationship with the Eurozone firms' performance in COVID-19 financial crisis; and H5: The relationship between WCM and the European firms' performance in the COVID-19 financial crisis is different between economic sectors, and levels of performance – To clarify doubts remaining regarding the transversality of WCM impact during COVID-19 across all economic sectors and firms' performance levels, as highlighted by Backes et al. (2020) and Zahra (2021).

In general, during COVID-19 significant statistical evidence that European firms' performance was influenced by different WCM strategies was found only in median-range performance firms. At least in Europe, crisis coming from productive capacity hibernation do not impact nor impose tough slow recovery with implementation of unlike WCM strategies, transversal to all firms, as occurred on other financial crises, and that, as far as our knowledge goes, we did not know about before. For COVID-19 financial crisis alike, this research provides additional guidance on the best use of WCM strategies, supporting benefits on performance due to more conservative WCM strategies. Therefore, empirical analyses framework is set for different firms' performance levels using quantile regression combined for two different time periods and Diff-in-Diff analysis. Results, a priori, can support WCM rational decisions, mitigating effects and speeding up firms' recovery from unanticipated adverse events.

For Abuzayed (2012) with the financial crisis of 2008, companies began to give more importance to WCM and this aroused the interest of researchers. This particular episode tells about important and useful WCM insights that provides new knowledge to literature that could be generalizable with further empirical research in other countries and with data from similar COVID-19 financial crises.

Paper main contributions to scientific knowledge aim to clarify how and which WCM policies, in periods of severe financial crises, can be more useful to mitigate negative effects on firms' performance in different scenarios such as: countries, sectors of economic activity and levels of performance.

Paper proceeds in Section 2 with the literature review regarding working capital, firms' performance and COVID-19. Section 3 outline methodology. Section 4 highlights the results and analyses, and Section 5 stand for conclusions.

2. Literature

2.1. Working capital and performance

For Aktas et al. (2015) WCM is widely used in corporate finance and is an important factor in financial management of firm (Banerjee & Deb, 2023; Berg, 2016). However, literature is not consensual regarding working capital and WCM interpretations and definitions, as well as regarding proxies used in empirical research.

According to Altaf and Ahmad (2019) and Liu et al. (2024) working capital is the difference between current assets and current liabilities, representing a measure of liquidity between short-term operations investment and short-term operations financing (Ding et al., 2013; Laghari & Chengang, 2019). Is also known as the net working capital or current liquidity according with accounting referential. However, this difference must be analysed from the perspective or conception of financing – when positive, it represents the amount of working capital to be financed with costly resources and, when negative, it expresses the amount of operational financial resources (working capital) available to finance other non-operational investments. Most companies have large financial amounts invested in working capital as well as accounts payable (Deloof, 2003; García-Teruel & Martínez-Solano, 2007).

As bottom line, working capital can be seen into four main components: inventories, accounts receivable, accounts payable (Banerjee & Deb, 2023; Deloof, 2003) plus cash (Akbar et al., 2021). Working capital changes form and substance in the course of operational and commercial activities (Nwude et al., 2021). The management of these four components, taking into account internal and external conditions, is called working capital management (Lefebvre, 2020). How firms finance working capital has impact in their performance (Altaf & Ahmad, 2019; Baños-Caballero et al., 2014, 2016; Deloof, 2003; Farhan et al., 2021; Panda & Nanda, 2018). Financial managers must consider WCM strategies to ensure the company's sustainability (Liu et al., 2024) and, to this end, should shorten the CCC (Sawarni et al., 2023).

For Akbar et al. (2021) WCM reflects policies and adjustments to the level of current assets and current liabilities. It is well known that WCM focus are short-term operational activity investment and financing decisions (Chang, 2018; Deloof, 2003; Laghari & Chengang, 2019; Nobanee & Abraham, 2015; Panda & Nanda, 2018). However, when setting working capital investment level, financing needs emerge with long-term scope and strategies.

Managing each working capital component should only be made towards firm increase performance and value (Akbar et al., 2021; Aktas et al., 2015; Altaf & Ahmad, 2019; Baños-Caballero et al., 2014, 2016; Deloof, 2003). How fast accounts receivable and inventories conversion into cash and when accounts payable become due, known in literature as cash conversion cycle, embodies WCM (Altaf & Ahmad, 2019; Baños-Caballero et al., 2010; Berg, 2016; Deloof, 2003; García-Teruel & Martínez-Solano, 2007; Laghari & Chengang, 2019). If bills became payable first than receivables, this delay means that working capital investment is made and financing is required, with costly financial resources selected according to cost/benefit analysis (Altaf & Ahmad, 2019; Deloof, 2003). The longer this delay, the greater the investment and related financing (Deloof, 2003). Thus, working capital dynamics and synchrony contributes to corporate performance, according to environmental and market conditions and the adopted WCM policy. The efficient WCM seeks to eliminate the risk of insolvency and avoid excessive investment and financing (Nwude et al., 2021) and for Bhattacharyya et al. (2023), improves operational efficiency and firm value (Banerjee & Deb, 2023).

In order to achieving greater performance, many firms increase operations can only be done with greater working capital investment, supporting more sales, more credit to customers and more cash discounts from suppliers. However, when working capital investment financing costs get into equation, performance will suffer (Altaf & Ahmad, 2019; Baños-Caballero et al., 2014, 2016; Deloof, 2003).

