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Working Capital Management Impact on Profitability: Pre-Pandemic and Pandemic Evidence from the European Automotive Industry

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Abstract: Efficient management of working capital is essential for firms to avoid overinvesting in short-term assets for maximum profitability while guaranteeing much-needed liquidity to run their operations. This study examines the impact of working capital management on firms' profitability in the automotive industry in Europe before and during the COVID-19 pandemic period. The automotive industry is vital to the European economy, being a major component of the total industrial value added to the GDP of the continent. Existing research on this topic is inconclusive, and there is a gap in the literature exploring the working capital management effect on firm performance in periods of crisis. Unlike most research, this study focuses on a single industry to better capture the impact of working capital management on firm profitability. It also adds the COVID-19 dimension to stress the importance of proper working capital management, especially in periods of economic distress. The results show that the receivables collection period, inventory conversion period, accounts payable period, and cash conversion cycle have a significant negative impact on ROA for both the pre-pandemic and pandemic period, suggesting that managers must be prudent regarding their firm's credit policy by not being overly generous with credit terms and making every effort to promptly collect their receivables. Moreover, excessive levels of inventory impair profitability by locking up valuable cash reserves, which are vital, especially in periods of crisis. Though seemingly counterintuitive, being profitable also means not postponing payables settlement unnecessarily.

Keywords: working capital management; profitability; return on assets; value-added; COVID-19 pandemic

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Citation: Demiraj, Rezart, Suzan Dsouza, and Mohammad Abiad. 2022. Working Capital Management Impact on Profitability: Pre-Pandemic and Pandemic Evidence from the European Automotive Industry. *Risks* 10: 236. https://doi.org/10.3390/risks10120236

Academic Editor: Paweł Niedziółka

Received: 24 October 2022
Accepted: 2 December 2022
Published: 12 December 2022

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1. Introduction

On 31 December 2019, Wuhan City, the capital of Hubei province in China, reported the first cases of pneumonia caused by a then-unknown type of coronavirus. Initially referred to as 2019-nCoV, the newly identified coronavirus was subsequently named COVID-19. Coronaviruses are a known family of viruses responsible for causing the common cold in humans. However, the new type of coronavirus, which was never found in humans before, caused a far more severe illness (Chowdhury et al. 2020; World Health Organization 2022). Despite the efforts to contain the virus, it spread and became a worldwide pandemic, affecting almost every country. In addition to catastrophic health consequences, infecting more than 400 million people to date and causing the death of nearly six million (Worldometer 2022), it has had devastating economic repercussions as well. Its effects range from economic activity disruption and business failures to capital market downturns and worldwide economic recessions (Szmigiera 2021).

Working capital (WC) is used to analyze the liquidity position of firms. In the literature, it may also be found as the net working capital (NWC) or circulating capital. WC is

calculated simply by deducting current liabilities from current assets. It involves day-to-day business activities. Its management (WCM) includes cash, accounts receivable (AR), accounts payable (AP), and inventory (INV) (Zimon 2021). Working capital helps mitigate the effect of cash flow shortages, while poor management thereof may lead to bankruptcy (Ball 2013; Ramiah et al. 2014). As such, proper WCM is vital for a firm's performance and survival, especially in times of economic distress (Ren et al. 2019; Simon et al. 2021).

Since the COVID-19 outbreak, an impressive amount of research has been conducted on its origin and cause as well as its health, social, and economic consequences. In addition, there is a vast body of literature on WCM and its impact on a firm's profitability in periods of normal economic conditions (Deloof 2003; García-Teruel and Martínez-Solano 2007; Nazir and Afza 2009; Raheman and Nasr 2007). However, very few studies were found on the WCM–profitability relationship during periods of economic crises in general (Ramiah et al. 2014; Ren et al. 2019) and the COVID-19 pandemic era in particular (Simon et al. 2021; Achim et al. 2021; Gajdosikova et al. 2022), which is odd since the current COVID-19 crisis has affected working capital directly (Chowdhury et al. 2020; Olowookere et al. 2021).

This article investigates the effect of WCM on the profitability of European firms in the automotive industry using a sample of 109 firms for the period 2010–2021. The automotive industry was selected mainly for the following reasons: Firstly, WCM practices differ considerably among industries; therefore, determining the impact of WCM on profitability is best done by focusing on single industries rather than multiple industries (Filbeck and Krueger 2005); secondly, working capital management is especially important for firms characterized by high levels of inventories, such as manufacturing and trading firms (Raheman and Nasr 2007); thirdly, the automotive industry is vital to the European economy as a major component of the total industrial value added to the GDP of the continent; and lastly, the automotive industry is one of the most affected industries by the COVID-19 pandemic (Xu et al. 2020; Ishida 2020; Valaskova et al. 2022).

This paper contributes to the existing literature on WCM's effect on profitability by adding the COVID-19 crisis dimension and comparing the effect of WCM on profitability before and during the pandemic era. Further, the samples used comprise firms from different countries (i.e., all the countries in the European continent). To the best of the authors' knowledge, this is a first since all previous studies reviewed focus on single countries. This paper demonstrates how important it is for firms to have proper WCM practices not only under normal operating conditions but in periods of economic distress as well.

This paper is structured as follows: in Section 2, a review of some of the most relevant literature on WCM and profitability is presented; this is followed by a discussion of the sample, variables, and explanation of the research model in Section 3; the discussion of the results is presented in Section 4, and finally, the article ends with conclusions in Section 5.

2. Literature Review and Hypotheses Development

2.1. Importance of Profitability and Working Capital

According to the conceptual framework of financial reporting, profitability is an indicator of a firm's efficiency and performance. Without profits, a business entity simply cannot survive. This is why being profitable is one of the primary goals of any firm. High profits enable firms to sustain themselves, invest more to expand their operations, and ultimately reward their shareholders with high investment returns (Tamulevičienė 2016; Alarussi and Alhaderi 2018; Valaskova et al. 2021). This is the reason why the topic of profitability has attracted the interest of numerous researchers over the years.

Working capital is defined simply as the difference between the current assets and current liabilities of a firm. Its management is directly related to a firm's liquidity since it involves managing current assets (such as AR and inventory) and current liabilities (such as AP) (Sharma and Kumar 2011; Dsouza 2015). Prior research shows that proper WCM is important for both business prosperity and survival. Efficient WCM is important for any firm but even more so for firms dealing with high levels of inventories, such as

manufacturing and merchandising companies, since inventories in these types of companies constitute a significant percentage of their total assets. Proper WCM involves ensuring that the firm is able to pay its dues in the short run while avoiding keeping excessive levels of current assets since this may result in less-than-optimal returns on investment (Raheman and Nasr 2007).

Therefore, WC decisions entail a trade-off between risk and profits. An aggressive WC policy characterized by low levels of current assets boosts profits by channeling funds to more investments and expansion of the firm and by minimizing funds locked up in current assets, but at the same time, increases the liquidity risk. However, a conservative working capital policy with higher levels of current assets minimizes liquidity risk at the expense of profitability. Hence, finding the optimal level of working capital helps companies maximize their value (Deloof 2003; Filbeck and Krueger 2005; Nazir and Afza 2009). Many studies have confirmed this dual relationship of working capital with profitability and liquidity.

2.2. Impact of Working Capital on Profitability

A large number of studies have been published on the relationship between working capital management and profitability. This section presents a review of some of the most relevant studies on this topic. Most of these studies examine the WC–profitability relationship in periods of normal economic conditions, with only a few of them dealing with periods of crises. Considering the diversity of variables, methodologies, and conclusions, this literature review is organized in chronological order starting from 2000 to the present day.

