

Article

The Impact of Firm Risk and the COVID-19 Crisis on Working Capital Management Strategies: Evidence from a Market Affected by Economic Uncertainty

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Abstract: The present study aims to investigate the impact of the COVID-19 crisis and firm risk on working capital management policies among manufacturing firms listed on the Tehran Stock Exchange (TSE). The study sample consists of 1200 observations and 200 companies listed on the TSE over a six-year period from 2016 to 2021; furthermore, the statistical method used to test the hypotheses is ordinary least squares (OLS). The results show that the COVID-19 pandemic has led managers to increase current assets to total assets ratio (CATAR), current ratio (CR), quick ratio (QR), net working capital (NWC), cash to current assets (CTCA) ratio, while it has caused a decrease in operational cycle (OC), days account receivables (DAR), and current liabilities to total assets ratio (CLTAR). Furthermore, we find that the higher the company's risk, the more managers are motivated to embrace the working capital investment policy, net working capital, cash to current assets ratio, and cash conversion efficiency (CCE). In general, our findings indicate that during times of crisis, Iranian companies tend to adopt conservative working capital policies to ensure sufficient liquidity to respond appropriately to unforeseen events. In this study, the theory of liquidity preference aligns with the observed behavior of firms in response to the COVID-19 crisis and firm risk, where the emphasis on liquidity and short-term financial stability becomes paramount.

Keywords: COVID-19 crisis; firm risk; working capital management; WC conservative policy; WC aggressive policy; Tehran Stock Exchange



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1. Introduction

In the current complex business environment, where technology is rapidly advancing and competition is becoming more intricate, effective working capital management has become a crucial task for managers (Zimon and Tarighi 2021; Ahmad et al. 2022; Patil and Prabhu 2024). Especially in critical times, the first mistake in adopting the working capital management strategy by managers can be the last mistake and lead to the collapse of a company's business future (Zimon and Tarighi 2021). Economic chaos around the world has taught great lessons to company managers and transformed their attitude towards working capital management (Salehi et al. 2019; Akgün and Karataş 2021; Simon et al. 2021; Ahmad et al. 2022). According to the theory of liquidity preference proposed by John Maynard Keynes, in times of uncertainty or crisis, firms tend to hold more liquid assets to ensure their ability to meet short-term obligations and manage risks effectively (Bibow 2013). On the other hand, in the scenario where working capital management policies are geared towards maximizing profitability rather than maintaining high levels of liquidity, the trade-off theory provides a theoretical framework to support this strategic

decision-making approach. The trade-off theory acknowledges that there is a balance between risk and return, and firms may choose to adopt more aggressive working capital management policies to optimize profitability even if it means sacrificing some liquidity (Vo and Ngo 2023).

Efficient working capital management refers to corporate managers' tendency to make necessary adjustments to their short-term assets and liabilities to pay maturing debts on time and arrange fixed assets for profitability, which is considered the cornerstone of companies' survival in today's competitive world (Akbar et al. 2021). Keep in mind that business performance can be significantly damaged by taking too many risks (Arif and Nauman Anees 2012; Kassi et al. 2019; Onsongo et al. 2020), and having too much liquidity can decrease the amount of capital available for long-term projects (Chen 2011; Yang et al. 2019). That is why one of the main concerns and challenges for managers is to be able to balance profitability and liquidity according to the economic conditions of the market in which their company operates (Akbar et al. 2021). According to Emery's (1984) argument, depending on the operating cash flows generated by a firm's assets, liquidity management is a constant manner. This means that liquidity management is not a one-time task, but an ongoing process that requires monitoring and adjustment based on the cash flows generated by the firm's assets to ensure financial stability and meet obligations effectively. However, there is still a gap in the research literature on the relationship between company risk and working capital management (Akbar et al. 2021), especially in the emerging market of Iran, where companies are at high risk. Given that there is a very close relationship between firm risk and working capital policy (Akbar et al. 2021), this research is one of the first to attempt to test whether firm risk has led Iranian managers' attitude towards working capital management policy to be affected substantially. Particularly in the Iranian market, firms' total risk in the manufacturing sector has been affected by the most unprecedented economic sanctions in the last decade. Economic sanctions can negatively affect the mentality and sentiments of investors and creditors in the capital markets, particularly those prone to emotional decision-making; thus, this can damage the financing of companies (Abakah et al. 2024). As for Iran's market, it can be stressed that during the last decade, Iran has faced the most severe economic sanctions, which have caused its manufacturing sector to struggle with many problems (Salehi et al. 2019; Moradi et al. 2021; Tarighi et al. 2023). In summary, economic sanctions against Iran have increased the total risk for firms in the manufacturing sector by limiting access to capital, impacting strategic sectors, forcing adjustments in capital structure, increasing import and logistics costs, and decreasing profitability (Moradi et al. 2021; Ghasseminejad and Jahan-Parvar 2021; Farzanegan and Batmanghelidj 2024; Tarighi et al. 2023; Shamsi 2023). Raw material shortages and difficulties in securing foreign currency have led to the suspension of many production units in Iran's manufacturing sector. Soaring inflation, reduced consumer purchasing power, and a decline in demand for intermediate goods have exacerbated the downturn in sales within the manufacturing sector. Besides, the government's contractionary approach to the industrial sector, along with its interventions, has contributed to the stagnation and lack of sustainable growth in manufacturing in Iran (Farzanegan and Batmanghelidj 2024). The industry sector has been more vulnerable than other segments due to its high dependence on exports and imports from abroad (Kelishomi and Nisticò 2022). In other words, due to the characteristics of manufacturing firms in Iran that face severe risks, this research has comprehensively used most of the working capital management strategies to gain a better understanding of whether Iranian managers are inclined to adopt policies that would allow them to hold more cash, which could cover transactional costs and meet unforeseen contingencies, or whether they believe that the higher a firm's total risk, the higher the expected return, and seek strategies to reduce their liquidity and expand their business operations. It seems that the results of this research can make a significant contribution to the research literature in the field of working capital management, because on the one hand, if the company's risk leads to the adoption of working capital management strategies in such a way that liquidity is a priority, managers

have perceived the economic conditions governing the market as a threat and move in line with the liquidity preference theory. However, if working capital management is managed in a way that supports operational actions and profitability, they may have perceived it as an opportunity and taken steps towards the trade-off theory.

The coronavirus pandemic that began in late 2019 prompted governments to adopt severe security measures, such as social distancing, stay-at-home orders, and social quarantine. These measures had fatal effects on all sectors of the economy, particularly disrupting the operational activities of manufacturing companies (Ahmad et al. 2022; Tarighi et al. 2023). The COVID-19 pandemic had several repercussions, including the decline of financial markets, sharp decreases in domestic consumption, spillovers of fragile demand to other sectors and economies through trade and production linkages, severe declines in business sales, and liquidity shortages (Shen et al. 2020; Zimon and Tarighi 2021; Tan et al. 2022; Zhao et al. 2023). The COVID-19 crisis, with its unique challenges, is completely different from the prior financial crunches in terms of severity, making enhancement even more difficult because it exposed company managers to a lack of liquidity (Tarkom 2022; He et al. 2022b). So far, several studies have investigated the impact of the COVID-19 crunch on energy (Jia et al. 2021; Shaikh 2022), interest rates (Lee et al. 2023; Garcia et al. 2023), exchange rates (Jamal and Bhat 2022; Jawad and Naz 2023), prices of gold and oil (Paramati et al. 2023; Cui et al. 2023; Terraza et al. 2024), unemployment rates (Davidescu et al. 2021), etc. Despite COVID-19 being of great importance in determining working capital management strategies, empirical evidence in different markets can rarely be found (Tarkom 2022). In fact, researchers worldwide have primarily focused on the role of COVID-19 at the macro level, while paying little attention to the financial challenges faced by firms, particularly in the area of working capital management (Ahmad et al. 2022). This gap is especially noticeable in the research literature from underdeveloped nations, such as Iran, which differs significantly from other markets in all aspects. As stated earlier, in Iran's inflationary economy, the cost of goods is increasing due to rising raw material prices, which are in turn affected by economic sanctions. Additionally, the purchasing power of consumers has decreased significantly, leading to a decrease in the demand for goods produced by Iranian manufacturing companies (Moradi et al. 2021; Tarighi et al. 2023). On the other hand, Iranian managers seem to have enough reasons to adopt strategies in the direction of profitability. For example, Iranian managers are primarily evaluated based on profitability, motivating them to make their firms profitable in order to receive the best possible reward and maintain their position (Zimon et al. 2021). Moreover, in times of financial crisis, managers often have a natural inclination to present a positive image of their company's financial condition to restore the confidence of investors and creditors (Zimon et al. 2021; Lassoued and Kanchel 2021; Usheva and Vagner 2021; Tarighi et al. 2023). Accordingly, the second goal of this research is to determine whether the COVID-19 crisis has had a significant impact on working capital management strategies in an emerging market called Iran. To put it another way, the main question is whether companies operating in the Iranian market aimed to expand their business activities and increase profitability to achieve maximum rewards and maintain their position during the coronavirus crisis, or whether they adopted a conservative approach and focused solely on their liquidity to respond effectively to unforeseeable events during the COVID-19 pandemic. Overall, the results of our study contribute to the literature on working capital management in the following ways. First, although companies may adopt different working capital management strategies depending on the economic conditions of each country, our research warns that in high-uncertainty markets, it is advisable for companies to adopt conservative working capital strategies to deal with unpredictable future events. Furthermore, our research suggests that evaluating the impact of external shocks on working capital management can be a useful tool for policy makers and regulators to implement appropriate protective measures.

The rest of the aforementioned study is organized as follows. The second section presents the theoretical underpinnings and discusses the strand of literature related to

WCM. Section 3 elaborates on the data and methodology, while Section 4 encapsulates data analysis. The final part relates to the research conclusion and discussion.