However, the objective is financial balance (Chang, 2018; Deloof, 2003) and for Prasad et al. (2019) several factors can impact the quality/efficiency of WCM. Jaworski and Czerwonka (2022) classifies them into: of the firm; macroeconomic conditions (specific to each country); and industry (sector of economic activity). Company's financial policies must monitor all these factors.

According to Altaf and Ahmad (2019) and Farhan et al. (2021), two WCM strategies can be found in literature: conservative and aggressive. Conservative strategy for high investment in current assets with long-term funding at higher interest rate, avoiding refinancing risk and raising the cost of liquidity. Aggressive strategy for low investment in current assets with short-term funding at lower interest rate, bearing higher refinancing risk and raising the cost of illiquidity.

These two WCM strategies may be related to the monetary economic theory and liquidity preference theory, given that the demand for money depends on the interest rate (Keynes, 1985). Thus, each firm liquidity level depends on: transactions volume for a given operation intensity; precaution regarding contractual compliances; and speculation regarding ahead advantages.

Several factors can influence the relationship between WCM and performance, making it complex and requiring efficient financial management, especially in periods of financial crises. For Akbar et al. (2021), WCM proves to be effective and flexible to withstand adverse or macroeconomic contingencies.

According to Zeidan and Shapir (2017) WCM efficiency, cash conversion cycle, and return on investment, requires operations rationalization bounded by operating margin and cash flow. Establish a trade-off between costs and benefits to attain WCM efficiency is crucial if firm value maximization is the goal (Deloof, 2003; Farhan et al., 2021; Panda & Nanda, 2018). Short-term financial management, liquidity, return and efficiency must be handled in the light of trade-off and pecking order theories with the aim also of seeking the sustainability and development of the firm (Fahran et al., 2021).

Trade-off theory guide on the equilibrium of an optimal capital structure, and this occurs when debt marginal benefits equal its marginal costs (Jensen & Meckling, 1976; Myers, 1984). Tax benefits through the use of debt instead of equity be balanced by agency and bankruptcy costs increase and by greater difficulty in raising new financial resources (Jensen & Meckling, 1976; Myers, 1984, 2001).

The Pecking Order suggests a hierarchy of preference for funding sources, with priority given to those generated internally followed by debt and then equity with new shares issue (Myers, 1984, 2001; Myers & Majluf, 1984). Extending DeAngelo and Masulis (1980) findings, to maximize performance and firm value, working capital investment financing optimal mix is sensitive both to the debt level and to agency and bankruptcy costs.

There are several recent research papers on the relationship between WCM and corporate performance in different environments and purposes. For instance, for Deloof (2003) and Nwude et al. (2021) seeking the optimal level of working capital is the way to WCM generate significant impact on performance (Deloof, 2003; Farhan et al., 2021; Nwude et al., 2021; Panda & Nanda, 2018). Thus, on one hand, high investment in working capital, especially in

inventories and customers, reduces risk (liquidity and supply) and tends to stimulate sales and, therefore, performance. However, on the other hand, there is a financial cost regarding working capital investment rather than other investments, rising opportunity cost.

The balance between costs and benefits coming from WCM provides the optimal level of investment, generally exhibiting an inverted U-Shaped relationship as stated by Akbar et al. (2021), Aktas et al. (2015), Altaf and Ahmad (2019), Baños-Caballero et al. (2014, 2016), Laghari and Chengang (2019) and Pais and Gama (2015).

Laghari and Chengang (2019) and Wang et al. (2020) research explored firms working capital strategies, life cycles and financial constraints, while Akbar et al. (2021), Chang (2018), Enqvist et al. (2014) and Liu et al. (2024) research focused on financial struggles and crises.

Literature bottom line in this matter point out a negative relationship between WCM and performance, supported on research carried out in different countries by Aktas et al. (2015), Berg (2016), Chang (2018), Deloof (2003), Enqvist et al. (2014), Garcia-Teruel and Martínez-Solano (2007), Pais and Gama (2015) and Wang et al. (2020). Nevertheless, more recent research by Amponsah-Kwatiah and Asiamah (2020) and Laghari and Chengang (2019) found a positive relationship.

2.2. Economic and financial crises

Forever remembered as the COVID-19 pandemic, 2020–2021 period was hit by a health crisis with severe effects on world economies. Recognized as an unprecedented event by Ashraf (2020) and capable of disrupting business and supply chains (Zahra, 2021), it puts their solvency at risk (Backes et al., 2020). Allowing companies to lose their financial balance and liquidity would contribute to worsening the economic and financial crisis. COVID-19 has therefore forced governments to provide financial and economic assistance to companies. For Abuzayed (2012) and Akbar et al. (2021) after the 2008 subprime financial crisis with global and severe consequences on corporate liquidity, managers moved their attention to the short-term financial management with emphasis on WCM, given the need to release free cash flow. Campello et al. (2010) surveyed 1,050 financial directors from 39 countries in the US, Europe and Asia and found that in financially constrained firms the impact of the subprime financial crisis was severe, with emphasis on cutting R&D expenditures, abandoned or delayed investment decision and fixed asset sales, however, with greater intensity in Asia and Europe.

Tarkom (2022), in a survey of 2,542 publicly traded U.S. companies, found that COVID-19 exposed firms' operations to higher levels of cash conversion cycle, but the opposite was found for firms with greater investment opportunities and government incentives to deal with the effects of COVID-19.

