sciendo

Zagreb International Review of Economics & Business, Vol. 27, No. 1, pp. 63-77, 2024

Faculty of Economics and Business, University of Zagreb and Sciendo. Printed in Croatia.
ISSN 1331-5609; UDC: 33+65
DOI: 10.2478/zireb-2024-0003

Does the Cash Conversion Cycle Affect Firm Profitability? Some Empirical Evidence from Listed Firms in North Macedonia

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Abstract: *This study aims to investigate the potential relationship between the cash conversion cycle (CCC) and firm profitability for the period from 2011 to 2019. To do this, a fixed effects panel regression model is applied to a sample of firms listed on the Macedonian Stock Exchange. Firm profitability is measured by the return on assets (ROA) ratio, while the liability ratio, firm size, current ratio, acid test and liquidity ratio are used as control variables. Our main finding is a decreasing and convex relationship between cash conversion cycle and profitability. In terms of working capital management policy, this implies that firms with a shorter cash conversion cycle perform better than others, since financial managers repay suppliers and reduce investments in working capital.*

Keywords: cash conversion cycle; profitability; fixed-effects panel estimation

JEL Classification: G31

Introduction

Since the cash conversion cycle (hereinafter, CCC) is a measure of working capital management efficiency (hereinafter, WCM), for financial managers the short-term liquidity of firms becomes an important issue as well as long-term financial decisions. Therefore, academic interest in WCM has been increasing for decades and there is a lot of empirical evidence in this field. There is still an ongoing academic debate re-

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garding working capital policies, *i.e.,* whether a firm should keep a shorter or longer CCC to improve financial performance in terms of profitability. This choice is crucial as the CCC model builds the relationship between the inventory conversion period, the receivables collection period, and the payables deferral period. Maintaining a given level of CCC can have both benefits and costs. Therefore, reducing receivables and inventory collection period (*i.e.*, using an aggressive strategy) by collecting customers earlier and lowering carrying costs leads to lower financing costs. However, this situation may be associated with shortage costs and the risk of losing customers. Otherwise, extending the receivables and inventory collection period (*i.e.*, using a conservative strategy) by collecting customers and increasing carrying costs leads to higher financing costs. For example, while Chang (2018) states that an aggressive working capital policy can improve firm profitability, this effect is reduced or reversed when firms are at the lower CCC level. Of course, a longer CCC implies greater working capital requirements, and these requirements are determined by industry conditions and practices (Bernstein and Wild, 1998). Furthermore, the accounts payable period, as another component of CCC, has its role and therefore paying suppliers in advance reduces the CCC while, on the contrary, delaying payments lengthens it.

Consequently, financial managers must examine how the difference between delays in collecting cash and delays in paying, or net delay, affects firms' profitability, since holding a higher liquidity is often associated to a reduction in profitability (opportunity cost of capital) and vice versa. Therefore, developing an optimal working capital policy represents a crucial task for the financial manager as there is a risk-return trade-off.

In this article we examine the relationship between short-term liquidity and profitability, following Deari *et al*. (2022), Altaf and Shah (2018) or Deloof (2003) who used the CCC as an inclusive measure of WCM efficiency.

While net working capital, defined as the difference between current assets and current liabilities, is a static amount, CCC is a dynamic measure because it depends on the period between payments to supplier and collections from customers. For example, Chakraborty (1973) suggests the concept of "operating cycle", since he considers the 2:1 ratio between current assets and current liabilities or the ratio 1:1 between liquid assets and current liabilities as no more than rules of thumb.

In general, CCC shows the time interval between spending, *i.e.*, disbursing cash for purchases (*e.g.*, raw materials) and receiving (collecting) cash from sales (see, among others, Wang, 2019 or Afrifa and Padachi, 2016). Additionally, Gentry *et al*. (1990) develop a weighted cash conversion cycle (WCCC) to combine the timing of flows and the amount of cash used in each segment of the cycle.

In this context, our objective is to understand if there is an optimal CCC that maximizes the firm's profitability and whether a short or long CCC is convenient for the same firm.

Accordingly, the aim of this article is to ascertain whether there is a relationship between the cash conversion cycle and corporate profitability in the period from 2011

to 2019 for firms listed on the Macedonian Stock Exchange, controlling for some other variables. Our main finding is a negative and convex relationship, so our results suggest that firms with a shorter cash conversion cycle are more likely to perform better in terms of profitability.