2. Literature Review

The selection of an appropriate working capital strategy can optimize operating costs and financial liquidity, providing companies with a competitive advantage and promoting sustainable growth (Zimon and Tarighi 2021). According to the existing research literature on WCM, there are two policies: working capital investment strategy and working capital financing policy (Zimon and Tarighi 2021; Demiraj et al. 2022; Ahmad et al. 2022). Investment policy primarily focuses on determining the levels of current assets, while financing policy pays more attention to current liabilities (Ahmad et al. 2022). Another important point is that both working capital investment policy and working capital financing strategy can be sub-categorized into aggressive and conservative (Nazir and Afza 2009; Aktas et al. 2015; Ahmad et al. 2022; Demiraj et al. 2022; Zimon et al. 2024). The adoption of an aggressive investment policy is more common among firms that require greater liquidity to increase operational flexibility and do not prioritize profitability. In contrast, a conservative working capital investment policy aims to increase sales by developing the production process and building a good relationship with customers, but at the cost of high-interest expenses and a cut in shareholders' worth (Baños-Caballero et al. 2014; Demiraj et al. 2022; Ahmad et al. 2022). As for the working capital financing strategy, when companies adopt an aggressive strategy and resort to short-term debt to finance their current assets, they expose themselves to more risk because they have a shorter time to settle them until the maturity date, although it is less expensive (Nazir and Afza 2009). Conversely, conservative companies tend to use long-term debt, which is less risky and allows them to have sufficient time to settle, despite incurring higher interest costs (Alrahamneh et al. 2020; Ahmad et al. 2022). According to the trade-off theory, companies try to optimize their working capital policies by weighing the costs and benefits (Ahmad et al. 2022; Dash et al. 2023; Kayani et al. 2023). Since the onset of the COVID-19 crisis, many CFOs have shifted from aggressive to conservative working capital policies (Prša 2020; Arnaldi et al. 2021; Yousaf and Bris 2021; Zimon and Tarighi 2021; Mazanec 2022). This change has led to improved financial security for companies during times of crisis, but at the cost of increased operational expenditures (Zimon et al. 2024). Overall, the economic conditions of each market can probably be one of the factors influencing companies' choice of working capital policy (Filbeck and Krueger 2005; Enqvist et al. 2014; Dash et al. 2023).

In a comprehensive review of most of the research conducted to date, it can be seen that most of the attention of scholars has been focused on the important role of working capital policy in the financial performance of companies (Kayani et al. 2019; Prasad et al. 2019). Working capital management is crucial for companies to mitigate the risk of bankruptcy, particularly in challenging and harsh situations, because it plays a significant role in maintaining financial liquidity, profitability, and cost control (Akbar et al. 2021; Akgün and Karataş 2021; Gajdosikova et al. 2022; Hashmi and Iqbal 2022; Zimon et al. 2024). It should be noted that the importance of a working capital management policy is more pronounced in economic downturns than in economic prosperity (Enqvist et al. 2014), for these events can result in mismanagement and finally loss of financial liquidity (Salehi et al. 2019; Zimon and Tarighi 2021; Akgün and Karataş 2021). The COVID-19 pandemic has been one of the most challenging issues of recent decades, affecting both developed and emerging markets (Didier et al. 2021; Achim et al. 2022; Tarighi et al. 2023; Zimon et al. 2024). In fact, this systematic risk arising from the COVID-19 crisis has prompted managers to think more deeply about working capital policies and to have more appropriate flexibility in critical conditions to maintain their business continuity (Zimon and Tarighi 2021). In the current complex and challenging business environment, where companies face unpredictable risks, managers have a crucial responsibility to make decisions about their companies' working capital policies (Salehi et al. 2019), especially during the COVID-19 pandemic, in which even the slightest error in working capital decisions can result in

losing ground to competitors in the marketplace (Zimon and Tarighi 2021). The COVID-19 pandemic disrupted economic activities in the market, resulting in a decrease in the value of companies' assets (Almaghrabi 2022; Tarkom 2022; Hassan et al. 2023). During times of crisis, banks and financial institutions may be hesitant to provide loans to companies with poor liquidity (Ivashina and Scharfstein 2010; Didier et al. 2021; Tarighi et al. 2023). In fact, less investment is made not only due to a lack of creativity and innovation in the market but also because of insufficient allocation of financial resources by banks (Zimon and Tarighi 2021). This ultimately leads to an increase in the cost of capital for firms and damages the net present value of budgeted projects (Tandoh 2020). Even though uncertainty in the macroeconomy and future cash flows can be a big obstacle to the willingness to invest and enter new markets and risk taking (Handley and Limao 2015), investing during periods of economic ambiguity can be more lucrative because it offers more investment opportunities rather than greater risk (Zimon and Tarighi 2021). As a result, the adoption of short-term strategies, such as working capital management, has become more necessary than ever. Working capital management is related to current assets, short-term liabilities, operational revenues, and costs (Zimon and Dankiewicz 2020; Tarkom 2022); managers need to pay a lot of attention on establishing an optimal level of their working capital to continue their business activities in the market (Zimon and Tarighi 2021). Apparently, excessive liquidity on the one hand specifies the accumulation of idle funds that do not fetch any profits for the firm, and on the other hand, insufficient liquidity might damage the firm's goodwill, worsen the firm's credit ratings, and make the firm go bankrupt (Panigrahi 2014). Efficient management of working capital actually means that firms must maintain the necessary liquidity to run their operations while avoiding overinvestment in short-term assets for maximum profitability (Nazir and Afza 2009; Demiraj et al. 2022).

Although the COVID-19 pandemic has been a significant economic crisis in the last decades that has affected the liquidity of companies, there has been little research investigating its impact on the working capital policies of companies (Demiraj et al. 2022; Ahmad et al. 2022), particularly in an emerging market called Iran, which has encountered greater economic uncertainty due to sanctions. Several studies have been carried out in different continents on the impact of the COVID-19 crisis on working capital strategies, with different results depending on the economic environment in each region. For instance, in the Polish market, Zimon et al. (2022) found that SMEs in the renewable energy market adopted conservative strategies during COVID-19 to improve their liquidity security. Specifically, the share of accounts receivable in their current assets was significantly reduced. As such, Zimon and Tarighi (2021) figured out that the COVID-19 pandemic crisis did not change working capital management strategies in Polish SMEs operating in group purchasing organizations (GPOs). Among Slovak enterprises, the inventory turnover period, receivables collection period and accounts payable period worsened during COVID-19 (Gajdosikova et al. 2022). Using data from 218 listed Romanian firms in various industries, Achim et al. (2022) showed that efficient management of ratios of WC and liquidity contributed to firms' survival during the COVID-19 crunch. By using data obtained from the automotive industry in Europe, Demiraj et al. (2022) proved that excessive levels of inventory impaired profitability by locking up valuable cash reserves during the COVID-19 pandemic. By analyzing 2542 publicly traded US firms, Tarkom (2022) discovered that the severe conditions of the COVID-19 pandemic made US companies inefficient in managing working capital, leading them to have higher CCC levels. This negative effect was moderated by firms receiving government incentives (deferred taxes and investment tax credit). Of course, this negative effect was mitigated by companies receiving government incentives (deferred taxes and investment tax credits). Through an analysis of Indian manufacturing firms, Pant et al. (2023) found that these firms suffered financially post-COVID-19, since they significantly lacked the working capital to run day-to-day operations. In another study conducted in the Indian context, Kumar and Olasiuk (2024) showed a negative relationship between the cash conversion cycle (CCC) and leverage ratio with ROA during the challenging environment of the COVID-19 pandemic and confirmed that corporate profitability

improves when firms reduce leverage, favor equity-based financing, and seek to increase the current ratio. [Satoto et al. \(2022\)](#) also analyzed data from manufacturing companies listed on the Indonesia Stock Exchange between 2017 and 2021. They found differences in inventory turnover and receivables turnover before and during the COVID-19 pandemic, but no differences in cash turnover and net working capital. In Bangladesh, problems such as product expiry, shortage of working capital, and limited operations of distributors have been identified as short-term consequences of the COVID-19 crisis, while corporate return on investment and the contribution of the firms to the gross domestic product may be at risk in the longer term ([Chowdhury et al. 2022](#)). Finally, using data from Compustat, [Lin et al. \(2023\)](#) found that the COVID-19 pandemic caused a significant increase in firms' operating cycle lengths.

Risk is a form of uncertainty regarding future expectations that can be controlled and managed by adopting appropriate policies that contribute to the maximization of corporate shareholder wealth ([Damodaran 2014](#); [Nirino et al. 2022](#)). Apart from the coronavirus crunch, which is only a type of systematic risk ([Tarighi et al. 2023](#)), the company's total risk includes both systematic and unsystematic risks ([Nirino et al. 2022](#)). The idiosyncratic risk is related to the characteristics of the company and rooted in endogenous aspects, whereas systematic risk, also known as undiversifiable risk, refers to the risk inherent to the entire market ([Nguyen et al. 2020](#); [Battisti et al. 2020](#); [Nirino et al. 2022](#)). The conditions of the Iranian market are such that it has been affected by systematic risk due to severe economic sanctions, and companies also face specific risks related to themselves due to their characteristics ([Moradi et al. 2021](#)). This is why companies need an optimal level of working capital to deal with uncertainty caused by market inefficiencies, such as transaction costs, ordering costs, information costs, and production limitations ([Akbar et al. 2021](#)). In a country like Iran, where many of its manufacturing companies are facing problems in obtaining the necessary raw materials and financial resources, and on the other hand, the demand for products has decreased significantly due to the decline in people's purchasing power, predicting the inflows and outflows has become difficult. Considering these inadequacies, firms either choose to settle their debts promptly ([Akbar et al. 2021](#)) or delay payments to suppliers, obtain short-term financing on unfavorable terms, or even sell their assets ([Emery 1984](#)). Managers managing working capital based on accurate financial information, actual economic facts, practical work experience, and a rational approach can have a positive impact ([Baker et al. 2007](#); [Zheng et al. 2022](#)), while uncertainty conditions create a different scenario. Companies' exposure to risk influences their working capital policies ([Akbar et al. 2021](#)). By considering a firm's total risk as a key factor in determining the cost of a firm's capital ([Nirino et al. 2022](#)), working capital management appears to act as a barrier to risk and can contribute to firm value ([Le 2019](#)). Working capital management is of particular importance in both firms with less access to capital and those that expand their investments during periods of economic recovery ([Le 2019](#)). Since cash and cash equivalents directly affect financing operations and payouts and allow firms to capitalize on potentially money-spinning prospects that may appear in the future and have more flexibility against unpredicted events ([Martínez-Sola et al. 2018](#); [Chen et al. 2020](#); [Haj-Salem and Hussainey 2021](#); [Zimon and Tarighi 2021](#); [Habib and Dalwai 2023](#)), it is recognized as one of most important elements of WC ([Akbar et al. 2021](#); [Zimon et al. 2024](#)).