In crisis context, firms' management is pressured considering low cash, low credit and low demand for products and services and, therefore, WCM efficiency is crucial, as shown by Enqvist et al. (2014). Liu et al. (2024) and Moussa (2018) noted that in periods of financial crisis, firm withdraw and tend to increase working capital. Regarding the influence of WCM on performance, Liu et al. (2024), in a research with China's agri-food companies, found a positive relationship in the 2008 crisis (subprime) and non-significance in the COVID-19 crisis. Therefore, it can be inferred that crises have different profiles.

Several other studies indicate that aggressive WCM strategy tends to improve performance when others do not, even in crisis scenarios. In a survey of 31,612 firms in 46 countries, Chang (2018) found a negative and statistically significant relationship between WCM and performance, which did not change when the subprime financial crisis variable is added,

but blurs for lower working capital investments. Earlier, Enqvist et al. (2014) in a survey to Finnish firms over the period 1990–2008, found a negative relationship between WCM and performance, also concluding that an efficient WCM has a positive impact on operational performance in periods of economic recession as measured by GDP.

Akbar et al. (2021) found opposite results regarding the more conservative WCM strategy followed by Pakistani firms, with a positive and statistically significant relationship between WCM and performance and no sign changes during the crisis period. According to Ramiah et al. (2014), during subprime financial crisis Australian firms adopted more conservative measures, such as reducing expenses, inventories and capital expenditures to preserve cash and liquidity, and increasing risk aversion.

In periods of economic recession and/or financial crises, financial difficulties may arise with a possible increase in insolvencies. Fortunately, WCM is dynamic in terms of responding to the adverse macroeconomic environment, mitigating financial difficulties and insolvencies situations, as Akbar et al. (2021), Farhan et al. (2021) and Nwude et al. (2021), Tarkom and Ujah (2023) points out.

3. Research method

3.1. Data

From 1,558 European firms (non-financial) available in the Refinitiv Reuters Eikon™ database a sample of 1,067 firms from 33 countries and 6 economic sectors was selected. The annual data between 2015 and 2021, collected in August 2022, resulted in 7 469 validated observations for each variable, already removed the outliers in order to qualify the sample for the purpose of the research.

Table 1. European companies by economic sector

Sector	Population	Filters	Sample #	Sample %
Basic Materials (*bm*)	226	52	174	16.31
Consumer Cyclicals (*cc*)	444	142	302	28.30
Consumer Non-Cyclicals (*cnc*)	188	48	140	13.12
Energy (*ene*)	119	45	74	6.94
Industrial (*ind*)	489	147	342	32.05
Utilities (*uti*)	92	57	35	3.28
Total	1,558	491	1,067	100.00

In Table 1 the following firm exclusion filters were used: (i) in Refinitiv Reuters Eikon™, firms with values equal to or less than zero for cost of goods sold, accounts payable, accounts receivable, inventories and total assets; (ii) in Stata®, firms with values equal to and less than zero for revenues, current assets and current liabilities. Of the 491 excluded firms, 192 (39.6%) are from the Eurozone and 299 (60.9%) from outside the Eurozone. As for economic sectors, the industrial (*ind*) and consumer cyclicals (*cc*) sectors have the highest representation (60.36%), consumer non-cyclicals (*cnc*) and basic materials (*bm*) sectors have the median representation (29.43%) and energy (*ene*) and utilities (*uti*) sectors have the lowest representation (10.22%) among all firms in the sample. This fact suggests some consistency as to

the nature and characteristics of the sectors and, a priori, may indicate different results in the relationship between WCM and performance in the regressions estimation.

Table 2 shows that the sample is made up of 503 (47.14%) companies outside the Eurozone in 17 countries and 564 (52.86%) in the Eurozone in 16 countries.

Table 2. Firms by country

Country	Population	Sample	Country	Population	Sample
Germany	173	138	Ireland	29	20
Austria	25	23	Iceland*	3	3
Belgium	24	20	Italy	84	56
Bulgaria*	4	3	Jersey*	17	7
Cyprus	11	6	Lithuania	4	3
Croatia*	7	7	Luxemburgo	25	16
Denmark*	28	22	Norway*	71	31
Slovenia	2	2	Poland*	80	51
Spain	60	44	Portugal	17	13
Estonia	8	5	United Kingdom*	276	160
Finland	67	35	Czech Republic*	4	1
France	158	134	Romania*	13	7
Greece	20	15	Russia*	45	26
Netherlands	49	34	Serbia*	1	1
Hungary*	5	4	Sweden*	157	102
Isle of Man*	4	3	Switzerland*	86	74
Faroe Islands*	1	1			
			Total	1.558	1.067

Note: * Eurozone countries.

It is worth noting that in the Eurozone 4 countries (4th quartile) concentrate 65.96% of the 564 firms, while outside the Eurozone 4 countries concentrate 76.94% of the 503 firms. Among the 17 countries, the 8 countries with the largest number of firms have a concentration of 85.82% and 94.04% in the Eurozone and outside the Eurozone, respectively. This concentration of the sample, which is more evident in the sub-sample outside the Eurozone, may indicate different behaviours in the relationship between WCM and performance.

3.2. Variables

Return on assets (*roa*) was set as the dependent variable, following Altaf and Ahmad (2019) and Laghari and Chengang (2019). Aktas et al. (2015), Amponsah-Kwatiah and Asiamah (2020), Berg (2016), Chang (2018), Garcia-Teruel and Martínez-Solano (2007), Pais and Gama (2015) and Wang et al. (2020) also used *roa* their research. Furthermore, it should be noted that in periods of financial crisis, the focus in keeping firms running must prevail, being *roa*

crucial. For Kayakus et al. (2023), *roa* is an important KPI for the sustainable profitability and performance of firms.