The remainder of the paper is organized as follows: Section 2 consists of a literature review, while Section 3 contains a description of the data and our proposed model. The final section discusses the empirical findings and concludes.

Literature review

The relationship between CCC and firm profitability has attracted the interest of several scholars as documented by various empirical studies. Thus, the literature confirms that CCC affects the profitability of the firm (see for example Dash *et al*., 2023; Umar and Al-Faryan, 2023; Kayani *et al*., 2023; Baños-Caballero *et al*., 2012).

On the contrary, there are also studies that find the absence of a significant relationship between WCM and profitability. For example, Hatane *et al*. (2023) show that WCM and board diversity have no significant impact towards profitability, but they positively impact firm value.

In general, there are empirical studies conducted in different countries in different periods. For example, Kayani *et al*. (2023) investigate New Zealand firms listed on stock exchange over the period 2009 to 2019, while Umar and Al-Faryan (2023) examine firms operating in Indonesia, Malaysia, Saudi Arabia, Pakistan, and the United Arab Emirates (UAE) between 2008 and 2021. Moreover, Karim *et al*. (2023) focus on listed firms of Bangladesh from 2003 to 2020.

Regarding the relationship between CCC and firm profitability, empirical studies suggest that the evidence is mixed. For example, Vlismas (2023) explores the moderating effects of strategy on the relationship between WCM and profitability for a sample of 72,444 firm-year observations of US-listed firms during 2000–2020 and reveals that the prospecting (defending) strategy has a decreasing (increasing) moderating effect on the relationship between WCM and profitability.

The positive relationship between CCC and firm profitability

The positive relationship between the CCC and firm profitability relies on argument that extending the receivables and inventory collection period can lead to higher sales (see Deloof, 2003) and therefore a longer CCC would increase the profitability of the firm.

For example, Deari *et al*. (2022) investigated the dynamic relationship between CCC and firm profitability for a sample of firms from eight EU countries for the

period from 2006 to 2015 and find a positive relationship between WCM and profitability. Also, Prempeh and Peprah-Amankona (2020) establish a significant positive linear relationship. Moreover, Erem Ceylan (2021) examine a sample SMEs listed in BIST Industrial Index from 2010 to 2019 and reveal that CCC has a significant and positive relation with profitability. Ng *et al*. (2017) assert that an increase in inventory conversion period is positively related to profitability.

The negative relationship between CCC and firm profitability

While the positive relationship between CCC and firm profitability is supported by the conservative strategy, the aggressive strategy proclaims that shorter CCC leads to higher profitability. The negative relationship between CCC and firm profitability is documented by a considerable number of studies which argue that an aggressive working capital policy can improve firm performance (Chang, 2018). For example, Le *et al*. (2018), Bieniasz and Gołaś (2011), among others, also find a negative relationship, while Zeidan and Shapir (2017) claim that reductions in the CCC should increase shareholder value.

Furthermore, several recent articles document a negative relationship between CCC and firm profitability. For example, Karim *et al*. (2023) reveal that CCC has a negative relationship with profitability in the case of listed firms, while Kayani et al. (2023) investigating Egypt and South Africa for the 2007-2020 period, find that CCC, average collection period and average age of inventory, have a significant inverse relationship, whereas the average payment period has a direct relationship with firm performance. Umar and Al-Faryan (2023) show that CCC significantly reduces the firm's profitability, while the accounts payment period significantly increases the firm's profitability.

However, despite the sign of WCM's influence on profitability, some studies have found a linear relationship (*e.g.,* Deloof, 2003), while other studies investigated the such influence through a non-linear function relationship (*e.g.,* Deari *et al*., 2022; Afrifa and Padachi, 2016; Fernandes *et al*., 2021; Baños-Caballero *et al*., 2012).

Given these premises, in this article we aim to contribute to previous literature by examining whether CCC affects firm profitability by focusing on listed firms in North Macedonia.

Empirical analysis

The data

The available data are collected from the financial statements of non-financial firms listed in the Macedonian Stock Exchange (*https://www.mse.mk/*) and covers the period from 2011 to 2019. The total amount of years is $T = 9$. For this period, we can assume that the data is not influenced by the direct consequences of the 2008 global crisis.

Furthermore, excluding the years starting from 2020 also avoids the effects of the Covid-19 pandemic and the recent conflict between Russia and Ukraine, as well as the escalation of turmoil in Israel.