In 2003, Deloof (2003) explored the WCM–profitability relationship among 1009 large Belgian firms between 1992 and 1996, across various industries. He used days-AR, days-AP, days-Inventory, and CCC to measure WCM and gross operating income to measure profitability. His results indicated a negative relationship between profitability and WC components, suggesting that firms may increase their value by keeping their AR and inventories to a reasonable minimum. According to him, the negative relationship between profitability and days-AP meant that less profitable firms postponed payment of their dues as much as they could, taking full advantage of the credit terms extended to them.

In 2006, in an analogous study, Lazaridis and Tryfonidis (2006) examined the WCM–profitability relationship among 131 listed Greek companies between 2001 and 2004. Using the same variables as Deloof (2003), they obtained similar results and revealed that CCC and its components are inversely related to profitability.

In 2007, three separate studies by García-Teruel and Martínez-Solano (2007) in Spain, Raheman and Nasr (2007) in Pakistan, and Vishnani and Shah (2007) in India, tested the WCM–profitability relationship. Departing from previous studies, García-Teruel and Martínez-Solano (2007) focused primarily on SMEs (8872 SMEs from 1996 to 2002) rather than large companies and used ROA to measure profitability instead of gross operating income. They established a significant negative relationship between profitability and days-AR and days-Inventory but could not confirm the relationship with days-AP due to endogeneity concerns. Raheman and Nasr (2007) studied data from 94 listed firms between 1999 and 2004. They remained loyal to the usual CCC components for working capital measurement and used the net operating profit to measure profitability. Their conclusions were consistent with previous studies, confirming an inverse relationship between profitability and all three components of CCC. Vishnani and Shah (2007) tested their hypothesis using a sample of 23 listed companies for the years 1995–2005. They were among the first to focus on a single industry, i.e., consumer electronics. Using the CCC and its components to measure WC and ROCE to measure profitability, they found profitability to be negatively related to days-Inventory and days-AR but positively related to days-AP. This marked a departure from the results of previous studies.

In 2008, in Turkey, Şamiloğlu and Demirgüneş (2008) investigated the effect WCM has on a firm's profitability using quarterly data from approximately 146 listed firms in the manufacturing sector, covering the period 1998 to 2007. Employing similar variables as García-Teruel and Martínez-Solano (2007), they determined that profitability is nega-

tively related to days-AR and days-Inventory; however, they did not observe a significant relationship with CCC.

In 2009, Nazir and Afza (2009) tested the impact of WCM on profitability (ROA) and market value (Tobin's q) by classifying WCM practices into two broad categories, namely aggressive/conservative (low/high levels of current assets or high/low levels of current liabilities). They were the first to include the market value variable in their study in addition to profitability, which had been used traditionally. Using a sample of 204 listed companies from the industrial sector on the Karachi Stock Exchange from 1998 to 2005, they concluded that an aggressive policy with regard to current assets (low levels of current assets) impacted both profitability and market value negatively, whereas an aggressive policy with regards to current liabilities (high levels of current liabilities), though negatively related to profitability, was surprisingly valued more by investors, affecting the market value positively.

In 2010, Gill et al. (2010) examined data from a sample of 88 manufacturing companies listed on the NYSE from 2005 to 2007 and came up with results that partially contradicted previous studies. Although they confirmed the negative relationship between days-AR and profitability, they found no significant relationship between profitability and days-Inventory or days-AP but found a positive relationship with CCC.

Four more studies were conducted on the impact of WCM on profitability in 2011 by Azam and Haider (2011) in Pakistan, Afeef (2011) in Pakistan, Sharma and Kumar (2011) in India, and Quayyum (2011) in Bangladesh. Except for Afeef (2011), who studied SMEs, the other three studies focused mainly on large companies. Out of the four, only Quayyum (2011) examined a single industry (i.e., the cement industry); the rest studied various industries. The results obtained from these studies were inconsistent. Azam and Haider (2011) showed that ROA and ROE were impacted negatively by days-Inventory and CCC but positively by days-AP; however, the relationship of days-AP with ROA and CCC with ROA was statistically insignificant. Sharma and Kumar (2011) demonstrated that ROA was impacted negatively by days-Inventory and days-AP but positively by days-AR and CCC. Afeef (2011) did not find a significant relationship between ROA and days-AR, days-Inventory, days-AP, or CCC, even though they found a significant relationship between days-AR and days-INV and Net Operating Margin. Quayyum (2011) used only CCC as a WC measure and found a negative relationship with profitability.

In 2012, three studies were published on the WCM–profitability relationship. Two were conducted in Turkey by Karadaglı (2012) and Vural et al. (2012), and one was conducted in Iran by Pouraghajan and Emamgholipourarchi (2012). They all included in their studies a market performance component in addition to profitability. Using a sample of 90 large firms and 72 SMEs in Turkey from 2002 to 2010, Karadaglı (2012) tested the effect of CCC on firm performance. His findings showed that an increase in CCC positively affected both profitability and market return for SMEs, but the results in the case of large firms were reversed. Vural et al. (2012) studied data from 75 listed firms in the manufacturing sector for the period 2002 to 2009 to test their hypothesis. Their findings showed a negative relationship between profitability and days-AR and CCC but no significant association with days-Inventory and days-AP. As for the market value (measured through Tobin's q), it was found to be significantly and positively related only to CCC. Pouraghajan and Emamgholipourarchi (2012) studied a sample of 80 listed companies on the Teheran Stock Exchange for the period 2006 to 2010. They confirmed a negative relationship between WC and profitability. However, unlike previous studies, they found that WCM and market performance were not related.

In 2013, Alavinasab and Davoudi (2013) tested the relationship between ROA and ROE (measures of profitability) and CCC (a measure of working capital) on a sample of 174 listed companies on the Teheran Stock Exchange. They found a negative relationship between CCC and ROA, and ROE.

In 2014, Baños-Caballero et al. (2014) conducted a study on a sample of non-financial firms in the UK. Contrary to prior research, their results indicated an inverted U-shaped

(concave) relationship between WC and profitability, implying that increasing WC levels impacts profitability positively up to a certain point, beyond which the relationship inverts. This means that there is an optimal level of WC that firms must strive to achieve. Furthermore, the results showed that financial constraints played an important role in this and concluded that the optimal level of WC is lower for financially constrained firms.

In 2015, Mathuva (2015) studied the WC–profitability linkage using empirical data from a sample of 30 listed companies in Kenya for the period 1993–2008. In line with a majority of previous studies, he found profitability to be negatively related to days-AR; however, contrary to previous findings, he found a positive relationship with days-Inventory and days-AP.

In 2016, Lyngstadaas and Berg (2016) examined a large sample of 21,075 SMEs in Norway for the period 2010 to 2013. They confirmed a negative relationship of profitability with all WC components, days-AR, days-Inventory, days-AP, and CCC.

In 2018, two studies from Altaf and Shah (2018) in India and Korent and Orsag (2018) in Croatia were published. Altaf and Shah (2018) used a data sample of 437 listed manufacturing companies in India, while Korent and Orsag (2018) studied data from 442 software firms in Croatia. In line with Baños-Caballero et al. (2014), their results indicated an inverted U-shaped non-linear relationship between WC and profitability, suggesting that managers need to balance risks and rewards when it comes to working capital management.

In 2020, Nguyen et al. (2020) investigated the association between WC and profitability (ROA) and market performance (Tobin's q) in a sample of 119 industrial listed companies in Vietnam from 2010 to 2018. In the same year, Sensini (2020) examined the relationship between WC and profitability (Gross Profit Margin) in a sample of 112 SMEs from the agroindustry in Italy for the period 2010 to 2016. Their results aligned with most of the previous studies, showing a negative relationship between profitability and all components of WC. Nguyen confirmed the negative impact of WC on market value as well.