Drawing on resource-based theory, firms can gain a competitive advantage if they can use resources effectively, which acts as a robust safeguard against external environmental vulnerabilities and enhances internal strong points ([Habib and Mourad 2022](#); [Habib 2023](#)). In order to use these resources efficiently and achieve a sustainable competitive advantage, companies need to manage their working capital appropriately ([Zimon et al. 2024](#)). As stated previously, the trade-off theory also suggests that financial managers can reach the optimal level for liquidity holding when there is a rational balance between the costs and benefits associated with it ([Ahmad et al. 2022](#); [Habib and Dalwai 2023](#); [Zimon et al. 2024](#)). For example, when the duty is used to incur debt, businesses must deal with the challenges of tax cuts and liquidation costs. However, in accordance with the pecking order theory,

Myers and Majluf (1984) argued that there is no optimal level of cash holdings. In fact, based on the logic of the pecking order theory, when companies encounter a lack of liquidity, they first try to rely on the internal resources of funds. Also, when businesses grow financially stable and advantageous, they look less for externally created assets because they have enough internal assets to support their undertakings (Myers and Majluf 1984). However, if external financing becomes necessary, companies may consider using debt as a more reasonable option compared to equity, which has high issuance costs (Zimon et al. 2024). Based on the compromise theory, in terms of profitability, more productive enterprises should imply a larger duty-serving limit and a more accessible wage to shield, which will result in a higher obligation proportion (Myers 2001). Uncertainty is often viewed as both a threat and an opportunity (Rubino 2018; Qazi et al. 2020; Akbar et al. 2021), and this largely depends on how well the company's total risk is assessed (Ruiz-Canela López 2021). Razi et al. (2021) suggest that operational risk can be controlled and managed by implementing effective policies; WC management is one of the most fundamental solutions (Akbar et al. 2021). However, companies with excess working capital sometimes have to pay higher interest costs and bear more operational risk (Kieschnick et al. 2013; De Almeida and Eid 2014; Chalmers et al. 2020). In general, taking all of the above into account, a firm's total risk can be one of the influencing factors in the choice of working capital strategies. In other words, the appropriate level of working capital for companies varies across markets and is significantly influenced by prevailing economic conditions and firm-specific dangers. As a result, managers adopt strategies that enable them to manage these risks effectively. In this regard, Le (2019) not only found a negative correlation between net working capital and risk, but also realized that managers must make a trade-off between their objectives for profitability and risk control.

3. Research Methodology

The study sample consists of 200 manufacturing firms listed on the Tehran Stock Exchange (TSE) over a six-year period from 2016 to 2021. The data-gathering method is descriptive-correlation research and targets the applied research category in terms of purpose. When a set of cross-sectional variables is selected randomly over a period, an investigation deals with panel data (Tarighi et al. 2023). Accordingly, the data collected for multiple firms over a specific period in the present study are referred to as longitudinal, pooled, or panel data. As the panel data contain both time-series and sectional aspects, the use of appropriate statistical explanatory models that describe the specifications of the variables is more difficult than the models used in sectional and time-series data (Moradi et al. 2021; Tarighi et al. 2023). All statistical tests in this research were conducted using Eviews 12 software and based on the latest econometric principles. First, the normality of the distribution of observations was evaluated using the Jarque–Bera test. In the second step, the F-Limer (Chow) test was used to evaluate the suitability of the research model for the ordinary least squares (OLS) or panel data method. If needed, the Hausman test was conducted to determine whether panel data should be estimated with fixed effects or random effects. The Durbin–Watson and Breusch–Godfrey tests were also used to investigate the problems of serial autocorrelation among residuals. The variance inflation factor (VIF) was employed to analyze the severity of multicollinearity, whereas the white test was carried out to explore heteroskedasticity issues as well.

3.1. Research Sample

The study sample of this research is all the manufacturing companies listed on the TSE during the period 2016–2021. In this study, to determine the sample size, the systematic elimination method was used based on the following criteria:

- The audited financial information of each of the companies under study must be available.
- The financial periods of companies should be finished at the end of the solar year (20 March).

- The companies should not have changed their fiscal year during the study period, and they should not have had more than six months' trading halts.
- Building on the research time (2016–2021), the company should be listed on the Tehran Stock Exchange before the year 2016, and its name is not removed from the listed companies by the end of 2021.
- The type of business activity should be productive; hence, our sample excludes investment companies, leasing companies, credit institutions, financial institutions, and banks, as they have different reporting and ownership structures.

Taking into account the conditions listed in Table 1 that have been used in many local studies (Salehi et al. 2020; Moradi et al. 2021; Tarighi et al. 2023; Dashtbayaz et al. 2023), a sample size of 200 manufacturing firms was selected.

Table 1. The study limitations.

Limitations	Firms
All listed firms on the Tehran Stock Exchange (TSE) by the end of March 2021	483
Investment firms, leasing, credit, and financial institutions, and banks	(88)
Companies that have more than six months' trading halt or have changed fiscal year during the period under study	(116)
Companies whose information is not available or have been removed from the stock exchange	(79)
The remaining firms in the sample	200

3.2. Research Model and Variables

For more than a decade, the Iranian market has been subject to severe economic sanctions, which have severely disrupted the efficiency of manufacturing companies (Moradi et al. 2021; Tarighi et al. 2023; Farzanegan and Batmanghelidj 2024). The World Bank's Iran Economic Monitor (IEM) report also stated that Iran's manufacturing sector faces the risk of escalating social tensions and strikes. These sanctions have made it difficult for Iranian firms to access international markets, which has led to a decline in their competitiveness and profitability. The sanctions have made risk and compliance management more complex and difficult for firms and organizations. In summary, economic sanctions can increase a firm's total risk by hurting its financial performance, decreasing its leverage and increasing its cash holdings, impacting specific industries, affecting employment and production, and introducing external risks to the economy (Ghasseminejad and Jahan-Parvar 2021; Farzanegan and Batmanghelidj 2024; Roudari et al. 2023). Companies are generally exposed to two risks, systematic and idiosyncratic, and the combination of both risks refers to a firm's total risk (Ross et al. 2016; Le 2019; Nirino et al. 2022). In addition, the coronavirus crisis as a systematic risk has also messed up the cycle of economic activities worldwide, making it difficult for companies to obtain sufficient liquidity (Zimon and Tarighi 2021). Due to the special importance of these two serious consequences, the present study employs the COVID-19 crisis and a firm's total risk as independent variables. Actually, the main purpose of this research is to investigate the effects of the COVID-19 pandemic as well as a firm's total risk on working capital management strategies in an emerging market called Iran. To achieve the goal of this research, the following research model was designed:

$$WC M_{it} = a_0 + a_1 COIVD19_{it} + a_2 Firm Risk_{it} + a_3 Firm Size_{it} + a_4 Firm Age_{it} + a_5 Sale Growth_{it} + a_6 Tobin Q_{it} + a_7 Tangibility_{it} + a_8 Dividends_{it} + a_9 \Delta GDP_{it} + Year Index + Industry Index + \varepsilon_{it}$$

Here, WCM is defined as our dependent variable. By reviewing the existing literature, it can be found that various researchers have used the cash conversion cycle (CCC) (Nobanee et al. 2011; Amponsah-Kwatiah and Asiamah 2021; Sawarni et al. 2023; Rahman et al. 2024), net working capital (NWC) (El-Ansary and Al-Gazzar 2021; Bugshan et al. 2023; Sargon 2024), receivables and inventory turnover (Knauer and Wöhrmann 2013; Zimon and Tarighi 2021; Zimon et al. 2024), liabilities turnover (Zimon and Tarighi

2021; Kouaib and Bu Haya 2024), and other important ratios as a measure for evaluating working capital management (WCM). The noteworthy point is that repetitive use of a few proxies for WCM in most prior studies have been identified (Prasad et al. 2019). This study is among the first to comprehensively explore various working capital management strategies to gain a deeper understanding of liquidity, profitability, efficiency, and related concepts. In this study, we used different working capital strategies, including current assets to total assets ratio (CATAR), current liabilities to total assets ratio (CLTAR), current ratio (CR), quick ratio (QR), net working capital (NWC), cash to current assets (CTCA) ratio, cash-to-sales (CTS) ratio, cash conversion cycle (CCC), cash conversion efficiency (CCE), operational cycle (OC), days account receivables (DAR), days inventory (DI), and days account payables (DAP). In other words, these ratios and metrics are essential tools for managing working capital and ensuring a company's short-term financial health and operational efficiency. By monitoring and analyzing these ratios, businesses can make informed decisions about spending, investment, and resource allocation to optimize their working capital management strategies.

With respect to control variables, different items, such as GDP, firm size, firm age, sales growth, dividends, and tangible assets, are regarded as the control variables. In general, each variable was chosen in this study based on its theoretical relationship with working capital management strategies. For example, to evaluate the influence of economic sanctions on the Iranian market, the gross domestic product (GDP) can be used; for the more severe the economic sanctions are, the more GDP is likely to fall (Moradi et al. 2021). As the economic conditions of each market can affect the riskiness for the firm and the type of working capital management strategy employed (Nazir and Afza 2009; Akbar et al. 2021), we controlled for the effect of GDP as a macroeconomic variable. As far as we know, firms in emerging markets may face unique challenges, such as market uncertainty and limited access to financing, which can impact their working capital management strategies (Abuzayed 2012). Smaller firms may have limited resources and struggle to maintain optimal levels of working capital, and they may face higher costs of borrowing and be more cautious in taking on debt, while larger firms may have more resources to manage their debt (Mansoori and Muhammad 2012; Li et al. 2014). Given that firm size can affect the operating and market risk of firms and their WC management policy (Akbar et al. 2021), firm size is considered a control variable. Since firm age is a measure of a firm's creditworthiness to its suppliers of debt and equity and can affect the cost of granting trade credit (Niskanen and Niskanen 2006), it relates to WC management (Baños-Caballero et al. 2010; Singh and Kumar 2017). It appears that a company's age and experience may reduce the impact of systematic and operational risks, which in turn may affect its choice of working capital strategy (Akbar et al. 2021). Furthermore, companies with a higher sales rate may benefit from adopting a strategy that focuses on investing in working capital (Abuhommous 2017; Rodeiro-Pazos et al. 2023). Growth opportunities allow a company to fund growth without taking on additional external debt that comes with interest costs, improving its creditworthiness and making it easier to obtain loans and other forms of credit. For example, to accelerate sales growth, firms may offer credit to customers, which can increase the amount of investment in receivables (Singh and Kumar 2017), or firms need to build up inventories to anticipate future sales (Kieschnick et al. 2006). As a result, higher sales growth reduces the risk for the firm and can affect WC management policy (Akbar et al. 2021). Tobin's Q is a measure of a firm's investment opportunities (Tarkom 2022). It should be noted that a higher Tobin's Q is associated with a firm's stock being more valuable than the replacement cost of its assets, which can lead to increased operating risk and systematic risk (Lin et al. 2018; Akbar et al. 2021; Lim and Mali 2023). This may suggest that the market is overvaluing the company or market, which could lead to increased competition and potential overvaluation or mispricing. This, in turn, could increase the potential default risk for investors and potentially affect credit ratings. As a result, companies may need to adjust their working capital management policies to ensure that they have sufficient liquidity to meet their obligations and maintain investor confidence. Additionally, a higher Tobin's Q