The selected firms belong to the 20 most liquid listed firms on the Official Market and are chosen according to the turnover. We excluded banks from our sample because they operate in the financial sector and consequently, they have some own characteristics (*i.e.,* industry specific characteristics such as type of assets and liabilities; financial risk factor; greater leverage ratios; financial service operations related to loans and deposits; operate under specific rules and controlled by the National Bank, etc.) versus non-financial entities. Of course, this is a common approach as several prior empirical studies use it in finance literature (for more see discussion, *e.g.,* Foerster and Sapp, 2005; Fama and French, 1992).

Therefore, we carry out an empirical analysis on a sample of $n = 13$ non-financial listed firms. Table 1 shows the different business sectors in which such firms operate.

Table 1: Distribution by business sectors

Description	Freq.	Percent
Agriculture	9	7.69
Catering	9	7.69
Construction	9	7.69
Industry	54	46.15
Services	18	15.38
Trade	18	15.38
Total	117	100

Moreover, Table 2 presents how examined variables are defined.

Table 2: Definition of variables

Description	Abbreviation	Calculation
Dependent variable		
Return on Assets	ROA	Net income / Total assets
Independent variable		
Cash Conversion Cycle	CCC	Inventory conversion period (ICP) + Accounts receivable collection period (ARP) – Accounts payable deferral period (APP) ICP = Inventories / (Sales / 365) ARP = Accounts receivables / (Sales / 365) APP = Accounts payable / (Sales / 365)
Squared CCC	CCC2	
Control variables		
Total liability ratio	liabrat	Total liability / Total assets
Firm size	size	Logarithm of total assets - Logarithm of sales
Current ratio	curr	Current assets / Current liabilities
Acid test	acid	(Current assets – Inventories) / Current liabilities
Cash ratio	liquid	Cash and equivalents / Current assets

In our framework, the dependent variable is firms' ROA since it is commonly recognized as a measure of firm profitability (see *e.g.,* Afrifa and Padachi, 2016 or García-Teruel and Martínez-Solano, 2007).

The crucial explanatory variable is CCC which shows the interaction between investment in inventories, trade credit provided to customers and obtained from suppliers.

Therefore, the CCC is calculated as the difference between the number of days of inventory and accounts receivable and the number of days of accounts payable.

Clearly, the relationship between CCC and firm profitability cannot be examined without controlling for some other variables, and thus we have selected some firm characteristics. First, the firm's profitability can be affected by working capital management indicators such as the current, acid and cash ratio, and by the financing patterns.

As a result, we used the total liability ratio which covers both short-term and long-term debt, but also other non-interest-bearing liabilities that are also important in carrying out business operations. Indeed, we consider this ratio more appropriate than other measures already used in literature. For example, Afrifa and Padachi (2016) use the debt scaled by the capital ratio, while García-Teruel and Martínez-Solano (2007) employ the ratio of debt to liabilities.

Second, the relationship between CCC and ROA is examined also considering the firm size which we expect to play a significant role in our analysis. Generally, one would expect that larger firms are able to obtain more trade credit from suppliers, and therefore be more profitable than others, as they obtain greater benefits in terms of liquidity. For example, Madaleno *et al*. (2019), examining data from eight European countries during the period 2004-2013, assert that size exerts a very strong positive influence on net trade credit.

Descriptive statistics

The ROA averages in Table 3 indicate that firms are operating profitably. Specifically, the catering sector appears the most profitable with an average ROA: 7.12%; it is followed by firms belonging to the trade (4.73%), services (4.30%), construction (3.57%), and industry (2.93%). Finally, the less profitable sector is the agricultural sector agriculture (2.12%). However, it can be noted that ROAs in agriculture, catering and services tend to decrease over the years, while other sectors show an increase in their values.

Table 3: ROA (in %) by sectors and years

Business description	**Years**								
	2011	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***
Agriculture	9.92%	2.08%	4.06%	-1.22%	0.81%	1.68%	1.61%	0.12%	0.03%
Catering	9.23%	8.84%	7.40%	6.68%	6.10%	5.87%	4.64%	8.25%	7.06%
Construction	4.50%	3.07%	3.44%	2.51%	4.07%	3.24%	1.65%	2.82%	6.82%
Industry	2.29%	2.52%	2.57%	-0.50%	1.29%	5.74%	5.17%	2.58%	4.39%
Services	9.20%	7.76%	3.18%	1.76%	1.61%	2.60%	4.65%	3.69%	4.28%
Trade	3.89%	3.43%	2.28%	1.67%	2.68%	5.75%	5.61%	8.02%	9.27%

On the other hand, Table 4 highlights the differences between the various sectors in relation to the average CCC, its components and ROA.