According to the literature, the following control variables were selected: sales growth (*cresrec*), leverage (*alav*), current liquidity (*lc*) and tangible fixed assets (*atf*). Gross profit (*lb*) was also included because it synthesizes and aggregate in cost and sales endogenous and exogenous influences on the firm, especially important in periods of financial crisis. In order to control the size effect (*atpib*) for country development level effect in firm performance, the ratio between total assets investment and country GDP was chosen, as the sample includes firms from 33 countries but with high concentration.

The cash conversion cycle (*net*) is an important KPI for analysing the financial liquidity of firms (Czerwinska-Kayzer et al., 2021). Coming from receivables, inventories, payables and net sales was used as WCM proxy according to Akbar et al. (2021), Aktas et al. (2015), Amponsah-Kwatiah and Asiamah (2020), Berg (2016), Chang (2018), Deloof (2003), Enqvist et al. (2014), Garcia-Teruel and Martínez-Solano (2007), Laghari and Chengang (2019), Pais and Gama (2015) and Wang et al. (2020). According to Chang (2018), Deloof (2003) and García-Teruel and Martínez-Solano (2007) the economic-financial rationale for including the *net* variable follows the importance of WCM strategies on firms' performance and value. Moreover, in periods of crisis, Akbar et al. (2021), Enqvist et al. (2014) and Zeidan and Shapir (2017) argue that dynamic WCM policies allow mitigating financial distress with operational optimization.

In addition, the following binary variables were added: (i) dummy *dc* – 1 for the period of the COVID-19 financial crisis (2020–2021) and 0 for the remain; (ii) dummy *dze* – 1 for Euro-zone firms and 0 for remain; (iii) dummy $dsector_i$ – 1 for the specific economic sector and 0 for remain, being cyclical consumption sector the reference. To meet the research objectives, variables were interacted, especially *net* and *dc*, according to the following topic related to the specification of the regression model.

3.3. Regression model

Altaf and Ahmad (2019) and Laghari and Chengang (2019) regression models were adjusted to analyse the influence of WCM on performance in European firms during COVID-19 financial crisis period.

$$\begin{aligned} roa_{it} = {} & \beta_0 + \beta_1 dc + \beta_2 net + \beta_3 netdc + \beta_4 dze + \beta_5 dsector_i + \\ & \beta_{10} netdcdze + \beta_{11} netdcdsector_i + \beta_{16} cresrec + \\ & \beta_{17} alav + \beta_{18} lc + \beta_{19} atf + \beta_{20} lb + \beta_{21} atpib + \mu_{it}, \end{aligned} \quad (1)$$

with *roa* as dependent variable, *dc*, *net*, *netdc*, *dze*, $dsector_i$, *netdcdze* e $netdcdsetor_i$ as independent variables of interest and *cresrec*, *alav*, *lc*, *atf*, *lb* e *atpib* as independent variables of control, all explained, computed, sign expectation and hypothesis testing in Table 3. Regressions coefficients given by $\beta_{1\,to\,21}$ for each independent variable, β_0 the constant and μ the error term.

According to Fávero et al. (2014), the Variance Inflation Factor (VIF) test and the Tolerance test for multicollinearity performed returned no multicollinearity evidence (VIF maximum value of 4.74 for the *netdc* variable, and Tolerance index greater than 0.5 for almost all variables).

According to Fávero et al. (2014) and Greene (2008) the Durbin-Watson test for residuals autocorrelation (Table 4) suggested the inclusion of an order 1 autoregressive component.

Thus, 1 period lagged residuals variable *resdef* was added to the adjusted regression below.

$$roa_{it} = \beta_0 + \beta_1 dc + \beta_2 net + \beta_3 netdc + \beta_4 dze + \beta_5 dsector_i + \beta_{10} netdcdze + \beta_{11} netdcdsector_i + \beta_{16} cresrec + \beta_{17} alav + \beta_{18} lc + \beta_{19} atf + \beta_{20} lb + \beta_{21} atpib + \beta_{22} resdef + \mu_{it}. \quad (2)$$

Table 3. Regression model variables

Variable	Value	Sign	Hyp.
roa – return on assets	$\frac{net\ income\ before\ taxes}{total\ assets}$	n/a	n/a
dc – dummy COVID-19	1 for 2020–2021; 0 for remain	+/–	H1
net – working capital	$\left(\frac{receivables + inventory - payables}{net\ sales}\right)$*365	–	H2
netdc	*net*dc*	+	H3
dze – dummy Eurozone	1 for Eurozone; 0 for remain	+/–	n/a
$dsector_i$ – dummy $sector_i$	1 for $sector_i$, with i = basic materials (*bm*), consumer non-cyclicals (*cnc*), energy (*ene*), industrial (*ind*) and utilities (*uti*); 0 for remain	+/–	n/a
netdcdze	*net*dc*dze*	+	H4
$netdcdsector_i$	$net*dc*dsector_i$	+/–	H5
cresrec – growth opportunies	$\frac{revenues_n - revenues_{n-1}}{revenues_{n-1}}$	+/–	n/a
alav – leverage	$\frac{total\ debt}{total\ assets}$	+/–	n/a
lc – liquidity	$\frac{current\ assets}{current\ liabilities}$	–	n/a
atf – fixed assets	$\frac{long\ term\ assets - intangible\ assets}{total\ assets}$	–	n/a
lb – gross profit	$\frac{net\ sales - cost\ of\ sales}{net\ sales}$	+	n/a
atpib – size	$\frac{total\ assets}{GDP}$	+/–	n/a