Most of the studies reviewed use the cash conversion cycle and its components to measure working capital management. A few of them have used alternative measures, such as current assets/total assets, current liabilities/total assets, and quick ratio, in combination with CCC components. The findings are predominantly consistent with few variations. A summary table of the most relevant studies is found in the Appendix A section.

2.3. Working Capital in Periods of Economic Crises

Two major crises have hit the world in the last two decades: the global financial crisis in 2008 and the current COVID-19 pandemic. Both have heavily affected firm liquidity and working capital (Chowdhury et al. 2020; Ramiah et al. 2014; Olowookere et al. 2021). However, oddly enough, very few studies examining working capital during periods of economic crises have been found and even fewer studying the role of WCM on firms' profitability during such periods.

In 2014, Ramiah et al. (2014) investigated the measures taken by Australian firms in terms of WCM in response to the global financial crisis. They found that most of the firms under study modified their WC practices to cope with the crisis, transitioning to a more conservative WC policy that prioritizes liquidity and risk minimization.

In 2019, Ren et al. (2019) studied the effect of WCM on profitability in the period following the financial crisis using a large sample of nearly 1000 listed manufacturing firms in China between 2010 and 2017. Their findings pointed to a negative relationship between a firm's profits and CCC. However, this relationship lost significance in the case of state-owned firms.

In 2020, Chowdhury et al. (2020) explored the impact of the COVID-19 crisis on the food and beverage industry in Bangladesh. They identified inventory expiry, WC shortage, and disruption of operations as some of the most serious immediate effects of the pandemic on the industry, while future effects proved to be more complex and elusive to pinpoint.

In 2021, Zimon and Tarighi (2021) used data from a sample of 61 SMEs in Poland from 2015 to 2020 to investigate how firms' WC management strategies changed in reaction

to the COVID-19 crisis. They concluded that Polish small and medium firms, in general, gravitated towards relatively conservative WCM policies and did not need to modify their WC strategies significantly due to the crisis.

Simon et al. (2021) conducted a study based on direct interviews with participants from 15 large, listed companies in Nigeria. One of the major research questions in their study was how firms adapted their WCM strategies in response to economic downturns. Their study concluded that firms must do away with traditional ways of managing WC and adopt a dynamic approach that allows them to navigate periods of crisis.

Achim et al. (2021) used a sample of 218 listed Romanian firms from various industries from 2019 to 2020 to investigate the performance behavior of firms during the COVID-19 crisis. Pointing out that the crisis had a severe, negative effect on firms' profitability, they found that WC ratios and liquidity ratios had a positive impact on performance, proving that proper WC management is essential to surviving economic distress.

Gajdosikova et al. (2022) examined the impact of the COVID-19 crisis on 12 financial indicators of the construction sector, using a sample of 2000 firms. They found that the global health crisis affected adversely in particular firms' profitability, inventory turnover period, receivables collection period as well as accounts payable period.

Based on this literature review and the gaps identified therein, it was decided to test the impact of working capital management on the profitability of the automotive industry in the European continent. Even though numerous studies explore the topic of profitability from different perspectives every year, studies in specific sectors are underrepresented in the literature (Kliestik et al. 2022). The real impact of WCM on profitability can be best captured by focusing on data from the same industry, and very few studies have done this to date. The automotive industry deals with large volumes of inventories, and credit sales are a common practice, which makes working capital management even more important. Since the COVID-19 outbreak, the automotive industry has been heavily impacted by health emergency restrictions, and it is worth investigating how WCM practices have helped firms cope with the crisis.

To achieve this study's objective, panel data regression was used on a sample consisting of all listed firms in the European automotive industry for the years 2010 to 2021, separating it into two periods: pre-pandemic (2010–2109) and pandemic (2020–2021). A total of nine variables were used: return on assets as the dependent variable representing firm profitability, accounts receivable collection period, inventory conversion period, accounts payable period, and cash conversion cycle as the independent variables representing working capital management, as well as four control variables of sales growth, size, current ratio, and leverage.

The research hypotheses for the dependent variable ROA were formulated as follows:

H1. *Days-AR has a negative impact on ROA in the pre-pandemic and pandemic period.*

H2. *Days-INV has a negative impact on ROA in the pre-pandemic and pandemic period.*

H3. *Days-AP has a negative impact on ROA in the pre-pandemic and pandemic period.*

H4. *CCC has a negative impact on ROA in the pre-pandemic and pandemic period.*

3. Methodology

This study employed panel data regression. Panel data was used due to the advantages it offers. It provides more information and variability, allows for control of collinearity, and is more efficient. Panel data can model the individual characteristics and behavior of the elements in a group. It allows for controlling heterogeneity and avoiding the bias of group aggregation. This is very important to this study since firms have specific characteristics and, as such, are heterogeneous (García-Teruel and Martínez-Solano 2007). Panel data is widely used in research and is found in a number of studies directly related to WCM topic, i.e., Deloof (2003); Raheman and Nasr (2007); Nazir and Afza (2009); Azam and Haider

(2011); Karadaglı (2012); Mathuva (2015); Lyngstadaas and Berg (2016); Altaf and Shah (2018); Korent and Orsag (2018); Ren et al. (2019); Nguyen et al. (2020).

3.1. Variables

In this study, the dependent variable was the return on assets (ROA) used to measure the firm's profitability consistent with García-Teruel and Martínez-Solano (2007); Şamiloğlu and Demirgüneş (2008); Sharma and Kumar (2011); Afeef (2011); Quayyum (2011); Baños-Caballero et al. (2014); Dsouza and Pandey (2017); Habibniya and Dsouza (2018); Korent and Orsag (2018); Dsouza and Habibniya (2021); and Dsouza et al. (2022a, 2022b). To represent working capital management, this study used receivables collection period (days-AR), inventory conversion period (days-INV), accounts payable period (days-AP), and the cash conversion cycle (CCC) as independent variables, consistent with Deloof (2003); Lazaridis and Tryfonidis (2006); García-Teruel and Martínez-Solano (2007); Gill et al. (2010); Sharma and Kumar (2011); Afeef (2011); Karadaglı (2012); Mathuva (2015); Lyngstadaas and Berg (2016); Nguyen et al. (2020); and Sensini (2020). While investigating the impact of working capital management on profitability, it is important to control for other variables that are known to have an impact on profitability as well. Following previous works, the control variables used in this study were Sales Growth (SG), Size (S), Current Ratio (CR), and Leverage (Lev), which are expected to have an impact on profitability (García-Teruel and Martínez-Solano 2007; Şamiloğlu and Demirgüneş 2008; Afeef 2011; Lyngstadaas and Berg 2016; Sawarni et al. 2020; Habibniya et al. 2022). The measurement for each variable used in this study is provided in Table 1.

Table 1. Variables and Measurements.

Category	Variables	Measurement
Dependent variable	Return on Assets (ROA)	EBIT/Total Assets
Independent variables	Receivables collection period (days-AR)	365 × (Account receivable/Sales)
	Inventory conversion period (days-INV)	365 × (Inventories/Cost of Goods Sold)
	Accounts payable period (days-AP)	365 × (Account payable/Purchases)
	Cash conversion cycle (CCC)	days-AR + days-INV − days-AP
Control variables	Sales Growth (SG)	$(Sales_1 - Sales_0)/Sales_0$
	Size (S)	Natural logarithm of Total Assets
	Current Ratio (CR)	Current Assets/Current Liabilities
	Leverage (Lev)	Total Debt/Total Assets

3.2. Data Sample

This study's sample consisted of all listed firms in the European automotive industry available on the Thomson Reuters Database for the period 2010–2021 (2010–2019 representing the pre-pandemic period and 2020–2021 representing the pandemic period). Once the firm-year data from all the listed firms were extracted, the dataset was cleaned from firms with insufficient or missing information for the key variables. After the data cleaning, an unbalanced cross-sectional panel data was obtained comprising 918 firm-year observations for 108 firms for the pre-pandemic period and 210 firm-year observations for 109 firms for the pandemic period.