Table 4: Mean of ARP, APP, ICP, CCC and ROA (%)

Business description	ARP	APP	ICP	CCC	ROA (%)
Agriculture	54	131	173	97	2.12%
Catering	25	17	26	34	7.12%
Construction	206	144	83	145	3.57%
Industry	72	56	271	286	2.93%
Services	96	42	28	82	4.30%
Trade	62	56	39	45	4.73%
Total	80	64	154	170	3.75%

Thus, data confirms what the theory suggests – that length of CCC and its components differ across sectors (see *e.g.*, Chauhan, 2019). For example, firms operating in the catering sector take less time to collect money from their clients (an average period of 25 days), while in the construction sector the average period is longer (about 206 days). The reason for this high discrepancy is that catering, and construction sectors have their own specifics, especially in relation to commercial credit granted

and obtained. Consequently, in the catering sector suppliers can expect to be paid by firms within 17 days, while in the construction sector the number of days rises to 144.

It can also be noticed that firms grant more trade credit than they receive. Indeed, in the catering sector we observe a net trade credit (ARP-APP) of 8 days, and in the construction sector this measure increases to 61 days. Significant differences are also found in other sectors. The only exception is the agricultural sector where 16-day net trade credit is positive. This implies that firms obtain more trade credit than they grant.

In addition, focusing on inventory conversion, Table 4 shows that catering firms stored inventory for the shortest period (an average of 26 days) compared to firms in industry which is the longest (an average of 271 days); they are followed by firms in the agriculture (an average of 173 days), etc.

Moreover, Table 5 shows that firms operating in the catering sector experienced the shortest CCC (average CCC is 34 days), while firms in the trade sector (45 days), services (82 days), agriculture (97 days), construction (145 days) and the industry (286 days) complete the cycle in a longer period.

Table 5: CCC by sectors and years

Business description	**Years**								
	2011	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***
Agriculture	159	218	145	149	36	2	31	54	75
Catering	33	29	38	42	38	44	39	37	4
Construction	88	129	139	166	156	139	134	194	160
Industry	511	305	285	290	248	264	252	256	278
Services	66	74	83	90	96	106	85	78	59
Trade	41	46	42	54	45	53	49	33	45

The model

In this paper, we propose a fixed-effects panel regression model which allows us to exploit the available sample to estimate a relationship between the firm profitability and the CCC, by taking some other variables into account. The equation of the baseline model is:

$$\begin{aligned} \mathrm{ROA}_{it} = {} & \alpha_i + \beta_1 \mathrm{ROA}_{i\,t-1} + \beta_2 \mathrm{CCC}_{it} + \beta_3 \mathrm{CCC2}_{it} + \beta_4 liabrat_{it} + \beta_5 \mathrm{size}_{it} + \beta_6 \mathrm{curr}_{it} + \\ & + \beta_7 \mathrm{curr}_{i\,t-1} + \beta_8 \mathrm{acid}_{it} + \beta_9 \mathrm{acid}_{i\,t-1} + \beta_{10} \mathrm{liquid}_{it} + \beta_{11} \mathrm{liquid}_{i\,t-1} + \varepsilon_{it} \end{aligned} \quad (1)$$

where $\varepsilon_{it} \sim i.i.d.\ (0, \sigma^2)$ is the model disturbance, $i = 1, 2, 3, ..., n$ and $t = 1, 2, 3, ..., T$. All the variables in our model are defined in Table 2.

In equation (1) firm profitability is measured by ROA and is used as the dependent variable, while CCC is used as the principal regressor. The variable CCC2 is the squared CCC, and it is included to investigate whether the relationship between firm profitability and CCC follows some nonlinear mechanism. To our best knowledge, from a methodological point of view, the inclusion of the CCC2 variable represents the main innovation compared to the previous evidence in the case of North Macedonia (see *e.g.,* Deari *et al.,* 2019; Deari, 2015). For example, Naumoski (2019) also examined 720 firms in ten South-Eastern European countries in the period 2006-2015 using a panel regression model. He revealed a significant negative relationship between firm profitability and CCC but did not specify this relationship in detail.