Table 4. Autocorrelation statistics for equation (1) and equation (2)

Analysis	Test	Regression (1)	Regression (2)
Autocorrelation	Durbin-Watson	.7569944	2.191245

Furthermore, Breusch-Pagan and White tests to verify heteroscedasticity and the Jarque-Bera test to verify normality were statistically significant at 1%. After performing the White robust standard error technique for residuals (Fávero et al., 2014; Greene, 2008) no issue remained regarding homoscedasticity and normality of the residuals.

In addition to descriptive statistics, pooled and quantile OLS regression was used. Quantile regression make sense because the WCM is dynamic in macroeconomic environments (Akbar et al., 2021) and allows mitigating financial distress in periods of financial crises and/or economic recessions (Enqvist et al., 2014), with the magnitude of the impact on performance dependent on the level of performance/efficiency of each firm (Chang, 2018; Deloof, 2003; García-Teruel & Martínez-Solano, 2007).

4. Results analysis

Table 5 shows basic descriptive statistics for all variables. According to skewness and kurtosis, almost all variables are not normally distributed also confirmed by the Jarque-Bera test. Regarding the *net* variable, a large standard deviation and amplitude are observed, which may indicate WCM discrepancies. This can also be seen in *netdc* variable higher mean for COVID-19 period, being lower for Eurozone firms (*netdcdze*). COVID-19 period cash conversion cycle volatility (*netdc*) is higher compared to the whole period (*net*) volatility and to Eurozone firms during COVID-19 (*netdcdze*) volatility. COVID-19 period cash conversion cycle volatility across economic sectors, ranging from 50.25 days in utilities sector to 127.03 days in non-cyclicals sector, also shows that WCM is more discrepant within some economic sectors compared to others, challenging the results of further statistical analysis across economic sectors.

Table 5. Descriptive statistics[1]

Variable	Mean	Median	SD	Min	Max	Skew.	Kurt.
roa	.049	.054	.115	–.974	.863	–1.942	18.533
net	70.253	60.144	85.476	–925.512	996.149	2.526	29.005
netdc	71.422	60.722	89.619	–702.976	940.358	2.666	25.529
netdcdze	66.986	58.058	85.323	–238.161	940.358	2.969	24.629
netdcdbm	71.938	67.639	71.533	–702.976	326.773	–4.413	52.016
netdcdcnc	79.085	57.127	127.029	–52.434	940.358	4.080	23.485
netdcdene	69.402	42.450	106.451	–138.310	775.360	3.350	20.138
netdcdind	80.066	78.492	65.552	–238.161	496.069	.298	6.661
netdcduti	31.434	31.059	50.248	–136.362	191.936	–.033	4.923
cresrec	.061	.026	.275	–.980	4.433	4.310	48.798
alav	.251	.238	.169	.000	2.365	1.115	7.919
lc	1.714	1.450	1.054	.087	9.688	2.556	13.042
atf	.469	.465	.197	.007	.986	.061	2.584
lb	.399	.368	.230	–2.886	.998	–.540	14.742
atpib	.010	.001	.035	.000	.667	9.849	135.923

Note: [1] 7,469 total observations.

In the COVID-19 period, the cash conversion cycle mean for Eurozone firms (*netdcdze*) and utilities firms (*netdcduti*), is lower than the 70.25 days in the whole period (*net*). The remaining economic sectors all exhibit high means, pointing to the expected higher COVID-19 impact on the WCM in those economic sectors firms. COVID-19 period cash conversion cycle mean across economic sectors, ranging from 31.43 days in utilities sector to 80.07 days in industrial sector, also shows large WCM discrepancies, as a result of different WCM effects on performance during the COVID-19 period across economic sectors.

Noted that, a priori, industrial (*netdcdind*) and utilities (*netdcduti*) sectors tend to present a normal distribution and stable dispersion of the cash conversion cycle for the COVID-19 period. This highlights the greater homogeneity in WCM among firms in each of these sectors, particularly utilities with the delivery of basic services to human needs.

The cash conversion cycle dispersion in COVID-19 period for Eurozone firms (*netdcze*) and economic sectors points to very different values of the mean and median, higher and lower, compared to all firms and sectors in COVID-19 period (*netdc*). This is presumably the result of different WCM policies and strategies, ranging from the most conservative to the most aggressive.