3.3. Research Model

First, data were collected for the period 2010 to 2021 from Thomson Reuters (Refinitiv) database for all the firms in the sample. After cleaning the data set from firms with incomplete or missing information on the variables used in this study, it was subsequently split into two subsets, i.e., 2010–2019 representing the pre-pandemic period and 2020–2021 representing the pandemic period. Data for the years before 2010 were not included in this study to avoid the effects of the global financial crisis.

Next, the descriptive statistics for the two subsets were obtained, as shown in Tables 2 and 3. To deal with the outliers, instead of removing them, all the pandemic and pre-pandemic variables were winsorized at 5% (Aivazian et al. 2005a, 2005b; Ayaz et al. 2021). Then the pairwise correlation analysis was carried out, as shown in Tables 4 and 5 to determine the degree of correlation among the variables, if any. Due to the moderate correlation found and the intrinsic dependency of CCC with the other three independent variables, it was decided to run separate regression models, one for each independent variable against the dependent variable, instead of a single model including all independent variables at once.

Table 2. Descriptive statistics of the variables (pre-pandemic period, 2010–2019).

Variables	Observations	Mean	Std. Dev.	Min.	Max.	Pr (Skewness)	Pr (Kurtosis)
Return on Assets (ROA)	918.00	0.07	0.05	−0.05	0.17	0.03	0.30
Receivables collection period (days-AR)	918.00	74.03	39.21	26.97	185.98	0.00	0.00
Inventory conversion period (days-INV)	918.00	99.17	64.72	27.38	283.09	0.00	0.00
Accounts payable period (days-AP)	918.00	85.89	58.43	25.81	233.34	0.00	0.00
Cash conversion cycle (CCC)	918.00	84.45	76.48	−44.90	252.83	0.00	0.05
Size (S)	918.00	20.74	2.36	16.96	25.54	0.00	0.00
Firm Leverage (Lev)	918.00	0.26	0.15	0.00	0.54	0.85	0.00
Current Ratio (CR)	918.00	1.73	1.06	0.55	5.01	0.00	0.00
Sales Growth (SG)	918.00	0.09	0.15	−0.19	0.46	0.00	0.07

Table 3. Descriptive statistics of the variables (pandemic period, 2020–2021).

Variables	Observations	Mean	Std. Dev.	Min.	Max.	Pr (Skewness)	Pr (Kurtosis)
Return on Assets (ROA)	210.00	0.04	0.08	−0.15	0.19	0.01	0.06
Receivables collection period (days-AR)	210.00	86.24	66.45	27.39	320.12	0.00	0.00
Inventory conversion period (days-INV)	210.00	116.03	81.91	30.04	346.04	0.00	0.00
Accounts payable period (days-AP)	210.00	106.61	86.06	21.75	374.55	0.00	0.00
Cash conversion cycle (CCC)	210.00	93.71	93.68	−57.59	300.89	0.00	0.42
Size (S)	210.00	20.84	2.43	16.88	25.87	0.10	0.01
Firm Leverage (Lev)	210.00	0.28	0.16	0.00	0.58	0.75	0.00
Current Ratio (CR)	210.00	1.64	0.89	0.63	4.39	0.00	0.00
Sales Growth (SG)	210.00	0.01	0.21	−0.31	0.40	0.15	0.00

Table 4. The correlation amongst the variables—pre-pandemic period (2010–2019).

Variables	ROA	Days-AR	Days-INV	Days-AP	CCC	S	Lev	CR	SG
ROA	1.00								
days-AR	−0.3473 *	1.00							
days-INV	−0.3554 *	0.3039 *	1.00						
days-AP	−0.402 *	0.4254 *	0.3798 *	1.00					
CCC	−0.1172 *	0.3231 *	0.5549 *	−0.318 *	1.00				
S	0.1557 *	−0.05	−0.3528 *	−0.0958 *	−0.2419 *	1.00			
Lev	−0.1953 *	0.0914 *	−0.03	0.1522 *	−0.0654 *	0.157 *	1.00		
CR	0.3312 *	−0.0899 *	0.0929 *	−0.4086 *	0.3976 *	−0.1649 *	−0.405 *	1.00	
SG	0.1887 *	−0.107 *	−0.0785 *	−0.1774 *	0.04	−0.05	−0.05	0.1078 *	1.00

* Statistically significant at 5 percent level.

Table 5. The correlation amongst the variables—pandemic period (2020–2021).

Variables	ROA	Days-AR	Days-INV	Days-AP	CCC	S	Lev	CR	SG
ROA	1.00								
days-AR	−0.2975 *	1.00							
days-INV	−0.3755 *	0.3771 *	1.00						
days-AP	−0.3302 *	0.5138 *	0.4795 *	1.00					
CCC	−0.2222 *	0.3035 *	0.5428 *	−0.2262 *	1.00				
S	0.261 *	0.04	−0.3669 *	−0.11	−0.207 *	1.00			
Lev	−0.1433 *	0.07	−0.07	0.07	−0.02	0.12	1.00		
CR	0.1851 *	−0.05	0.05	−0.2568 *	0.3218 *	−0.164 *	−0.4006 *	1.00	
SG	0.2572 *	−0.2166 *	−0.07	−0.11	−0.06	−0.05	−0.146 *	0.1542 *	1.00

* Statistically significant at 5 percent level.

Finally, the Housman test was run to decide whether to employ fixed effects or random effects regressions. Based on the Housman test values, the fixed effect model was used for the pre-pandemic sample, and the random effects model was used for the pandemic sample.

To test the research hypotheses, the following model was adopted. The model aims to reveal the specific effects of the selected variables across the firms over time.

$$\text{Profitability} = f\ (\text{WCM, Control Variables}) \quad (1)$$

$$\text{PROFITABILITY} = \propto it + \beta 1 \text{WCM} + \beta 2\ \text{CONTROL VARIABLES} + \text{FixedEffects} + \varepsilon it \quad (2)$$

where

- PROFITABILITY refers to the return on assets (ROA) of firm i in year t;
- WCM refers to days-AR, days-INV, days-AP, and the cash conversion cycle (CCC);
- Control Variables refer to Size (S), Sales Growth (SG), Current Ratio (CR), and firm Leverage (Lev);
- Year fixed effects are included in the model;
- εit denotes the error term.

To obtain the results, the following simple regression equations were used.

$$ROA_{it} = \beta_0 + \beta_1\ \text{days-AR}_{it} + \beta_2\ SG_{it} + \beta_3\ LEV_{it} + \beta_4\ CR_{it} + \beta_5\ S_{it} + \mathrm{e}_{it} \quad (3)$$

$$ROA_{it} = \beta_0 + \beta_1\ \text{days-INV}_{it} + \beta_2\ SG_{it} + \beta_3\ LEV_{it} + \beta_4\ CR_{it} + \beta_5\ S_{it} + \mathrm{e}_{it} \quad (4)$$

$$ROA_{it} = \beta_0 + \beta_1\ \text{days-AP}_{it} + \beta_2\ SG_{it} + \beta_3\ LEV_{it} + \beta_4\ CR_{it} + \beta_5\ S_{it} + \mathrm{e}_{it} \quad (5)$$

$$ROA_{it} = \beta_0 + \beta_1\ \text{days-CCC}_{it} + \beta_2\ SG_{it} + \beta_3\ LEV_{it} + \beta_4\ CR_{it} + \beta_5\ S_{it} + \mathrm{e}_{it} \quad (6)$$

The data were processed using the STATA software package, and all the tables in this paper, apart from Table A1 (in Appendix A), were produced using the same package.