However, the inclusion of the squared CCC represents an attempt to estimate a general relationship that could be monotonic, concave, or convex. In practice, we define a quadratic equation to verify whether there is a trade-off between risk and return of WCM policies. This is in line with some prior studies, for example, Korent and Orsag (2018) who find the existence of a quadratic and concave relationship between net working capital and return on assets.

Since Baños-Caballero et al. (2012) argue that an optimal CCC would balance costs and benefits, once we estimate our model, we aim to determine whether there is such an optimal CCC to maximize profitability. Second, our approach should allow us to understand if the examined firms that have performed better are those with longer CCC or those with shorter CCC.

Third, while we are aware that our analysis is conducted on listed firms from North Macedonia, our results can be useful to scholars, financial managers in terms of increasing efficiency in working capital management, and corporate policy makers.

In our framework, we use total liability ratio, size, current ratio, acid test, and liquid ratio as control variables. The final model specification is determined by minimizing the Bayesian information criterion, therefore the delayed current ratio, acid test and liquid ratio were included to achieve better prediction accuracy.

Model estimation

As we have already claimed, we estimate a fixed-effects model for panel data and parameters are estimated via the within estimator. The choice of a static model is clearly motivated by the small sample size which effectively prevents the use of a dynamic approach. From a theoretical point of view, it is well known that the fixed-effects model is the most suitable specification for exhaustive samples therefore, since the individuals in our sample are firms, we can treat them as exhaustive events since their union gives the entire sample space of Macedonian firms. The only drawback in this framework is that we cannot control the impact of different sectors since the time-invariant regressors would be collinear with the fixed effects. Overall, the within estimator is still consistent, regardless of the correlation between individual

characteristics with the explanatory variables, and the possibility of having random effects (see, for example, Wooldridge, 1988). Furthermore, for our data, a fixed effects model appears to be more adequate than the random effects model because the Hausman test shows no evidence to support the choice of a random effects model (the test statistic is 25.8477, and the related *p*-value is 0.0068).

Our estimates are provided in Table 6 and Table 7.

Table 6: Correlation matrix

	CCC	**CCC2**	**liabrat**	**size**	**curr**	**acid**	**liquid**
ROA	-0.1202	-0.1213	-0.3990	0.1745	0.2316	0.2505	-0.0273
CCC		0.9665	-0.2641	0.5983	0.0544	-0.1705	-0.2012
CCC2			0.2832	0.5540	0.0981	-0.1148	-0.1207
liabrat				-0.4358	-0.6055	-0.5110	-0.0226
size					0.5181	0.3987	-0.4955
curr						0.9629	-0.2475
acid							-0.1967

First of all, our findings denote that firms with shorter CCC have higher profitability as indicated by an estimated negative relationship. Moreover, in contrast to some previous contributions in which the relationship between CCC and firm profitability follows an inverted U-shaped pattern (see *e.g.*, Deari *et al.*, 2022; Altaf and Shah, 2018), our analysis suggests that such relationship is decreasing and convex, since the estimated coefficient related to CCC2 is positive and significant.

From Table 7 it can be seen that we used some lagged variables in the model. This is essentially due to two reasons: on the one hand we tried to capture a possible dynamic through a "delay effect", on the other hand we noticed that from a statistical point of view our model benefited from the addition of these variables[1]. Specifically, the lagged dependent variable is likely to play a positive and significant impact and this finding is in line with Nobanee, Abdullatif and AlHajjar (2011). Table 7 also shows that firms with lower liability ratios performed better, while larger firms and those with higher current ratios appear to be more profitable.

Considering the effect of the acid test given by the difference between the current ratio of inventories, a negative and significant relationship is found which is compensated for by the effect of the delayed acid test. Focusing on liquid ratio, only its lag impacts significantly, and the estimated impact is positive. This implies that firms with higher liquidity (cash) in the previous year seem to be more profitable in the actual year.

Despite the sample size not being too large, the model seems to be correctly specified since almost all the regressors appear to be significant. This is also evidenced by the good results in terms of the R^2 indices and by the Least Squares Dummy Variables (LSDV) F test that strongly rejects the null. From our results, mixed evidence emerges on residual autocorrelation: on the one hand the Wooldridge test highlights

some problems and, on the other hand, both the Durbin-Watson statistic and the autoregression of the residuals indicate that the proposed model problems do not seem to suffer from some model misspecification.

Finally, the test for differing group intercepts does not reject the null of common intercepts, thus evidencing that there is not visible heterogeneity between the firms[2].