ratio may indicate that the company or market is experiencing a period of overvaluation, which could be a sign of a potential bubble or an extended period of undervaluation (Hoyt and Liebenberg 2011). In this case, companies may need to be more cautious in their working capital management policies to avoid overinvesting in assets that may not be sustainable in the long term. Finally, a higher Tobin's Q ratio may indicate that the market is pricing future growth potential or intangible assets that are not reflected in the company's book value. In this case, companies may need to adjust their working capital management policies to ensure that they are investing in the right assets and effectively managing their cash flow to support future growth (Bolton et al. 2011; Hingurala Arachchi et al. 2017). Hence, for the aforementioned reasons, since Tobin's Q ratio is related to operational and market risks and affects the working capital of firms (Singh and Kumar 2017; Akbar et al. 2021), this research has controlled for the effect of Tobin's Q index on working capital management policy. In addition, according to Fazzari and Petersen (1993), investing in tangible fixed assets will reduce the funds available for working capital in times of financial constraints. Various studies have also highlighted the role of tangible assets of a firm in WC management (Wasiuzzaman and Arumugam 2013; Singh and Kumar 2017; Tarkom 2022; Lefebvre 2023). Finally, in an inflationary economy and an unbridled market, one of the ways to attract more investors' trust is to convey a good picture of firms' financial position to the outside by paying dividends (Salehi et al. 2019). When a company declares a dividend, it must record a liability on the balance sheet; thus, this accounting treatment reflects the short-term financial obligation created by the declaration of the dividend and its effect on the company's working capital position (Karimi 2020). A higher dividend payout ratio may lead to a reduction in retained earnings, affecting a company's ability to finance operations and investments and potentially requiring more efficient working capital management to ensure sufficient liquidity. The dividend ratio can influence working capital management policies by affecting liquidity, profitability, and the balance between distributing profits to shareholders and retaining earnings for future investments (Oladipupo and Ibadin 2013; Ikunyua 2020; Yakubu 2021). In short, Table 2 shows how to calculate and define all the variables in this research.

Table 2. Definition of the variables.

Variable	Type	Measurement
CATAR	Dependent	The working capital investment policy is calculated by current assets to total assets ratio (CATAR) (Nazir and Afza 2009; Ahmad et al. 2022).
CLTAR	Dependent	The working capital financing policy is measured by current liabilities to total assets ratio (CLTAR) (Nazir and Afza 2009; Ahmad et al. 2022).
CR	Dependent	Current ratio (CR) is calculated by dividing current assets by current liabilities (Akbar et al. 2021; Zimon and Tarighi 2021; Hashmi and Iqbal 2022; Naz et al. 2022).
QR	Dependent	Quick ratio (QR) is obtained from the sum of cash, receivables, and short-term investments divided by debts (Akbar et al. 2021; Zimon and Tarighi 2021; Zhang and Xi 2024).
NWC	Dependent	Net working capital (NWC) ratio is equal to current assets minus current liabilities divided by total assets (Le 2019; Ahmad et al. 2022).
CTCA	Dependent	It represents cash to current assets ratio (Akbar et al. 2021).
CTS	Dependent	It shows cash-to-sales ratio (Akbar et al. 2021).
CCE	Dependent	It represents the ratio of operating cash flow to sales (Naz et al. 2022)
CCC	Dependent	The cash conversion cycle (CCC) equals the sum of days inventory outstanding and days sales outstanding minus days payables (Singh and Kumar 2017; Le 2019; Tarkom 2022; Hashmi and Iqbal 2022; Zimon et al. 2024).
OC	Dependent	The operating cycle (OC) is the time it takes for a business to receive inventory, sell the inventory, and collect cash from the sale of the inventory (Zimon and Tarighi 2021; Chen et al. 2023; Lin et al. 2023).

Table 2. Cont.

Variable	Type	Measurement
DAR	Dependent	Days account receivables (DAR) is obtained from the ratio of account receivables to sales multiplied by 365 (Le 2019; Akbar et al. 2021; Zimon and Tarighi 2021; Hashmi and Iqbal 2022).
DI	Dependent	Days inventory (DI) is obtained from the ratio of inventory to sales multiplied by 365 (Le 2019; Akbar et al. 2021; Zimon and Tarighi 2021; Hashmi and Iqbal 2022).
DAP	Dependent	Days account payables (DAP) is obtained from the ratio of account payables to sales multiplied by 365 (Le 2019; Akbar et al. 2021; Zimon and Tarighi 2021; Hashmi and Iqbal 2022).
COVID-19 crisis	Independent	COVID-19 is a dummy variable that equals one if it is during the COVID-19 pandemic, and zero otherwise (Zheng et al. 2022; Tarkom 2022; Tarighi et al. 2023; Almustafa et al. 2023).
Firm Risk	Independent	Firm risk is equal to the annualized standard deviation of a firm's daily stock returns (Coles et al. 2006; Aktas et al. 2015; Le 2019; Gupta and Chaudhary 2023; Almustafa et al. 2023; Cho et al. 2024).
Firm Size	Control	The natural logarithm of a company's total assets (Singh and Kumar 2017; Moradi et al. 2021; Akbar et al. 2021; Tarkom 2022; Zimon et al. 2024).
Firm Age	Control	The number of years of company activity (Singh and Kumar 2017; Le 2019; Akbar et al. 2021; Hashmi and Iqbal 2022; Naz et al. 2022; Almustafa et al. 2023).
Sale Growth	Control	It is the rate of change in sales from the previous year to the current year (Singh and Kumar 2017; Akbar et al. 2021; Tarkom 2022; Naz et al. 2022).
Tobin Q	Control	The ratio of Tobin Q equals to the market value of equity to book value of total assets (Akbar et al. 2021; Tarkom 2022; Ahmad et al. 2022).
Tangibility	Control	Tangibility shows the ratio of property, plant, and equipment to total assets (Singh and Kumar 2017; Tarkom 2022).
Dividends	Control	Dividends represent the payments a firm makes to its shareholders as a return on the company's profits (Le 2019; Buerthey et al. 2024; Al-Hiyari et al. 2024).
Δ GDP	Control	It is equal to the current year's gross domestic product (GDP) minus the previous year's GDP divided by the previous year's GDP (Nazir and Afza 2009; Akbar et al. 2021; Moradi et al. 2021; Ahmad et al. 2022; Angosto-Fernández and Ferrández-Serrano 2024).

4. Results

4.1. Descriptive Statistics

The descriptive statistics quantitatively describe the features of a dataset (Ding et al. 2021; Dashtbayaz et al. 2023). Table 3 presents the descriptive statistics results, including the mean, median, standard deviation, minimum, and maximum.

From an econometric point of view, since probability of the Jarque–Bera test for all variables is more than five percent, it can be concluded that the normal distribution of observations is fulfilled. What stands out from Table 3 is that, on average, the gross domestic product (GDP) of the Iranian market has grown by almost 1% a year, and these small changes are partly due to the uncertain economic environment arising from sanctions. The heavy shadow of these severe economic sanctions can be felt on Iranian manufacturing companies, as it has reached a firm's overall risk of 0.3262 on average. Fluctuations in the Iranian market are so intense that a minimum value of -74% and a maximum of 155% can be found in sales growth. The result of Tobin's Q ratio is completely different and shows that ideal investment opportunities have been created. During economic crises, more profitable investment opportunities are found in exchange for accepting more risk (Zimon and Tarighi 2021). Since the Tobin Q index is 2.14, and greater than 1, it is a clear example of the existence of investment opportunities for companies. Given that the average value of Tobin's Q is greater than 1, the shares of Iranian companies appear to be more

expensive than the replacement cost of their assets, implying that the stocks are overvalued. As for WC policies, the average of the two variables CATAR and CLTAR is 0.65 and 0.45, respectively, indicating that Iranian firms are more inclined towards a working capital investment policy. It should be noted that 45% of the assets of sample firms are financed by external debt, for the interest rate in Iran has been constant at around 18% for most of the recent years. Furthermore, the mean value of DI is 93 days, which is quite large and reveals that the sample firms are facing problems converting their inventory into sales. Moreover, on average, sample firms collect their receivables in 125 days, which indicates a lack of necessary liquidity in the market. As such, these enterprises make payments to the creditors in 77 days, which has taken less time compared to receivables collection and inventory conversion. On average, ample firms take 141 days to convert their working capital accounts into cash, which is a very long time. Regarding cash ratios, firms keep 6% of their assets in cash on average and maintain 4.4% of sales value in the form of cash. Finally, the sample companies have an average of more than 4 decades of continuous activity in the market.

Table 3. Descriptive statistics.