4. Results and Discussion

4.1. Descriptive Statistics and Variable Correlation

As shown in Tables 2 and 3, the mean of ROA is 0.07 and 0.04 with a standard deviation of 0.05 and 0.08 (for the pre-pandemic and pandemic periods, respectively). A positive average for ROA shows a positive trend in profitability for the industry. Even though ROA remained positive on average, firms' profitability has been negatively affected by the pandemic, as indicated by the decline in the ROA mean. The mean of days-AR is 74.03 and 86.24, with a standard deviation of 39.21 and 66.54 (pre-pandemic and pandemic). The mean of days-INV is 99.17 and 116.03 with a standard deviation of 64.72 and 81.91

(pre-pandemic and pandemic), while the mean of days-AP is 85.89 and 106.61 with a standard deviation of 58.43 and 86.06 (pre-pandemic and pandemic). When compared to the pre-pandemic period, the mean of days-AR and days-INV increased by about 17% during the pandemic period, while the mean of days-AP increased by around 24%. The increase in days-AR is probably a reflection of customers' liquidity constraints on the one hand and firms' need to preserve or boost sales by extending trade credit periods on the other hand. The increase in days-INV could be explained by the demand disruption due to worldwide lockdowns, which mostly affected the automotive industry, and a shift to greener technologies, which was particularly accentuated during the COVID-19 pandemic. The increase in days-AP could be an indication of firms' liquidity troubles, although it could also be related to changes in suppliers' trade credit policies in response to the crisis. The mean of CCC is 84.45 and 93.71, with a standard deviation of 76.48 and 93.68 (pre-pandemic and pandemic). The increase was about 11%, which is more moderate than the increase in the three individual WC measures, and it is explained by the fact that CCC is affected positively by variations in days-AR and days-INV but negatively by the variations in days-AP (see Table 1). In addition, the data of all independent variables are roughly symmetric and do not show any indication of outliers according to the values of Skewness and Kurtosis (all values are approximately 0) for both periods (pre-pandemic and pandemic periods).

The pairwise variable correlation matrix is presented in Tables 4 and 5 (pre-pandemic and pandemic periods, respectively). The correlation coefficient of days-AR (−0.3473, −0.2975), days-INV (−0.3554, −0.3755), days-AP (−0.402, −0.3302), and CCC (−0.1172, −0.2222) (pre-pandemic and pandemic periods, respectively) with ROA is significant, negative, and shows weak-to-moderate correlation. This means that days-AR, days-INV, days-AP, and CCC are inversely related to ROA. The correlation matrix shows the association magnitude between variables and is used to reveal any collinearity among them. As for the effects of the independent variables on the dependent variable, these are obtained from the regression analysis.

4.2. Regression Results

The panel regression analysis was used in this part to examine the influence of each of the independent variables (days-AR, days-INV, days-AP, and CCC) on the dependent variable (ROA). Because the independent variables are correlated, the model was created separately for each independent variable. Furthermore, the whole dataset was split into two subsets representing two time periods in the analysis: pre-pandemic (2010–2019) and pandemic (2020–2021), resulting in a total of eight models that were developed and studied below. The most significant result among No dummy, Year dummy, Country dummy, and Year and Country dummy in the model was used to analyze the panel regression model. Furthermore, the Hausman test was used to determine whether a fixed or random effect should be considered for analysis. VIF values were displayed in the model's output to confirm the absence of multicollinearity in the data.

In Table 6, the results of the fixed-effects model, including the Country dummy (the most significant result in the model), are shown, which have achieved the objectives of this study concerning the impact of days-AR on the firms' profitability (ROA). Based on the Hausman test statistic ($p = 0.0034$), only the fixed-effects results have been analyzed. According to the VIF values (very close to one), there are no multicollinearity problems in the model. The results reveal a negative and statistically significant ($p < 0.01$) coefficient of days-AR with respect to ROA. Days-AR had a negative impact on ROA during the pre-pandemic period.

Table 6. Results of the fixed effects of days-AR on ROA, as per panel regression (pre-pandemic period, 2010–2019).

Variables	No Dummy	Year Dummy	Country Dummy	Year and Country Dummy	VIF	1/VIF
	ROA	ROA	ROA	ROA		
days-AR	−0.0002974 ***	−0.000273 ***	−0.0002974 ***	−0.000273 ***	1.03	0.973314
	0	0	0	0		
S	−0.004	−0.008 **	−0.004	−0.008 **	1.05	0.95686
	(0.003)	(0.004	(0.003)	(0.004)		
Lev	−0.07 ***	−0.062 ***	−0.07 ***	−0.062 ***	1.21	0.823832
	(0.014)	(0.014)	(0.014)	(0.014)		
CR	0.008 ***	0.009 ***	0.008 ***	0.009 ***	1.23	0.815763
	(0.003)	(0.003)	(0.003)	(0.003)		
SG	0.039 ***	0.05 ***	0.039 ***	0.05 ***	1.02	0.97749
	(0.008)	(0.008)	(0.008)	(0.008)		
_cons	0.162 **	0.236 ***	0.162 **	0.236 ***		
	(0.072)	(0.081)	(0.072)	(0.081)		
Observations	918	918	918	918		
R-squared	0.112	0.141	0.112	0.141		
Adj R^2	−0.011	0.011	−0.011	0.011		
Hausman test (Prob > chi2)	0.0034 ***	0.0034 ***	0.0034 ***	0.0034 ***		
Mean VIF					1.11	

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$.

In Table 7, the results of the random-effects model, including the Year dummy (the most significant result in the model), are shown, which have achieved the objectives of this study concerning the impact of days-AR on the firms' profitability (ROA). Based on the Hausman test statistic ($p = 0.5913$), only the random-effects results have been analyzed. According to the VIF values (very close to one), there are no multicollinearity problems in the model. The results reveal a negative and statistically significant ($p < 0.01$) coefficient of days-AR with respect to ROA. Days-AR had a negative impact on ROA during the pandemic period.

Therefore, combining the results of Tables 6 and 7, it can be concluded that days-AR had a negative impact on ROA in both periods (pre-pandemic and pandemic). These results support the first hypothesis of this study, where days-AR was predicted to have a negative impact on ROA and that this impact would be the same in both the pre-pandemic and pandemic periods. These findings are consistent with prior studies regarding the impact of days-AR on ROA, such as García-Teruel and Martínez-Solano (2007); Şamiloğlu and Demirgüneş (2008); Lyngstadaas and Berg (2016); and Nguyen et al. (2020).

In Table 8, the results of the fixed-effects model, including the Year and Country dummy (the most significant result in the model), are shown, which have achieved the objectives of this study concerning the impact of days-INV on the firms' profitability (ROA). Based on the Hausman test statistic ($p = 0.0033$), only the fixed-effects results have been analyzed. According to the VIF values (very close to one), there are no multicollinearity problems in the model. The results reveal a negative and statistically significant ($p < 0.01$) coefficient of days-INV with respect to ROA. Days-INV had a negative impact on ROA during the pre-pandemic period.

Table 7. Results of the random effects of days-AR on ROA, as per panel regression (pandemic period, 2020–2021).