Table 7: Fixed-effects model estimates

Variable	Coefficient	Std. error	t-ratio	p-value
const	0.0636	0.0271	2.3490	0.0214 **
ROA(-1)	0.4139	0.0975	4.2440	0.0001***
CCC	-0.0239	0.0126	-1.8970	0.0616 *
CCC2	0.2305	0.0953	2.4190	0.0179 **
liabrat	-0.1586	0.0527	-3.0060	0.0036 ***
size	0.0485	0.0219	2.2170	0.0296 **
curr	0.0095	0.0035	2.7340	0.0078 ***
curr(-1)	-0.0113	0.0033	-3.4750	0.0008 ***
acid	-0.0101	0.0038	-2.6700	0.0093 ***
acid(-1)	0.0103	0.0037	2.7780	0.0069 ***
liquid	-0.0484	0.0516	-0.9383	0.3510
liquid(-1)	0.1138	0.0505	2.2520	0.0271 **

*Notes: *, **, *** significant at 10%, 5% and 1%.*

Mean dependent var	0.0363;	S.D. dependent var	0.0396;
Sum squared resid	0.0480;	S.E. of regression	0.0250;
LSDV R-squared	0.6932;	Within R-squared	0.4577;
LSDV F(23, 77)	7.5640;	p-value(F)	0.0000;
Log-likelihood	243.0927;	Akaike criterion	-438.1855;
Schwarz criterion	-375.4226;	Hannan-Quinn	-412.773;
rho	-0.1511;	Durbin-Watson	1.8882.

Autoregression of residuals
t-ratio: -0.2129 with p-value 0.8350

Wooldridge test for autocorrelation in panel data -
Null hypothesis: No first-order autocorrelation (rho = -0.5)
Test statistic: F (1, 12) = 23.2294
with p-value = P (F (1, 12) > 23.2294) = 0.0004

Joint test on named regressors -
Test statistic: F (11, 77) = 5.9076 with p-value = P (F (11, 77) > 5.90761) = 0.0000

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F (12, 77) = 1.71752
with p-value = P (F (12, 77) > 1.71752) = 0.0791

Conclusions

The cash conversion cycle as an indicator of working capital management is a useful tool for financial managers in the business decision making process. Given its importance, this indicator has been intensively studied in the literature for various countries and periods.

Our study aims to contribute to the existing literature by estimating the relationship between CCC and firm profitability on a sample of listed firms in Macedonian Stock Exchange over the period from 2011 to 2019.

Overall, our analysis provides empirical evidence that such a relationship exists, and this has some possible implications in the decision process of the financial managers. Our analysis shows that it is better for firms to invest less in inventories and accounts receivable. A short CCC will be associated with low working capital level, so firms should obtain trade credit from suppliers as an interest-free fund rather than from bank loans. Further, a low level of inventories is suggested for firms operating in the agriculture sector, while firms belonging to the construction should reduce investments in accounts receivable.

Although our results were obtained for a sample about North Macedonia, they can be useful to both business practitioners and scholars as well. The examined relationship between short-term liquidity and profitability can help managers, investors, creditors, and other related business stakeholders to consider the cash conversion cycle matter as important to the firm's profitability. The results can contribute to preparing better working capital management policies and therefore improving the firm's profitability. Further, this study can contribute to the existing theoretical evidence of working capital management by providing some empirical results which can be extended by future research.

Even though we provide unique evidence toward understanding the relationship between cash conversion cycle and firm profitability, it still has its own limitations. Since the sample size is not large in our analysis, adding firms would make our model more robust. Otherwise, it could be useful to also consider a longer period, but in this case, it would be necessary to take the effects of the Covid-19 pandemic and the wars in Eastern Europe and the Middle East under control.

Declarations

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest/Competing interests

There is no conflict of interest/Competing interests.

Availability of data and material

Not applicable.

Code Availability

All programming routines are available upon request from the authors.

Authors' Contributions

Fitim Deari: Conceptualization, Investigation, Writing - Original Draft, Formal analysis, Writing - Review & Editing.
Giulio Palomba: Methodology, Software, Validation, Data Curation, Writing - Review & Editing.

NOTES

[1] Technically, the use of lagged variables lowers the Bayesian information criterion that we adopted for the model specification. Preliminary estimates are available upon request from authors.
[2] Specifically, the estimated vector of the constants is

$$\hat{\alpha} = [0.09160.14920.09230.05440.00210.0588 - 0.05420.11090.05230.03640.10120.05850.0808]'$$

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