Variable	Mean	Median	S. Deviation	Max	Min	Prob. Jarque–Bera
Firm Risk	0.3262	0.3067	0.1341	0.4974	0.0028	0.1860
CCE	0.1377	0.1159	0.3489	0.5474	−0.2661	0.2703
CCC	141.3017	111.1320	118.4974	511.2899	−215.8709	0.3599
OCFTTA	0.1094	0.0934	0.1433	0.4297	−0.2109	0.6951
CR	1.4936	1.4054	2.1706	3.3203	0.2093	0.5017
QR	0.8246	0.7487	2.0965	2.2232	0.0700	0.4248
CATS	0.8142	0.7262	2.2349	2.0759	0.0461	0.1309
CTCA	0.0611	0.0468	0.0826	0.2143	0	0.0752
CTS	0.0445	0.0345	0.1274	0.1593	0	0.1823
DAR	124.9108	94.9612	180.8803	445.2167	0	0.7165
DI	92.5264	85.1588	226.3007	259.4266	0	0.1372
DAP	77.2270	68.1559	218.6438	237.9055	0.9871	0.0801
OC	233.9864	199.2639	356.0947	656.6924	14.7019	0.1634
NWC	0.2015	0.2045	0.2401	0.7336	−0.3655	0.8308
CATAR	0.6492	0.6667	0.2090	0.9863	0.0284	0.4216
CLTAR	0.4503	0.4499	0.2082	1.0254	0.0134	0.6197
Firm Size	15.0434	14.9285	1.5971	19.0027	11.3610	0.2536
Firm Age	41.7667	43	13.6939	71	10	0.5031
GROWTH	0.4049	0.3701	1.1898	1.5500	−0.7400	0.2453
Tobin Q	2.1416	1.5997	4.7525	7.4833	0.1245	0.3357
Dividends	0.0772	0.0678	0.1231	0.2903	−0.1378	0.1404
Tangibility	0.2426	0.2014	0.1897	0.7724	0	0.0701
ΔGDP	0.0110	−0.0361	0.2628	0.4978	−0.3261	0.7209

4.2. F-Limer and Hausman Tests

In finance and accounting research, when data on several companies are collected for a specific period of time, we generally deal with longitudinal data (pooled or panel), which makes it necessary to first determine the type of model assessment (Salehi et al. 2020; Moradi et al. 2020; Tarighi et al. 2022; Arianpoor and Mehrfard 2023). According to the principles of econometrics, the first step should be to perform the F-Limer (Chow) test to determine precisely whether the research model should be estimated using ordinary least squares (OLS) or panel data. The null hypothesis (H0) in the Chow test assumes that the coefficients estimated for individual cross-sections and individual masses are not different, which means that there is no need to estimate the model using panel data (De Jager 2008; Moradi et al. 2021; Zimon et al. 2021; Tarighi et al. 2022; Ajam et al. 2023). If the null hypothesis of this test is confirmed, there is no need to perform the Hausman test; otherwise, the Hausman test must be performed in the second step to determine whether a fixed effects panel or a random effects panel should be used (Tarighi et al. 2022). In general,

the outcomes of the F-Limer test for all research models of this study show that the p -value of the H0 is greater than five percent, highlighting the fact that the OLS method is accepted and it is no longer necessary to do the Hausman test.

4.3. Heteroskedasticity and Multicollinearity Tests

The absence of heteroskedasticity is another key assumption of a regression model (Tarighi et al. 2022). When heteroscedasticity is present, consistent estimation results of coefficients that are not effective will be produced (Zimon et al. 2021; Moradi et al. 2021). To examine the issue of heteroskedasticity, this study takes the white test. As a result, given that the p -value of the white test for all models in this research is more than 5%, it can be concluded that there is no heteroskedasticity problem. Additionally, the variance inflation factor (VIF) can be used to explore the severity of multicollinearity in a regression analysis. It should be noted that when the VIF of the estimated model coefficients is less than 10, no linearity problem can be concluded (Thompson et al. 2017; Zimon et al. 2021; Tarighi et al. 2022; Na et al. 2024). According to the results obtained from the VIF in the last column of Table 4, it can be understood that the linearity problem does not exist in this study.

Table 4. The results of the first model.

Variable	Coefficient	Std. Error	T-Statistic	p -Value	MM-Estimation	VIF
C	1.2110	0.0449	26.9376	0.0294 **	0.9956 ***	---
COVID-19	0.0504	0.0109	4.6170	0.0000 ***	0.8014 ***	1.6621
Firm Risk	0.6088	0.3060	1.9895	0.0468 *	0.1145 **	1.1045
Firm Size	−0.0269	0.0026	−10.0038	0.0497 *	−0.0008 *	1.2328
Firm Age	0.0002	0.0002	0.8447	0.3984	0.0301	1.0283
Sale Growth	−0.0053	0.0034	−1.5626	0.1183	−0.0029	1.0307
Tobin Q	−0.0014	0.0009	−1.5652	0.1177	−0.0132	1.2411
Tangibility	−0.7910	0.0214	−36.9029	0.0218 **	−0.9940 ***	1.0370
Dividends	0.0834	0.0332	2.5117	0.0121 ***	0.0419 *	1.0491
GDP	0.0027	0.0181	0.1525	0.8787	0.0044	1.4288
Year Index	Yes					
Industry Index	Yes					

Dependent Variable: CATAR; Method: OLS Regression; Adjusted R-squared: 0.5378; F-statistic: 4.621; Prob. (F-statistic): 0.0000; Probability of F-Limer Test: 0.3911; Probability of Heteroskedasticity Test (White): 0.2039; Durbin–Watson Stat: 1.8396; Probability of Breusch–Godfrey Test: 0.1827. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level: 99% (***).

4.4. Serial Correlation Test

According to one of the most important assumptions of a regression model, error sentences should not be correlated meaningfully (Zimon et al. 2021; Tarighi et al. 2023). When errors are correlated with each other, serial autocorrelation occurs (Nuță et al. 2024). Durbin–Watson and Breusch–Godfrey tests are usually used to explore the issue of serial autocorrelation among residuals (Savin and White 1977; Muhammad et al. 2021; Tarighi et al. 2022; Li et al. 2023). In this study, the Durbin–Watson test is used to investigate the low level of serial autocorrelation (Lag 1) in residuals, whereas the Breusch–Godfrey test is done to examine higher levels of serial autocorrelation (Lag 2). Overall, as the outputs of the Durbin–Watson test in the research models are between 1.5 and 2.5, the error terms do not have serial autocorrelation (Lag 1). We also did not find any problem with the serial autocorrelation (Lag 2) in the residuals due to the p -value of the Breusch–Godfrey tests being more than five percent.

4.5. Robustness Test

Robustness tests are a critical component of empirical research, particularly in the fields of finance and accounting. Robustness tests in EViews encompass a broader range of methods and tools, including robust regression techniques such as M-estimation, S-estimation, and MM-estimation, as well as stability diagnostics, leverage plots, influence

statistics, and formal outlier detection algorithms. These tests are designed to assess the reliability and validity of research findings by examining how sensitive the results are to changes in assumptions, models, or data. In essence, robustness tests aim to ensure that the conclusions drawn from a study are not dependent on specific conditions or assumptions. Overall, EViews software offers a range of robust regression techniques, including M-estimation, S-estimation, and MM-estimation that enhance the robustness of empirical analyses by mitigating the impact of outliers on regression estimates (Qu 2021). These methods play a crucial role in ensuring the validity and stability of research findings in econometrics and applied economics. In the robust regression approach, if the dependent variable has an outlier observation, M-estimation is used, and when the independent variables have an outlier observation, S-estimation is used. Additionally, if both independent and dependent variables have an outlier observation, MM-estimation can be employed. In this study, we used the MM-estimation technique to see if there is a difference between the MM-estimation results and our research findings. Hence, since no important difference was found between MM-estimation results and our research findings, it can be concluded that outliers in the data do not significantly impact the regression estimates and indicate the absence of influential outliers affecting the results. Accordingly, the results of this study are reliable because, under different circumstances, when the effects of outliers were minimized, the results did not differ from the research findings.

4.6. The Results of the Research Models

As previously stated, each working capital policy has its own benefits and costs, in line with the trade-off theory (Ahmad et al. 2022; Kayani et al. 2023). When firms adopt an aggressive working capital investment policy, they obtain sufficient liquidity but at the cost of low sales, while a conservative working capital investment strategy can lead to an improvement in sales and profitability but at the cost of high interest expenses and insufficient liquidity (Nazir and Afza 2009; Aktas et al. 2015; Ahmad et al. 2022). Similarly, an aggressive working capital financing policy is highly risky but at the cost of low interest expenses, while conservative working capital financing protects liquidity but reduces profitability due to the cost of high interest expenses (Ahmad et al. 2022). As a result, managers of companies ultimately decide whether to prioritize sufficient liquidity or to prioritize sales and profitability based on prevailing economic conditions in each market (Merville and Tavis 1973; Filbeck and Krueger 2005; Nazir and Afza 2009; Dash et al. 2023). During the past decade, the Iranian market has faced severe economic sanctions, which have increased company risk strikingly (Moradi et al. 2021; Tarighi et al. 2023). Meanwhile, the COVID-19 pandemic has imposed severe limitations and risks on manufacturing companies across various industries (Didier et al. 2021; Achim et al. 2022; Tarkom 2022; Tarighi et al. 2023; Hassan et al. 2023; Zimon et al. 2024). In the first step, the aim of this research is to investigate whether the COVID-19 pandemic and firm risk in Iran's emerging market have led to significant changes in managers' adoption of working capital investment and financing policies. In general, the results of the first and second models are shown in Table 4 and Table 5, respectively.

What stands out from the research model summary is that the model of this research should be estimated based on the ordinary least squares (OLS) regression model thanks to the F-Limer (Chow) test results. Furthermore, our evidence proves that there is no heteroskedasticity problem because the p -value of the white test is 0.2039 and more than five percent; besides, the linearity problem also does not exist, for the VIF of the estimated model coefficients in the last column is less than 10. Regarding the issue of serial autocorrelation among residuals, we can note that as the output of the Durbin–Watson test in this research model is 1.8396 (between 1.5 and 2.5), the error terms do not have serial autocorrelation (Lag 1), while the p -value of the Breusch–Godfrey test being 0.1827 and more than five percent does not confirm any signal of the serial autocorrelation (Lag 2) in the residuals. Finally, since the p -value calculated for the F-statistic is zero and less than 0.05, the significance of the whole model can be confirmed at the 5 percent error level.

Table 5. The results of the second model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	0.6832	0.0582	11.7199	0.0691	0.8349 *
COVID-19	−0.0526	0.0141	−3.7169	0.0002 ***	−0.0452
Firm Risk	−0.3067	0.3968	−0.7731	0.4395	−1.5599
Firm Size	−0.0035	0.0034	−1.0229	0.3065	−0.0057
Firm Age	−0.0003	0.0003	−0.9162	0.3597	−0.0001
Sale Growth	−0.0157	0.0044	−3.5542	0.0003	−0.0239
Tobin Q	−0.0069	0.0012	−5.7454	0.0297 **	−0.0121 ***
Tangibility	−0.2297	0.0277	−8.2671	0.0424 *	−0.3852 ***
Dividends	−0.6478	0.0430	−15.0408	0.0180 ***	−1.6791 ***
GDP	0.0524	0.0235	2.2279	0.0260 *	0.0618
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: CLTAR; Method: OLS Regression; Adjusted R-squared: 0.4902; F-statistic: 16.7795; Prob. (F-statistic): 0.0001; Probability of F-Limer Test: 0.1203; Probability of Heteroskedasticity Test (White): 0.4295; Durbin–Watson Stat: 1.9304; Probability of Breusch–Godfrey Test: 0.5368. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level (***): 99% (***).