Table 6. OLS and Quantile (Q) regressions coefficients

Variables	OLS	Q10	Q25	Q50	Q75	Q90
dc	–.003069	–.004405	–.006970a	–.005622a	–.003009	–.002993
	(.003681)	(.006625)	(.002462)	(.001287)	(.001991)	(.003881)
net	–.000006	.000023	–.000007	–.000032a	–.000058a	–.000094a
	(.000027)	(.000035)	(.000013)	(.000007)	(.000011)	(.000020)
netdc	.000013	.000010	.000008	.000034b	.000010	–.000021
	(.000036)	(.000085)	(.000032)	(.000017)	(.000026)	(.000050)
dze	–.014468a	.000711	–.007944a	–.014790a	–.023162a	–.029087a
	(.002242)	(.004892)	(.001818)	(.000950)	(.001470)	(.002865)
dbm	.003044	.008845	.002891	.002436	.003883	.008834c
	(.003500)	(.007896)	(.002934)	(.001534)	(.002373)	(.004625)
dcnc	.009280a	.027388a	.011682a	.006534a	.000472	.000653
	(.003498)	(.007969)	(.002961)	(.001548)	(.002395)	(.004668)
dene	–.061162a	–.111308a	–.068228a	–.051601a	–.041349a	–.019861a
	(.006379)	(.010263)	(.003814)	(.001994)	(.003084)	(.006012)
dind	–.004193	.010792c	–.001503	–.006270a	–.010785a	–.017882a
	(.002860)	(.006279)	(.002333)	(.001220)	(.001887)	(.003678)
duti	–.027123a	–.006982	–.016455a	–.024577a	–.030967a	–.041931a
	(.003610)	(.014046)	(.005220)	(.002728)	(.004220)	(.008227)
netdcdze	.000079c	.000135c	.000040	.000049a	.000078a	.000076
	(.000044)	(.000081)	(.000030)	(.000016)	(.000024)	(.000047)
netdcdbm	.000134b	.000101	.000056	.000075a	.000057	.000151c
	(.000067)	(.000133)	(.000050)	(.000026)	(.000040)	(.000078)
netdcdcnc	–.000083c	–.000102	–.000029	–.000074a	–.000081b	–.000068
	(.000043)	(.000110)	(.000041)	(.000021)	(.000033)	(.000065)

End of Table 6

Variables	OLS	Q10	Q25	Q50	Q75	Q90
netdcdene	–.000335a	–.001271a	–.000285a	–.000309a	–.000148a	–.000131
	(.000117)	(.000151)	(.000056)	(.000029)	(.000045)	(.000088)
netdcdind	–.000121c	–.000112	–.000030	–.000047b	–.000081b	–.000081
	(.000064)	(.000110)	(.000041)	(.000021)	(.000033)	(.000064)
netdcduti	–.000090	.000030	–.000055	–.000138c	–.000094	–.000097
	(.000063)	(.000421)	(.000157)	(.000082)	(.000127)	(.000247)
cresrec	.052194a	.054339a	.057503a	.058171a	.065564a	.077437a
	(.009380)	(.008307)	(.003087)	(.001614)	(.002496)	(.004866)
alav	–.142046a	–.174954a	–.148437a	–.134108a	–.130324a	–.113558a
	(.010985)	(.015083)	(.005605)	(.002930)	(.004532)	(.008835)
lc	.006140a	–.000347	.004005a	.006631a	.009676a	.013918a
	(.001414)	(.002557)	(.000950)	(.000497)	(.000768)	(.001498)
atf	.056600a	.086641a	.061056a	.039091a	.014516a	–.007457
	(.008461)	(.014158)	(.005261)	(.002750)	(.004254)	(.008293)
lb	.094462a	.076220a	.078533a	.077705a	.082400a	.094519a
	(.006364)	(.010504)	(.003904)	(.002041)	(.003156)	(.006153)
atpib	.122204a	.155709b	.107706a	.111249a	.109263a	.086763b
	(.024859)	(.066093)	(.024561)	(.012839)	(.019860)	(.038714)
resdef	.629108a	.733537a	.719516a	.688397a	.590226a	.499973a
	(.021745)	(.021089)	(.007837)	(.004097)	(.006337)	(.012353)
β_0	.019413a	–.049642a	.005577	.039326a	.074280a	.106364a
	(.005800)	(.010480)	(.003895)	(.002036)	(.003149)	(.006139)

Note: Standard error in parenthesis | Significance level: a – 1%; b – 5%; c – 10%. | N. Obs. 7,468 | F-test 85.74a | R-squared .4707.

Table 6 provides the outputs for the OLS and quantile regressions in order to allow a comparative analysis. At a first glance, the data shows that the COVID-19 crisis negatively influenced median-low-range performance firms, although mitigated by positive influence on median-high-range performance firms in the Eurozone. Regarding the WCM over the whole period, it is noted that the negative impact on performance is more evident in median-top-range performance firms, which underlines the lower performance of Eurozone firms. Compared to consumer-cyclicals firms, basic materials and consumer-non-cyclicals firms seems to outperform, with the remaining firms underperforming.

Regarding the relationship between WCM and the European firms' performance stated in hypothesis H2, no statistical significance was found in the overall OLS regression results. However, a negative and statistically significant coefficient for quantile 50 and above was found at the 1% significance level, seems to show that median-top-range firms' performance benefits from more aggressive WCM strategies before COVID-19 crisis, in accordance with Enqvist et al. (2014). Previously, Aktas et al. (2015), Berg (2016), Chang (2018), Deloof (2003), Garcia-Teruel and Martínez-Solano (2007), Pais and Gama (2015) and Wang et al. (2020), and also found an inverse relationship, as shorter cash conversion cycle stands for higher performance levels.

When combined analysis WCM in COVID-19 period (*netdc*) is performed, only a shy but positive and significant relationship with median-range performance firms is found. This means that more conservative WCM strategy tend to slightly mitigate COVID-19 crisis negative effects on those firms' performance. Thus, no negative and statistically significant relationship between WCM and European firms' performance in the COVID-19 financial crisis (hypothesis H3) holds. The same was found by Akbar et al. (2021) for Pakistan during 2002–2013 and the opposite was found by Chang (2018) for 46 countries during 1994–2011 and by Enqvist et al. (2014) for Finland during 1990–2008.