Variables	No Dummy	Year Dummy	Country Dummy	Year and Country Dummy	VIF	1/VIF
	ROA	ROA	ROA	ROA		
days-AR	−0.000331 ***	−0.0003317 ***	−0.0002315 **	−0.000233 **	1.05	0.950812
	0	0	0	0		
S	0.01 ***	0.01 ***	0.011 ***	0.011 ***	1.03	0.968859
	(0.003)	(0.003)	(0.003)	(0.003)		
Lev	−0.007	−0.008	−0.002	−0.003	1.21	0.829023
	(0.035)	(0.035)	(0.039)	(0.039)		
CR	0.014 **	0.014 **	0.012 *	0.012 *	1.22	0.816884
	(0.006)	(0.006)	(0.006)	(0.006)		
SG	0.071 ***	0.068 ***	0.073 ***	0.066 ***	1.08	0.92578
	(0.014)	(0.022)	(0.014)	(0.023)		
_cons	−0.156 ***	−0.157 ***	−0.157 **	−0.157 **		
	(0.057)	(0.056)	(0.078)	(0.078)		
Observations	210	210	210	210		
R-squared	.z	.z	.z	.z		
Adj R^2	.z	.z	.z	.z		
Hausman test (Prob > chi2)	0.5913	0.5913	0.5913	0.5913		
Mean VIF					1.12	

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8. Results of the fixed effects of days-INV on ROA, as per panel data regression (pre-pandemic period, 2010–2019).

Variables	No Dummy	Year Dummy	Country Dummy	Year and Country Dummy	VIF	1/VIF
	ROA	ROA	ROA	ROA		
days-INV	−0.0001449 ***	−0.0001528 ***	−0.0001449 ***	−0.0001528 ***	1.16	0.862858
	0	0	0	0		
S	−0.002	−0.008 **	−0.002	−0.008 **	1.18	0.844265
	(0.004)	(0.004)	(0.004)	(0.004)		
Lev	−0.063 ***	−0.053 ***	−0.063 ***	−0.053 ***	1.21	0.826068
	(0.015)	(0.014)	(0.015)	(0.014)		
CR	0.007 **	0.007 ***	0.007 **	0.007 ***	1.23	0.815316
	(0.003)	(0.003)	(0.003)	(0.003)		
SG	0.044 ***	0.056 ***	0.044 ***	0.056 ***	1.02	0.976328
	(0.008)	(0.008)	(0.008)	(0.008)		
_cons	0.125 *	0.237 ***	0.125 *	0.237 ***		
	(0.073)	(0.082)	(0.073)	(0.082)		
Observations	918	918	918	918		
R-squared	0.093	0.129	0.093	0.129		
Adj R^2	−0.033	−0.003	−0.033	−0.003	1.16	
Hausman test (Prob > chi2)	0.0033 ***	0.0033 ***	0.0033 ***	0.0033 ***		
Mean VIF						

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In Table 9, the results of the random-effects model, including the Year dummy (the most significant result in the model), are shown, which have achieved the objectives of this study concerning the impact of days-INV on the firms' profitability (ROA). Based on the Hausman test statistic (p = 0.1333), only the random-effects results have been analyzed. According to the VIF values (very close to one), there are no multicollinearity problems in the model. The results reveal a negative and statistically significant ($p < 0.01$) coefficient of days-INV with respect to ROA. Days-INV had a negative impact on ROA during the pandemic period.

Table 9. Results of the random effects of days-INV on ROA, as per panel regression (pandemic period, 2020–2021).

Variables	No Dummy	Year Dummy	Country Dummy	Year and Country Dummy	VIF	1/VIF
	ROA	ROA	ROA	ROA		
days-INV	−0.0002168 ***	−0.0002211 ***	−0.000145 *	−0.0001471 *	1.17	0.855124
	0	0	0	0		
S	0.007 **	0.007 **	0.01 ***	0.01 ***	1.19	0.840627
	(0.003)	(0.003)	(0.003)	(0.003)		
Lev	−0.018	−0.018	−0.004	−0.005	1.21	0.828112
	(0.035)	(0.035)	(0.039)	(0.039)		
CR	0.014 **	0.014 **	0.012 *	0.012 *	1.22	0.816782
	(0.006)	(0.006)	(0.006)	(0.006)		
SG	0.076 ***	0.085 ***	0.077 ***	0.079 ***	1.04	0.95731
	(0.014)	(0.021)	(0.014)	(0.022)		
_cons	−0.094	−0.092	−0.127	−0.127		
	(0.062)	(0.062)	(0.081)	(0.081)		
Observations	210	210	210	210		
R-squared	.z	.z	.z	.z		
Adj R^2	.z	.z	.z	.z		
Hausman test (Prob > chi2)	0.1333	0.1333	0.1333	0.1333		
Mean VIF					1.17	

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Therefore, combining the results of Tables 8 and 9, it can be concluded that days-INV had a negative impact on ROA in both periods (pre-pandemic and pandemic). These results support the second hypothesis of this study, where days-INV was predicted to have a negative impact on ROA and that this impact would be the same in both the pre-pandemic and pandemic periods. Similar results were obtained by a number of prior studies regarding the impact of days-INV on profitability, such as García-Teruel and Martínez-Solano (2007); Şamiloğlu and Demirgüneş (2008); Azam and Haider (2011); Sharma and Kumar (2011); Lyngstadaas and Berg (2016); and Nguyen et al. (2020).

In Table 10, the results of the fixed-effects model, including the Year and Country dummy (the most significant result in the model), are shown, which have achieved the objectives of this study concerning the impact of days-AP on the firms' profitability (ROA). Based on the Hausman test statistic ($p = 0.0010$), only the fixed-effects results have been analyzed. According to the VIF values (very close to one), there are no multicollinearity problems in the model. The results reveal a negative and statistically significant ($p < 0.01$)

coefficient of days-AP with respect to ROA. Days-AP had a negative impact on ROA during the pre-pandemic period.

Table 10. Results of the fixed effects of days-AP on ROA, as per panel data regression (pre-pandemic period, 2010–2019).

Variables	No Dummy	Year Dummy	Country Dummy	Year and Country Dummy	VIF	1/VIF
	ROA	ROA	ROA	ROA		
days-AP	−0.0001053 **	−0.0001522 ***	−0.0001053 **	−0.0001522 ***	1.27	0.786358
	0	0	0	0		
S	−0.003	−0.01 **	−0.003	−0.01 **	1.08	0.928577
	(0.004)	(0.004)	(0.004)	(0.004)		
Lev	−0.073 ***	−0.067 ***	−0.073 ***	−0.067 ***	1.21	0.827591
	(0.015)	(0.015)	(0.015)	(0.015)		
CR	0.006 **	0.006 **	0.006 **	0.006 **	1.45	0.690866
	(0.003)	(0.003)	(0.003)	(0.003)		
SG	0.043 ***	0.054 ***	0.043 ***	0.054 ***	1.04	0.963745
	(0.008)	(0.008)	(0.008)	(0.008)		
_cons	0.146 **	0.273 ***	0.146 **	0.273 ***		
	(0.073)	(0.082)	(0.073)	(0.082)		
Observations	918	918	918	918		
R-squared	0.087	0.127	0.087	0.127		
Adj R^2	−0.04	−0.005	−0.04	−0.005		
Hausman test (Prob > chi2)	0.0010 ***	0.0010 ***	0.0010 ***	0.0010 ***		
Mean VIF					1.21	

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$.

In Table 11, the results of the random-effects model, including the Year dummy (the most significant result in the model), are shown, which have achieved the objectives of this study concerning the impact of days-AP on the firms' profitability (ROA). Based on the Hausman test statistic ($p = 0.1069$), only the random-effects results have been analyzed. According to the VIF values (very close to one), there are no multicollinearity problems in the model. The results reveal a negative and statistically significant ($p < 0.05$) coefficient of days-AP with respect to ROA. Days-AP had a negative impact on ROA during the pandemic period.

Therefore, combining the results of Tables 10 and 11, it can be concluded that days-AP had a negative impact on ROA in both periods (pre-pandemic and pandemic). These results support the third hypothesis of this study, where days-AP was predicted to have a negative impact on ROA and that this impact would be the same in both the pre-pandemic and pandemic periods. These results are consistent with a few prior studies regarding the impact of days-AP on profitability, such as Sharma and Kumar (2011); Lyngstadaas and Berg (2016); and Nguyen et al. (2020).