The results show that both the COVID-19 crisis and firm risk have made Iranian managers more willing to adopt the working capital investment policy, which is in line with a conservative approach. This implies that to manage and control the threats associated with a firm’s risks and the unpredictable COVID-19 crisis, companies prefer to adopt an investment working capital strategy, leading to ensuring sufficient financial flexibility to react appropriately. Due to their wider share distribution and ownership profile, larger firms have less information asymmetry and more access to funding options, as well as stronger growth prospects (Sulong et al. 2013). Therefore, they are predicted to require less liquidity and may not prioritize the adoption of a WC investment strategy. Consistent with our expectations, our findings confirm a negative relation between firm size and the CATAR variable, for larger businesses have more access to information resources to create economically added value and are less subject to liquidity shortage. In addition, there is a negative correlation between tangibility and WC investment policy. This means that when faced with financial constraints, investing more in tangible fixed assets will inevitably decrease the funds available for working capital (Fazzari and Petersen 1993; Baños-Caballero et al. 2010; Singh and Kumar 2017). Finally, our evidence strongly confirms that the ratio of current assets to total assets increases as companies pay dividends to their shareholders.

As for WC financing policy, we found that COVID-19 substantially decreased the ratio of current liabilities to total assets, while the destructive effects of company risk were not statistically significant. Actually, our findings are consistent with the idea that firms prioritize precautionary measures and maintain financial flexibility in the face of the unprecedented and unpredictable impact of the pandemic on their operations and financial stability (Haque and Varghese 2021). The COVID-19 pandemic has increased cash flow risk across the supply chain, making it difficult for firms to determine whether producers are able to operate at full capacity or whether buyers actually want the goods produced. This heightened uncertainty may have led firms to avoid working capital financing to reduce their exposure to cash flow risk. Firms may be reducing their current liabilities to avoid the risk of default and financial distress, which can be exacerbated by the economic challenges posed by the pandemic (Qadri et al. 2023). However, the lack of significance of the firm risk coefficient may be due to effective risk management strategies implemented by firms to ensure their financial obligations remain stable even in the face of increased risks. Sound financial planning and management practices could also have helped firms maintain their current liabilities unaffected by firm risk. Furthermore, the increase in current assets due to firm risk may have provided firms with additional liquidity, allowing them to cover their short-term obligations without the need to adjust their current liabilities.

Regarding the control variables, we also found a negative association between Tobin's Q index and CLTAR. In fact, the more growth opportunities companies have, the less current liabilities they use. This may be because they are better able to secure financing through the issuance of shares, internal cash generation, or long-term borrowing. Moreover, using fewer current liabilities can indicate effective capital management and reduce financial risk. Also, evidence shows a positive relationship between GDP and CLTAR. This could be attributed to the fact that a stronger economic situation enables companies to acquire facilities and credit from banks and external sources with ease, thereby allowing them to make more investments. Additionally, the use of current liabilities can help companies take advantage of short-term investment opportunities and increase profitability.

Despite the difficulties arising from the complicated connection between profitability and liquidity, especially in times of financial crisis, one of the key factors for a company's success is the ability to effectively manage financial liquidity. The liquidity ratio consists of two parts, namely the current ratio and the quick ratio (Zimon and Tarighi 2021). The liquidity ratio indicates a company's ability to meet its financial obligations (Akbar et al. 2021; Dziwok and Karaś 2021; Wiśniewski 2022). Thus, we seek to investigate whether the effects of the COVID-19 crisis and firm risk have led to drastic changes in the liquidity policies of manufacturing firms in Iran. Accordingly, the results of the third and fourth models are presented in Table 6 and Table 7, respectively.

Table 6. The results of the third model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	1.9800	0.6606	2.9971	0.0027 ***	0.9702 ***
COVID-19	0.3861	0.1604	2.4065	0.0162 ***	0.9327 **
Firm Risk	1.8324	4.4967	0.4075	0.6837	2.4198
Firm Size	−0.0303	0.0395	−0.7655	0.4440	−0.0249
Firm Age	0.0084	0.0043	1.9515	0.0512	0.0007
Sale Growth	0.1738	0.0500	3.4717	0.0005 ***	0.0149 *
Tobin Q	0.0258	0.0137	1.8768	0.0607	0.0174
Tangibility	−1.9647	0.3149	−6.2376	0.0025 ***	−0.5444 ***
Dividends	2.5456	0.4880	5.2155	0.0013 ***	4.5315 ***
GDP	−0.4013	0.2668	−1.5038	0.1328	−0.2435
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: CR; Method: OLS Regression; Adjusted R-squared: 0.3802; F-statistic: 22.5288; Prob. (F-statistic): 0.0003; Probability of F-Limer Test: 0.4382; Probability of Heteroskedasticity Test (White): 0.6480; Durbin-Watson Stat: 2.1305; Probability of Breusch-Godfrey Test: 0.2639. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level (***): 99%.

The coronavirus crisis, a type of systematic and unpredictable risk, has caused a significant increase in the current ratio of companies. However, there has been no significant effect on the quick ratio. The current ratio includes all current assets, while the quick ratio only contains highly liquid assets. Therefore, the quick ratio is considered more conservative than the current ratio. It can be inferred that, given the country's poor economic conditions, Iranian companies have adopted a moderately conservative policy. This policy includes not only cash but also other current assets, such as inventory and accounts receivable, which can aid in the growth of companies. Looking at the details, it can be understood that companies with superior sales growth and higher dividend payouts to shareholders tend to have better short-term liquidity ratios. On the other hand, a negative association between the tangible assets of firms and quick and current ratios has been seen. In other words, tangible fixed assets, such as equipment or other physical assets, are not easily convertible into cash. Therefore, an increase in tangible fixed assets may cause an increase in non-current assets and a decrease in the current ratio. This indicates that these firms are using more of their fixed assets for investment, which may reflect management approaches or specific industry conditions.

Table 7. The results of the fourth model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	0.0386	0.6234	0.0619	0.9506	0.1165
COVID-19	0.1128	0.1342	0.8403	0.4008	0.6714
Firm Risk	0.4455	4.2922	0.1038	0.9173	2.0925
Firm Size	0.0452	0.0379	1.1929	0.2331	0.0575
Firm Age	0.0082	0.0043	1.8955	0.0582	0.0030
Sale Growth	0.1318	0.0500	2.6344	0.0085 ***	0.0436 **
Tobin Q	0.0192	0.0127	1.5017	0.1334	0.0112
Tangibility	−1.8150	0.3075	−5.9014	0.0005 ***	−0.3341 **
Dividends	1.8783	0.4749	3.9548	0.0000 ***	2.2619 *
GDP	−0.3863	0.2619	−1.4750	0.1404	−0.1407
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: QR; Method: OLS Regression; Adjusted R-squared: 0.2104; F-statistic: 21.9157; Prob. (F-statistic): 0.0024; Probability of F-Limer Test: 0.1703; Probability of Heteroskedasticity Test (White): 0.3615; Durbin–Watson Stat: 2.0031; Probability of Breusch–Godfrey Test: 0.4164. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level: 99% (***).

The net working capital (NWC) ratio is an important financial metric that helps assess a company’s ability to meet its short-term obligations and fund its operations (Wang et al. 2020; El-Ansary and Al-Gazzar 2021; Sargon 2024). The net working capital ratio is often used in conjunction with other financial ratios, such as the current ratio or quick ratio, to assess a company’s liquidity and short-term financial health. In addition to the current and quick ratios, this study also considers net working capital (NWC) as another measure of short-term financial health. This study aims to investigate whether firm risk and the COVID-19 pandemic have put pressure on financial managers to make substantial changes in the NWC strategy. Therefore, the results of the fifth model are shown in Table 8.

Table 8. The results of the fifth model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	0.5278	0.0568	9.2921	0.0097 ***	0.6125 ***
COVID-19	0.1030	0.0137	7.4685	0.04342 *	0.7395 *
Firm Risk	0.9155	0.3866	2.3676	0.0180 ***	0.6947 **
Firm Size	−0.0233	0.0034	−6.8674	0.0015 ***	−0.0286 ***
Firm Age	0.0006	0.0003	1.6082	0.1080	1.2301
Sale Growth	0.0103	0.0043	2.4107	0.0160 ***	0.0241 **
Tobin Q	0.0055	0.0011	4.6572	0.0000 ***	0.0050 ***
Tangibility	−0.5612	0.0270	−20.7217	0.0045 ***	−0.3777 ***
Dividends	0.7312	0.0419	17.4232	0.0282 **	2.0297 ***
GDP	−0.0497	0.0229	−2.1658	0.0305 *	−0.0947 ***
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: NWC; Method: OLS Regression; Adjusted R-squared: 0.7109; F-statistic: 42.6503; Prob. (F-statistic): 0.0001; Probability of F-Limer Test: 0.4233; Probability of Heteroskedasticity Test (White): 0.6824; Durbin–Watson Stat: 2.2481; Probability of Breusch–Godfrey Test: 0.1955. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level: 99% (***).