Interestingly, for median-range performance firms, the negative impact (–.00003 for *net*) of conservative WCM strategies on performance turns into a positive impact of the same magnitude on performance in the COVID-19 period. The opposite is true for aggressive WCM strategies.

At this point, results indicate WCM efficiency of more aggressive strategies in pre-crisis periods (with less investment in inventories and accounts receivable, and more accounts payable, regarding sales), and of more conservative strategies in crisis periods. More recently, Tarkom (2022) noted the latter finding. Certainly, the financing decision to support WCM needs can distort WCM effects on firms' performance, as stated by Altaf and Ahmad (2019), Baños-Caballero et al. (2014, 2016), Berg (2016), Chang (2018), Deloof (2003) and Pais and Gama (2015).

Output also shows that Eurozone firms had a lower performance compared to all European firms, as *dze* shows a negative and statistically significant relation in the OLS regression and for all but the lowest firms' performance level. Nevertheless, in COVID-19 crisis, Eurozone firms also benefit from conservative WCM strategies, mainly in median-high-range performance firms. Thus, there is no statistically significant evidence of a negative relationship between WCM and Eurozone firms' performance in COVID-19 crisis, rejecting H4. However, this result shows that in the COVID-19 period aggressive WCM strategies should be avoided to mitigate lower performance. Conservative WCM strategies in the COVID-19 period seems to benefit more Eurozone firms than remain European ones, at least for median-range performance firms. Note that the impact on Eurozone firms' performance (.000049 for *netdcdze*) is bigger than the impact on all European firms (.000034 for *netdc*) for median-range performance firms in COVID-19 crises.

Eurozone firms should mitigate their lower performance with more aggressive WCM strategies in pre-crises periods and with more conservative WCM strategies in crises periods, mainly for median-high-range performance firms. This is in accordance to liquidity preference theory (Keynes, 1985) since, anticipating the crisis, protection is sought with higher levels of performance generated by aggressive WCM strategies. The big difference here compared to other crises is that during the COVID-19 crisis seems to be no preference for liquidity, as higher levels of performance are generated by conservative WCM preferences. For Tarkom and Ujah (2023), in periods of great uncertainty, the firms tend to adopt more conservative working capital management strategies. This particular episode can be explained at least in part by the need to stock large inventories to face supply chain disruptions resulting from several economic lockdowns around the world. Provide support to customers and suppliers with liquidity difficulties could also explains WCM strategies effects on performance in COVID-19 crisis. Previously Backes et al. (2020) had stated that COVID-19 would generate an economic and financial crisis with different impacts and duration across countries, forcing economic agents to be resilient and adopt coping strategies adapted to each circumstance.

For Liu et al. (2024), financial management needs to adjust its strategies according to external contingencies.

Regarding the relationship between WCM and the European firms' performance across economic sectors during the COVID-19 crisis, statistical results suggest differences between economic sectors and levels of performance, confirming H5. Regardless statistical significance issues, it seems that only consumer-cyclicals and basic materials sectors have a positive effect on performance when more conservative WCM strategies are adopted in COVID-19 crises. For the remaining sectors, negative effects arise, promoting the adoption of more aggressive WCM strategies to mitigate performance losses.

From interaction between WCM and economic sectors during COVID-19, almost no statistically significant evidence of a negative effect on the performance of utilities sector firms was found. This economic sector, devoted to satisfying people's basic needs, normally faces a continuous and undisturbed demand in periods of crisis. For this reason, WCM strategies has little importance in those firms' performance during crises.

The energy sector is the one with the highest negative and statistically significant relationship between WCM and performance, including in all-range performance firms, except top-range ones. This suggests that at the end of the day energy firms will lose performance with more conservative WCM strategies during COVID-19 crises, since energy prices and consumption are very tight with economic cycles.

Also, non-cyclical and industrial sectors shows a similar negative statistically significant coefficients up to 5% significance level in median-high-range performance firms and 10% significance level in OLS. Being the two first sectors suffering with COVID-19 lockdown, since the measures to control and combat COVID-19 first affected the basic industry and non-essential products, negative impact on performance from demand/supply disruption and usually long CCC could only be mitigated with more aggressive WCM strategies.

Since public support focused on maintaining operations of economic sectors essential to life, as is the case of consumption and basic needs, the consumer cyclicals and basic materials sectors revealed a positive relation between WCM and performance, particularly in median-range performance firms. This means that these firms could have improved their performance during the crisis using more conservative WCM strategies, i.e. a higher cash conversion cycle (*net*). As far as we know, this is contrary to what is known about WCM strategies in crises periods. Moreover, we believe that these two sectors were responsible for spreading to the remaining firms the benefits in the performance of more conservative WCM management during the COVID-19 crisis, as found above for Eurozone firms.

Table 7 objectively show that the hypotheses 1, 2 and 5 were not rejected (partially) and the 3 and 4 were rejected, meaning that: COVID-19 negatively affected European firms only with mediun-below performance (H1); Before the COVID-19 crisis, European firms with medium-high performance used more aggressive WCM strategy to improve performance (H2); WCM in the crisis COVID-19 explains the performance of European firms only at its mediun level and with conservative strategy – opposite to expected (H3); In the COVID-19 crisis, medium-high performance of Eurozone firms is related to the more conservative WCM strategy (H4) – contrary to expectations, this finding may also explain the relationship between COVID-19 and performance in European firms; In the COVID-19 crisis, WCM explains performance differently between sectors of economic activity and also across performance levels (H5) – for example, it seems that the WCM strategy in the basic materials and cyclical consumption sector is conservative and in the others sectors it is aggressive.