In Table 12, the results of the fixed-effects model, including the Country dummy (the most significant result in the model), are shown, which have achieved the objectives of this study concerning the impact of CCC on the firms' profitability (ROA). Based on the Hausman test statistic ($p = 0.0038$), only the fixed-effects results have been analyzed. According to the VIF values (very close to one), there are no multicollinearity problems in the model. The results reveal a negative and statistically significant ($p < 0.01$) coefficient of CCC with respect to ROA. CCC had a negative impact on ROA during the pre-pandemic period.

Table 11. Results of the random effects of days-AP on ROA, as per panel regression (pandemic period, 2020–2021).

Variables	No Dummy	Year Dummy	Country Dummy	Year and Country Dummy	VIF	1/VIF
	ROA	ROA	ROA	ROA		
days-AP	−0.0001314 **	−0.0001353 **	−0.0000737	−0.0000755	1.11	0.904424
	0	0	0	0		
S	0.009 ***	0.009 ***	0.011 ***	0.011 ***	1.06	0.946084
	(0.003)	(0.003)	(0.003)	(0.003)		
Lev	−0.01	−0.011	−0.006	−0.007	1.21	0.828727
	(0.036)	(0.036)	(0.04)	(0.04)		
CR	0.012 *	0.012 *	0.01	0.01	1.31	0.761007
	(0.006)	(0.006)	(0.006)	(0.006)		
SG	0.08 ***	0.088 ***	0.08 ***	0.08 ***	1.04	0.960979
	(0.014)	(0.022)	(0.014)	(0.022)		
_cons	−0.146 **	−0.145 **	−0.155 *	−0.155 *		
	(0.059)	(0.059)	(0.08)	(0.08)		
Observations	210	210	210	210		
R-squared	.z	.z	.z	.z		
Adj R^2	.z	.z	.z	.z		
Hausman test (Prob > chi2)	0.1069	0.1069	0.1069	0.1069		
Mean VIF					1.14	

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 12. Results of the fixed effects of CCC on ROA, as per panel data regression (pre-pandemic period, 2010–2019).

Variables	No Dummy	Year Dummy	Country Dummy	Year and Country Dummy	VIF	1/VIF
	ROA	ROA	ROA	ROA		
CCC	−0.0002396 ***	−0.0002118 ***	−0.0002396 ***	−0.0002118 ***	1.26	0.794635
	0	0	0	0		
S	−0.003	−0.007	−0.003	−0.007	1.09	0.92022
	(0.003)	(0.004)	(0.003)	(0.004)		
Lev	−0.06 ***	−0.053 ***	−0.06 ***	−0.053 ***	1.23	0.812109
	(0.014)	(0.014)	(0.014)	(0.014)		
CR	0.01 ***	0.01 ***	0.01 ***	0.01 ***	1.45	0.691733
	(0.003)	(0.003)	(0.003)	(0.003)		
SG	0.045 ***	0.054 ***	0.045 ***	0.054 ***	1.01	0.987307
	(0.007)	(0.008)	(0.007)	(0.008)		
_cons	0.135 *	0.202 **	0.135 *	0.202 **		
	(0.071)	(0.081)	(0.071)	(0.081)		
Observations	918	918	918	918		
R-squared	0.123	0.147	0.123	0.147		
Adj R^2	0.001	0.017	0.001	0.017		
Hausman test (Prob > chi2)	0.0038 ***	0.0038 ***	0.0038 ***	0.0038 ***		
Mean VIF					1.21	

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In Table 13, the results of the random-effects model, including the Year dummy (the most significant result in the model), are shown, which have achieved the objectives of this study concerning the impact of CCC on the firms' profitability (ROA). Based on the Hausman test statistic ($p = 0.275$), only the random-effects results have been analyzed. According to the VIF values (very close to one), there are no multicollinearity problems in the model. The results reveal a negative and statistically significant ($p < 0.05$) coefficient of CCC with respect to ROA. CCC had a negative impact on ROA during the pandemic period.

Table 13. Results of the random effects of CCC on ROA, as per panel regression (pandemic period, 2020–2021).

Variables	No Dummy	Year Dummy	Country Dummy	Year and Country Dummy	VIF	1/VIF
	ROA	ROA	ROA	ROA		
CCC	−0.0001385 **	−0.000142 **	−0.0001173 **	−0.0001234 **	1.18	0.844979
	0	0	0	0		
S	0.008 ***	0.008 ***	0.011 ***	0.011 ***	1.06	0.939471
	(0.003)	(0.003)	(0.003)	(0.003)		
Lev	−0.006	−0.006	0.004	0.005	1.22	0.816756
	(0.036)	(0.036)	(0.04)	(0.04)		
CR	0.017 ***	0.018 ***	0.014 **	0.014 **	1.38	0.725056
	(0.006)	(0.006)	(0.006)	(0.006)		
SG	0.081 ***	0.076 ***	0.079 ***	0.07 ***	1.05	0.955002
	(0.013)	(0.022)	(0.013)	(0.022)		
_cons	−0.154 ***	−0.153 ***	−0.157 **	−0.156 **		
	(0.058)	(0.058)	(0.078)	(0.078)		
Observations	210	210	210	210		
R-squared	.z	.z	.z	.z		
Adj R^2	.z	.z	.z	.z		
Hausman test (Prob > chi2)	0.275	0.275	0.275	0.275		
Mean VIF					1.18	

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$.

Therefore, combining the results of Tables 12 and 13, it can be concluded that CCC had a negative impact on ROA in both periods (pre-pandemic and pandemic). These results support the fourth hypothesis of this study, where CCC was predicted to have a negative impact on ROA and that this impact would be the same in both the pre-pandemic and pandemic periods. Similar results regarding the impact of CCC on profitability were obtained by García-Teruel and Martínez-Solano (2007); Quayyum (2011); Pouraghajan and Emamgholipourarchi (2012); Alavinasab and Davoudi (2013); Lyngstadaas and Berg (2016); and Nguyen et al. (2020).

The R^2 values in the regression models are relatively low, ranging between 0.112 and 0.129. Generally speaking, R^2 values are lower in cross-sectional panel data than in time series due to the heterogeneity of the cross-sections. Moreover, low R^2 values are common in social sciences research, especially when dealing with highly unpredictable dependent variables. Conceptually, the R^2 value represents the portion of the total variance in the dependent variable explained by the independent variables. The implication, in this case, is that numerous factors affect profitability, some of which are not yet known to science,

and the variables used in this study represent only a fraction of them. However, as long as the relationships are statistically significant, the results can be used to draw meaningful conclusions. Due to the low R^2 and the relatively high number of variables in the model, the Adjusted R^2 values are close to zero or negative (between −0.011 and 0.001). This suggests that the inclusion of multiple variables in the model did not help increase the explanatory power of the model.

In summary, it can be said that all four hypotheses of this study predicting a negative impact of days-AR, days-INV, days-AP, and CCC on ROA have been confirmed. When considering all four variables combined, the results in this study are consistent with Lyngstadaas and Berg (2016) and Nguyen et al. (2020). They found that all components of the working capital have a negative impact on profitability represented by ROA. The prediction that the impact of all WC variables on ROA would be the same in both periods, pre-pandemic and pandemic, is also confirmed.

4.3. Practical and Theoretical Implications

Receivables Collection Period and ROA: The results concerning days-AR show a significant negative relationship with ROA, suggesting that managers should be mindful of their firm's credit policy with regard to sales and receivables. Despite the fact that offering credit to customers is accepted as a profitable short-term investment (Şamiloğlu and Demirgüneş 2008) and is known to boost sales, the findings imply that being overly generous with credit terms may be detrimental to profitability, as it may bring an extra burden on the firm in the form of credit loss and factoring costs. The results regarding the pandemic period are important, especially since the temptation to offer unusually favorable credit terms to customers may be stronger in periods of crises when firms seek to come to the rescue of their financially distressed customers in an attempt to preserve their sales levels.