Both the coronavirus crisis and a firm’s total risk have forced managers to adopt a higher NWC policy that can both meet their short-term financial obligations and provide sufficient resources to continue operations. The reason why companies have adopted a higher NWC policy during the COVID-19 pandemic can be due to the need for firms to fund their operational needs, address liquidity constraints, and protect against future cash flow shocks. The pandemic has resulted in reduced corporate revenues and increased cash flow fluctuations, which have had an adverse impact on economic activity (He et al. 2022b). In such uncertain economic conditions, companies have faced challenges such as declining profits, liquidity constraints, and the need to continue paying employees, debtors,

and suppliers despite reduced revenues, leading companies to maintain higher levels of working capital to fund their operational needs and ensure liquidity. Besides, to safeguard against future negative cash flow shocks and to address the limited access to credit for companies with higher default probabilities, firms tend to create and maintain larger liquidity buffers consisting of cash and short-term assets (Demary et al. 2021). This focus on liquidity and cash management contributed to the higher net working capital ratios observed during the COVID-19 pandemic. As for firm risk, one of the most important reasons why high-risk companies adopt a policy based on a high net working capital ratio can be that it may signal to investors and lenders that the firm is managing its risks effectively and is less likely to default on its debt obligations, which can lead to a higher credit rating. It is also necessary to mention this key point that the net working capital ratio can be influenced by various factors, such as industry, business cycle, size, and growth stage (Çelik et al. 2016). Considering the severe economic sanctions that have had destructive effects on all manufacturing industries in the Iranian market, those firms operating in industries with high risk or facing cyclical challenges seem to have chosen higher net working capital ratios to manage their risks and maintain financial stability. With respect to the control variables, it can be noted that there is a negative linkage between firm size and NWC. It looks like larger firms generally have better access to capital and can more easily obtain loans to finance their operations. As a result, these firms may have more resources to manage their cash flow and invest in growth opportunities. Also, by diversifying their operations, larger firms can better manage their cash flow and reduce the impact of fluctuations in specific industries or markets on their overall financial performance. We also find that sale growth and Tobin's Q are positively correlated with net working capital. Firms that experience superior sales growth may have greater opportunities to invest in growth projects and expand their operations (Li et al. 2014). A higher net working capital ratio can help these firms fund their growth initiatives and maintain a healthy balance between current assets and current liabilities. Firms with a higher Tobin's Q are often perceived to have higher growth and profit potential. This may lead to increased competition and the need for additional investment to capture market share, which can be supported by a higher net working capital ratio. It should also not be neglected that firms with higher Tobin's Q have more market power and seek to navigate the challenges posed by the pandemic and ensure their financial resilience. Given that tangible assets can generate cash flow through sales and other revenue streams and reduce the need for additional working capital to fund short-term obligations, our outputs witness a negative relationship between tangibility and NWC.

Cash to current assets (CTCA) ratio is another working capital strategy that reflects financial stability. Financial stability can be demonstrated by larger cash reserves relative to current assets, which can also help firms meet unexpected liquidity requirements (Akbar et al. 2021). Therefore, the sixth model of this study attempts to analyze whether the COVID-19 pandemic and firm risk could have encouraged Iranian firms to allocate more cash to their current assets. Consequently, the results of the sixth model in Table 9 are provided. Furthermore, a larger cash-to-sales (CTS) ratio indicates the availability of idle funds. Therefore, a negative correlation is expected between firm risk and market risk (Akbar et al. 2021). In Table 10, the seventh model of this study also aims to examine whether both the market risk arising from COVID-19 and the firm risk due to economic sanctions have caused firms to keep sufficient cash to generate sales to minimize these possible damages.

Whether during COVID-19 or when facing greater risk, firms are keen on having larger cash balances to be less shocked by unexpected events. Our results support the liquidity preference theory, which suggests that firms improve their liquidity position and financial flexibility to navigate through uncertain times. Furthermore, the positive relationship between property, plant, and equipment (PPE) and cash to current assets (CTCA) ratio can be elucidated by the illiquidity of PPE assets compared to other current assets. This tie-up of capital in illiquid assets can impact a company's ability to access cash quickly

to meet short-term obligations or unexpected cash needs. As a result, companies with a higher concentration of PPE in their asset mix may exhibit a higher CTCA ratio, reflecting a larger proportion of cash relative to their current assets. Considering all its merits, it should also be considered that businesses that keep larger cash volumes are deemed ineffective because idle cash does not earn any return (Akbar et al. 2021). When the country's economy is performing well and there is an increase in GDP, companies are less threatened by risks and have less desire to maintain a high ratio of CTCA. Exactly the negative and significant relationship between GDP and the CTCA ratio is a confirmation of such reasoning in the Iranian market.

Table 9. The results of the sixth model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	0.0247	0.0252	0.9786	0.3279	0.0362
COVID-19	0.0167	0.0061	2.7223	0.0065 ***	0.4037 ***
Firm Risk	0.3800	0.1719	2.2103	0.0272 *	0.0119 *
Firm Size	0.0006	0.0015	0.4416	0.6787	0.0003
Firm Age	−0.0001	0.0001	−0.8403	0.4008	−0.0025
Sale Growth	0.0012	0.0019	0.6573	0.5111	0.0024
Tobin Q	0.0027	0.0005	5.2760	0.0002 ***	0.0008 **
Tangibility	0.0705	0.0120	5.8556	0.0384 *	0.0714 ***
Dividends	0.0496	0.0186	2.6601	0.0079 ***	0.0793 **
GDP	−0.0264	0.0102	−2.5912	0.0096 ***	−0.0193 *
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: CTCA; Method: OLS Regression; Adjusted R-squared: 0.5611; F-statistic: 17.4111; Prob. (F-statistic): 0.0005; Probability of F-Limer Test: 0.1109; Probability of Heteroskedasticity Test (White): 0.1831; Durbin–Watson Stat: 1.6429; Probability of Breusch–Godfrey Test: 0.3752. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level (***): 99% (***).

Table 10. The results of the seventh model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	0.0992	0.0397	2.4985	0.0125 *	0.0291
COVID-19	0.0077	0.0096	0.8075	0.4196	0.0657
Firm Risk	0.2419	0.2703	0.8951	0.3708	0.0087
Firm Size	−0.0032	0.0023	−1.3477	0.1779	−0.0006
Firm Age	0.0001	0.0002	0.0579	0.9562	0.0304
Sale Growth	−0.0035	0.0030	−1.1792	0.2385	−0.0019
Tobin Q	0.0044	0.0008	5.3885	0.0007 ***	0.0725 **
Tangibility	−0.0069	0.0189	−0.3681	0.7128	−0.0286
Dividends	−0.0351	0.0293	−1.1975	0.2313	−0.0574
GDP	−0.0234	0.0160	−1.4647	0.1432	−0.0179
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: CTS; Method: OLS Regression; Adjusted R-squared: 0.1294; F-statistic: 45.7703; Prob. (F-statistic): 0.0361; Probability of F-Limer Test: 0.5135; Probability of Heteroskedasticity Test (White): 0.3981; Durbin–Watson Stat: 1.7566; Probability of Breusch–Godfrey Test: 0.1634. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level (***): 99% (***).

During the COVID-19 pandemic and times of increased variability in operating income, the need for cash relative to sales for firms has remained unchanged. In summary, the unchanged cash-to-sales ratio for firms during the COVID-19 pandemic can be attributed to precautionary motives, public policy support, reduced investment, and the impact of the pandemic on firm performance. For instance, firms have accumulated cash and cash equivalents as a precautionary measure against future uncertainties and potential negative cash flow shocks (Demary et al. 2021). This strategy helps them maintain a healthy cash buffer to ensure business continuity during challenging times. Furthermore, the COVID-19 pandemic has led to unprecedented public policy support in the form of financial assistance

programs, low interest rates, and various relief measures. These actions have enabled firms to maintain their cash holdings, even as they have depleted some of the newly accumulated cash buffer in 2022 (Bräuning et al. 2023). Firms in countries strongly affected by COVID-19 have shown reduced sensitivity to cash flow during the crisis (He et al. 2022a). This may be due to the uncertainty surrounding the pandemic and its impact on economic activity, leading firms to adopt a more cautious approach to investment. Furthermore, firms with better financial performance (higher Tobin's Q) are found to have a higher cash-to-sales ratio. The main reason for this is that firms with a higher Tobin's Q index are perceived to have high growth and profit potential, which may lead to increased competition and the need for additional investment to capture market share. Therefore, these firms may need to maintain a higher cash-to-sales ratio to ensure that they have sufficient funds to invest in growth opportunities and maintain their competitive advantage. Additionally, companies with higher Tobin's Q may face greater idiosyncratic risks or uncertainties associated with their growth strategies. Holding more cash can act as a buffer against these risks, providing a safety net for the firm in times of economic downturns or unexpected events. Maintaining a higher cash-to-sales ratio can also be a strategic choice to enhance shareholder value. By having ample cash reserves, firms can signal financial stability, attract investors, and potentially support stock prices, aligning with the interests of shareholders.

The cash conversion cycle (CCC) and cash conversion efficiency (CCE) are both measures of a company's efficiency in managing its working capital. The CCC measures the average length of time firms' funds are tied up in the cycle of raw material purchase, sale of inventories, and collection of sales, while the CCE is a metric that expresses the time it takes for a business to convert its stock or inventory into cash flows from sales. In summary, the CCC focuses on the entire cash cycle from inventory to sales to cash (Akbar et al. 2021; Ahmad et al. 2022; Tarkom 2022; Zheng et al. 2022), while the CCE specifically looks at the time it takes to convert inventory into cash flows from sales (Naz et al. 2022). Market and operating risks can both influence a company's cash conversion cycle by affecting sales, inventory management, accounts receivable collection, and payment to suppliers, ultimately impacting the efficiency of converting resources into cash flows (Akbar et al. 2021), leading to a longer CCC and CCE. Therefore, in Tables 11 and 12, this research aims to analyze whether COVID-19 and corporate risk have led to changes in CCE and CCC strategies.

Table 11. The results of the eighth model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	−0.2205	0.1099	−2.0066	0.0449 *	−0.1829 ***
COVID-19	−0.0462	0.0267	−1.7310	0.0836	−0.3066
Firm Risk	1.5994	0.7133	2.2421	0.0251 *	0.9859 **
Firm Size	0.0227	0.0063	3.6173	0.0003 ***	0.0160
Firm Age	0.0001	0.0007	0.1668	0.8674	0.0005
Sale Growth	0.0011	0.0083	0.1327	0.8944	0.0260
Tobin Q	−0.0026	0.0022	−1.1829	0.2370	−0.0776
Tangibility	0.0294	0.0524	0.5617	0.5744	0.1939
Dividends	0.2173	0.0812	2.6767	0.0075 ***	0.9771 ***
GDP	0.0237	0.0444	0.5339	0.5934	0.0370
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: CCE; Method: OLS Regression; Adjusted R-squared: 0.2419; F-statistic: 7.4825; Prob. (F-statistic): 0.0001; Probability of F-Limer Test: 0.0934; Probability of Heteroskedasticity Test (White): 0.1685; Durbin–Watson Stat: 2.0151; Probability of Breusch–Godfrey Test: 0.2734. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level (***): 99% (***)

Table 12. The results of the ninth model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	228.9236	158.6942	1.4425	0.1493	83.4037
COVID-19	−71.4062	38.5494	−1.8523	0.0642	−94.0537
Firm Risk	−487.5368	1080.1943	−0.4513	0.6518	−225.3658
Firm Size	2.4714	9.5079	0.2599	0.7949	0.5516
Firm Age	2.3501	1.0438	2.2514	0.0245 *	0.9830 **
Sale Growth	11.6254	12.0282	0.9665	0.3339	14.5332
Tobin Q	−2.2099	3.3042	−0.6688	0.5037	−0.2300
Tangibility	−537.5857	75.6634	−7.1049	0.0032 ***	−149.5488 *
Dividends	85.3092	117.2461	0.7260	0.4669	326.1353
GDP	62.6433	64.1056	0.9771	0.3286	21.4430
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: CCC; Method: OLS Regression; Adjusted R-squared: 0.1406; F-statistic: 28.1326; Prob. (F-statistic): 0.0017; Probability of F-Limer Test: 0.3799; Probability of Heteroskedasticity Test (White): 0.2519; Durbin-Watson Stat: 1.9068; Probability of Breusch-Godfrey Test: 0.3204. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level: 99% (***).