Table 7. Summary of hypothesis results

Hypoteses	Variables	OLS	Q10	Q25	Q50	Q75	Q90	Result
H1: –	*dc*			–a	–a			Not rejected
H2: –	*net*				–a	–a	–a	Not rejected
H3: –	*netdc*				b			Rejected*
H4: –	*netdcdze*	c	c		a	a		Rejected*
H5: ≠	*netdcsector*							not rejected
	netdcdbm	b			a		c	
	netdcdcnc	–c			–a	–b		
	netdcdene	–a	–a	–a	–a	–a		
	netdcdind	–c			–b	–b		
	netdcduti				–c			

Note: * Expected sign was negative |Significance level: a – 1%; b – 5%; c – 10%.

The results seem to indicate that Eurozone firms have benefited more from the government financial support during the COVID-19 crisis. However, it should be noted that all European firms with average performance maintained a conservative strategy, probably due to the influence of Eurozone firms which also mitigated the effect of COVID-19 on European firms. These conclusions are in line with the characteristics and nature of the firms in the sample, as previously noted.

All control variables return statistically significative coefficients at 1% significance level in the OLS and in almost all quantiles' regressions, ensuring statistical model robustness. The results for the control variables are mostly consistent with those found in the literature. As expected, high-end-range performance firms benefit from a greater positive impact on performance due to higher sales growth, current liquidity, and gross profit, compared to median-low range ones. Debt leverage negative impact on performance was slightly lower for high-end-range performance firms. Surprising were the lower positive impact on performance due to higher tangible fixed assets and size for high-end-range firms.

In relation to the *atpib* variable, it is significant (5%) at the extremes of performance and with a smaller impact. This suggests that GDP influences the level of investment and has an effect on the performance of the firms in the sample. The behavior of the *atpib* variable may explain the more conservative WCM during the COVID-19 period. This finding also applies to the gross profit (*lb*) variable.

5. Conclusions

This paper concerns to the relationship between WCM and firms' performance during the COVID-19 financial crisis using 7,469 observations of 1,067 non-financial firms from 33 European countries, between 2015 to 2021. The data collected from the Refinitiv Reuters Eikon® database were analysed using the OLS, robust and quantile pooled regressions.

The data shows that firms' performance can be explained by debt leverage negative relation and by positive relation regarding sales growth, current liquidity, gross profit, and size. Moreover, the WCM as proven to provide useful information to explain performance across

different levels of performance and across different economic sectors, before and during COVID-19 crisis.

Results suggest that the COVID-19 crises did not, in general, have a statistically significant negative impact on the performance of European firms, but rather occurred at median-low-range performance levels, deepening the whole period lower performance evidence in median-top-range performance Eurozone firms. However, the worse performance on Eurozone firms, likely due to a greater dispersion of firms across countries, as opposed to a greater concentration of firms in few countries outside Eurozone that reacted better to COVID-19, had additional positive benefit on performance when more conservative WCM strategies during COVID-19 crisis were adopted. So, crisis coming from productive capacity hibernation do not impact nor impose tough slow recovery, transversal to all firms, as occurred on other financial crises.

Another finding suggests that firms with higher levels of performance benefit more from aggressive WCM strategies, but during COVID-19 crisis they should adopt more conservative WCM strategies to mitigate negative impacts on performance, as significant statistical evidence was found for median-range performance firms.

During the COVID-19 crisis, WCM strategies has little importance on utilities and consumer-cyclicals sectors firms' performance, probably because they offer basic and indispensable services in any economic circumstance. If negative impact on performance of industrials, non-cyclicals, energy and utilities sectors benefited with more aggressive WCM strategies, basic materials and consumer-cyclicals sectors benefited with more conservative strategies. We believe that WCM positive impact on performance in these two basic commodities sectors is explained by consumers' and firms' fear regarding their scarcity uncertainty during lockdowns. This sentiment made them more prone to stock up and avoid supply chain disruptions, as well as more prone to relax the terms of receivables and payables in accordance with customers' and suppliers' short-term liquidity conditions, keeping firms running.

This paper findings should improve ability to mitigate the effects of crises on firms' performance using WCM strategies adapted to the location, economic sector, and performance level of each firm. New knowledge is added to literature, since contrary to knowledge on WCM, performance and financial crises, for COVID-19 alike crises in Europe, performance benefits from higher cash conversion cycles and thus encourage conservative WCM strategies. Achieving liquidity should not be pushed by adopting aggressive WCM strategies.

This research highlights the importance of the WCM to maximize firms' performance and contribute to value creation, especially in adverse conditions such as the COVID-19 crisis, as well as in other similar contingencies or future financial crises. The nature, causes and other characteristics of each crisis, as well as firms' performance levels, should be taken into the equation when deciding upon WCM strategies to deal with crises scenarios.

Further research on this topic should extend the analysis to other countries and continents attempting to generalize our findings. A deeper analysis focused on Eurozone firms should help to find reasons for their lower performance. An analysis should also be conducted to find out when conservative and aggressive WCM strategies outperform or underperform. Obtaining homogenised data was the greatest difficulty faced by this research.

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