Inventory Conversion Period and ROA: The results concerning days-INV show a significant negative relationship with ROA, suggesting that proper inventory management is vital not only during normal periods but during periods of crises as well. Keeping unnecessarily high levels of inventory not only comes with increased operational costs but also deprives the firm of valuable cash reserves that could be better used elsewhere. Longer inventory conversion periods may be a result of a sudden drop in sales, inventory ill management, or a combination of both (Lazaridis and Tryfonidis 2006). The COVID-19 pandemic period was characterized by demand disruption due to worldwide lockdowns and a shift in focus to greener technologies, which affected the automotive industry more than most industries. This stresses even more the importance of agile inventory management practices that offer firms flexibility, enabling them to respond quickly to sudden changes in the economic environment.

Accounts Payable Period and ROA: The observed negative impact of days-AP on ROA may be explained by the significant implicit financing costs associated with credit purchases. Profitable firms do not postpone their payables' settlement unnecessarily and take full advantage of potential discounts offered by their suppliers. During crisis periods, there is a lot of pressure on managers to prolong the payables period in an attempt to preserve much-needed cash reserves. However, as the results indicate, such a practice has its toll on the firm's profitability, probably by putting the firms in line for less favorable treatment by their suppliers.

Cash Conversion Cycle and ROA: When it comes to interpreting the results concerning CCC, it must be stressed that CCC represents the combined effect of days-AR, days-INV, and days-AP being positively related to the first two variables and negatively related to the third one (See Table 1). Hence, depending on which variable effect is dominant, the impact of CCC on profitability may be somehow unpredictable. This explains the rather inconsistent results of prior empirical studies regarding this variable (See Table A1 in Appendix A).

5. Conclusions

Working capital is important for both business prosperity and survival. Proper WC management is a risk-reward balancing act. An aggressive WC policy may boost profits but comes with increased liquidity risk, whereas a conservative policy mitigates risk while locking up valuable funds. This study aimed to investigate the impact of WCM on the profitability of European listed firms in the automotive industry using panel data regression for the pre-pandemic and pandemic periods. The sample consisted of 108 and 109 firms (pre-pandemic and pandemic periods, respectively) from the European continent. Data was collected for the periods 2010–2019 and 2020–2021 (pre-pandemic and pandemic periods, respectively). Empirical results for both periods show that all variables used to measure WC management, i.e., days-AR, days-INV, days-AP, and CCC, have a negative impact on ROA, which was used to measure profitability. These overall results support all four hypotheses of this study and are consistent with the previous works of Lyngstadaas and Berg (2016) and Nguyen et al. (2020).

The implication of this study's results with regard to days-AR is that managers should be extra cautious and meticulously manage their receivables, especially in periods of economic crises. They may increase their firms' profitability by shortening the receivables collection period. With regards to days-INV, the results emphasize the importance of proper inventory management. Excessive levels of inventory deteriorate firm profitability. Periods of economic crises can be better dealt with by adopting agile inventory management practices that do not require keeping large quantities of inventory. As for the days-AP negative impact on ROA, the implication is that firms must not postpone their payables' settlement unless it is necessary to do so, as it often comes with hidden costs. Finally, with respect to the negative impact of CCC on ROA, considering that CCC is positively related to days-AR and days-INV and negatively related to days-AP, their effects offset one another. In the automotive industry, it appears that the effects of days-AR and days-INV overwhelm the effect of days-AP.

In conclusion, it can be said that managers can make their firms more profitable by keeping each CCC component, i.e., the receivables collection period, the inventory conversion period, and the accounts payable period, to a reasonable minimum. These recommendations are valid for periods of normal economic conditions and economic crises alike.

However, this study has limitations. Due to availability constraints, only two years of data for the pandemic period were examined in contrast to ten years for the pre-pandemic. This disparity in data availability may affect the comparison to a certain extent. Later studies may overcome this limitation by including more years for the pandemic period as they become available. Another limitation is related to the accounting practices employed by the firms. Since the value of inventories and receivables can be significantly influenced by the accounting practices employed, this in turn influences the results and the implications of this study.

Future research may investigate the same relationship using a global sample which may provide stronger implications. Since profitability was measured by accounting ratios, the inclusion of financial reporting quality or earnings management variables would further add value to the study of profitability determinants. Finally, since the COVID-19 pandemic crisis triggered a freefall in share prices worldwide, research may be conducted to investigate the impact of working capital management on firms' market value during periods of crisis.

Author Contributions: Conceptualization, R.D. and S.D.; methodology, R.D. and S.D.; software, S.D.; validation, R.D., S.D. and M.A.; formal analysis, M.A.; investigation, R.D.; resources, S.D.; data curation, S.D.; writing—original draft preparation, R.D., S.D. and M.A.; writing—review and editing, R.D.; visualization, R.D.; supervision, R.D.; project administration, R.D.; funding acquisition, R.D., S.D. and M.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The data used in this study may be obtained through the Thomson Reuters (Eikon) database. https://eikon.refinitiv.com/index.html, last accessed on 20 September 2022.

Acknowledgments: The authors appreciate the support from the American University of the Middle East, Kuwait.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Literature Review Summary.

Author(s) (Year)	Sample Size (Firms)	Country	Industry	Performance Measure(s)	Impact of WCM on Profitability			
					d-AR	d-INV	d-AP	CCC
Deloof (2003)	1009	Belgium	Various	Gross Operating Income	–	–	–	–
Lazaridis and Tryfonidis (2006)	131	Greece	Various	Gross Operating Income	–	–	–	–
García-Teruel and Martínez-Solano (2007)	8872	Spain	Various	ROA	–	–	0	–
Raheman and Nasr (2007)	97	Pakistan	Various	Net Operating Income	–	–	–	
Vishnani and Shah (2007)	23	India	Consumer Electronics	ROCE	–	–	+	
Şamiloğlu and Demirgüneş (2008)	≈146	Turkey	Manufacturing	ROA	–	–		0
Gill et al. (2010)	88	USA	Various	Gross Operating Income	–	0	0	+
Azam and Haider (2011)	21	Pakistan	Various	ROA and ROE		–	0	0
Sharma and Kumar (2011)	263	India	Various	ROA	+	–	–	+
Afeef (2011)	40	Pakistan	Various	ROA	0	0	0	0
Quayyum (2011)	5	Bangladesh	Cement	ROA				–
Karadaglı (2012)	162	Turkey	Various	Operating Profit and Market Return				+/–
Vural et al. (2012)	75	Turkey	Manufacturing	Gross Operating Income and Tobin's Q	–	0	0	–
Pouraghajan and Emamgholipourarchi (2012)	80	Iran	Various	ROA and ROI and Tobin's Q				–
Alavinasab and Davoudi (2013)	147	Iran	Various	ROA and ROE				–
Baños-Caballero et al. (2014)	N.d.	UK	Various	ROA				U
Mathuva (2015)	30	Kenya	Various	Gross Operating Income	–	+	+	–
Lyngstadaas and Berg (2016)	21,075	Norway	Various	ROA and ROIC	–	–	–	–
Altaf and Shah (2018)	437	India	Various	Gross Operating Margin				U
Korent and Orsag (2018)	442	Croatia	Software	ROA				U
Ren et al. (2019)	≈1000	China	Manufacturing	Core Profit				–
Nguyen et al. (2020)	119	Vietnam	Various	ROA and Tobin's Q	–	–	–	–
Sensini (2020)	112	Italy	Agro-industy	Gross Profit Margin	–	–	–	–

Source: Compiled by the authors.

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