The outputs from Table 11 witness a positive association between firm risk and CCE strategy in the Iranian context. The ratio of cash conversion efficiency (CCE) may increase when firms face more risks due to the need for higher cash reserves to mitigate potential challenges. Firms with higher systematic risk and operational dangers may choose to maintain a higher ratio of cash to mitigate the impact of worse contractual terms on their lines of credit (Cardella et al. 2021). However, it is important to note that the optimal level of CCE depends on the company's specific circumstances and financial management strategy. We also see a positive connection between firm size and the CCE ratio. It appears that larger firms may have higher receivables that can be converted into cash immediately, contributing to a higher CCE ratio. Larger firms may hold higher cash reserves as a strategic preparation for substantial purchases or as a defense against potential risks, which can lead to a higher CCE ratio as well. Furthermore, firms with higher dividends are seen to have a higher CCE ratio. Firms with higher dividends have a higher CCE ratio due to the need for more cash retention, financing growth initiatives, managing the cost of capital, and potential challenges in growing dividends.

Neither the coronavirus pandemic nor the company's risk has had a significant impact on the CCC ratio of companies. In essence, when the COVID-19 pandemic and firm risk do not affect the cash conversion cycle significantly, it suggests that the company's internal operational efficiency and management of working capital components are robust enough to withstand external fluctuations without impacting the conversion of resources into cash flows. In this study, firm age is linked to CCC positively, and this connection may be influenced by factors such as financing and trade credit practices, access to external finance, growth stability, and industry-specific characteristics (Wang 2019). Moreover, firms with more tangible assets may have lower inventory holding costs, which can lead to a lower CCC ratio (Attari and Raza 2012). In fact, a higher property, plant, and equipment (PPE) ratio can lead to lower production lead times by enabling companies to have the necessary equipment and resources readily available, which can streamline the production process. With adequate PPE, companies can reduce delays caused by equipment shortages or breakdowns, leading to more efficient production timelines and a decrease in the cash conversion cycle (CCC).

Operational cycle (OC) is the time it takes for a company to complete its operations, from purchasing raw materials to selling finished goods. In this regard, Lin et al. (2023) believe that the COVID-19 pandemic can disrupt firms' operational cycles by introducing demand shocks, supply chain disruptions, economic uncertainty, and challenges in receivables management, all of which collectively contribute to a lengthening of the operating cycle for many businesses. However, by analyzing the operational cycle, businesses can

make informed decisions about production, inventory management, and sales strategies to optimize their working capital efficiency (Zimon and Tarighi 2021). This research aims to investigate whether the COVID-19 crisis, which caused problems in inventory provision and production of goods, compelled Iranian managers to make fundamental changes in their operating cycles to optimize efficiency. Additionally, the tenth model of this research attempts to determine whether companies with higher risk consider their operating cycles more extensively. The results of Table 13 are provided below.

Table 13. The results of the tenth model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	508.7579	199.3773	2.5517	0.0108 ***	217.4062 *
COVID-19	−97.3974	48.4320	−2.0110	0.0445 *	−35.9394 **
Firm Risk	−367.9780	1357.1146	−0.2711	0.7863	−163.2572
Firm Size	−1.4582	11.9445	−0.1220	0.9028	−1.2436
Firm Age	1.5837	1.3114	1.2076	0.2274	0.7496
Sale Growth	−2.1824	15.1118	−0.1444	0.8851	−6.9811
Tobin Q	−1.8297	4.1512	−0.4407	0.6594	−1.2534
Tangibility	−604.4707	95.0607	−6.3587	0.0001 ***	−171.8864 *
Dividends	−433.6266	147.3035	−2.9437	0.0033 ***	−72.8910 *
GDP	83.6595	80.5399	1.0387	0.2991	4.3623
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: OC; Method: OLS Regression; Adjusted R-squared: 0.2274; F-statistic: 16.7571; Prob. (F-statistic): 0.0000; Probability of F-Limer Test: 0.1205; Probability of Heteroskedasticity Test (White): 0.1869; Durbin–Watson Stat: 1.9852; Probability of Breusch–Godfrey Test: 0.5302. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level (***): 99% (***)

Inconsistent with our expectations, the results highlight the fact that the occurrence of COVID-19 caused firms to lower their operational cycle (OC) ratio. Although COVID-19 presented significant challenges, it led to a decrease in the operational cycle of Iranian firms. This means that some companies have been able to adapt, innovate, and optimize their operations, resulting in increased efficiency and reduced time to convert resources into cash flows. When Iranian firms faced systematic risk because of the coronavirus pandemic, they tried to lower the ratio of operational cycle (OC) to mitigate the impact of market fluctuations on their financial performance. Although companies with higher risks have also done such work, it was not statistically significant. Similarly, tangibility and dividends variables have a negative effect on OC strategy. It can be interpreted that lowering the ratio of the operational cycle (OC) can benefit firms with more tangible assets by enabling more efficient use of assets, improving cash flow management, and reducing reliance on debt (Harc 2015). Companies that pay more dividends to their shareholders prefer to minimize their OC ratio, as it allows them to have sufficient cash flow to meet their dividend responsibilities without relying heavily on external financing or troublemaking their operational activities. Additionally, a lower operational cycle can signal to investors that the company is professionally managing its working capital, which may help keep investor confidence and support the payment of dividends (Bushuru 2015).

Days account receivables (DAR) represents the average time customers take to repay a business for products or services purchased, reflecting credit and collection process efficiency. Higher DAR can increase the likelihood of bad debts, which increases operational and market risk (Akbar et al. 2021). Accordingly, this study is trying to examine whether companies reduce their credit sales at a time when they are threatened with more risks and during the Corona crisis when the lack of liquidity is more annoying. Days inventory (DI) represents the average time it takes for a company to convert its inventory into cash, also known as the inventory conversion period. Days inventory is an essential metric in working capital management, as it helps businesses optimize their cash flow and minimize the risk of inventory obsolescence. The days inventories are expected to be positively

linked to firm risk (Akbar et al. 2021). Therefore, we are curious to determine whether the COVID-19 crisis and firm risk have led financial managers to make significant changes in their DI policy. Days account payables (DAP) represents the average time it takes for a company to pay its suppliers for goods or services purchased on credit, reflecting the efficiency of the company's accounts payable management. Managing accounts payables is essential for businesses to optimize their cash flow and maintain good relationships with suppliers. The most important point is that a larger DAP will provide liquidity to the firm for a longer time, thus resulting in a lower perceived risk of a short-term liquidity crunch (Akbar et al. 2021). Due to this characteristic, in the last step we are going to analyze whether the pandemic and firm risk have led Iranian companies to decide to increase their DAP strategy to improve their liquidity or not. In general, the results of the three variables of DAR, DI, and DAP are presented in Table 14, Table 15 and Table 16, respectively.

Table 14. The results of the eleventh model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	222.9547	174.8243	1.2753	0.2024	68.9389
COVID-19	−109.6422	42.4677	−2.5817	0.0099 ***	−61.5318 **
Firm Risk	−152.8394	1189.9882	−0.1284	0.8978	−243.4361
Firm Size	5.4631	10.4743	0.5215	0.6020	2.8606
Firm Age	1.7832	1.1499	1.5507	0.1212	0.2720
Sale Growth	11.8444	13.2508	0.8938	0.3715	2.4010
Tobin Q	−4.1093	3.6400	−1.1289	0.2591	−1.1088
Tangibility	−465.9497	83.3541	−5.5900	0.0010 ***	−62.1644 ***
Dividends	−261.3908	129.1633	−2.0237	0.0432 *	−110.5439 ***
GDP	86.6852	70.6215	1.2274	0.2198	27.0311
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: DAR; Method: OLS Regression; Adjusted R-squared: 0.2053; F-statistic: 17.7032; Prob. (F-statistic): 0.0003; Probability of F-Limer Test: 0.4296; Probability of Heteroskedasticity Test (White): 0.1305; Durbin–Watson Stat: 2.3153; Probability of Breusch–Godfrey Test: 0.1622. Note: Confidence level (*): 95%; confidence level (**): 98%; confidence level (***) 99%.

Table 15. The results of the twelfth model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	285.8032	70.8837	4.032	0.0000 ***	166.9564 ***
COVID-19	12.2448	17.2188	0.7111	0.4771	28.0153
Firm Risk	−215.1388	482.4888	−0.4458	0.6557	−338.5868
Firm Size	−6.9214	4.2469	−1.6297	0.1034	−5.1729 *
Firm Age	−0.1994	0.4662	−0.4277	0.6688	−0.2395
Sale Growth	−14.0269	5.3726	−2.6108	0.0091 ***	−12.0779 ***
Tobin Q	2.2795	1.4758	1.5445	0.1227	0.03771
Tangibility	−138.5210	33.7965	−4.0986	0.0000 ***	−26.9621 *
Dividends	−172.2357	52.3701	−3.2888	0.0010 ***	−15.6827 *
GDP	−3.0256	28.6339	−0.1056	0.9158	−7.2087
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: DI; Method: OLS Regression; Adjusted R-squared: 0.1893; F-statistic: 9.7493; Prob. (F-statistic): 0.0000; Probability of F-Limer Test: 0.0781; Probability of Heteroskedasticity Test (White): 0.3750; Durbin–Watson Stat: 2.0824; Probability of Breusch–Godfrey Test: 0.2593. Note: Confidence level (*): 98%; confidence level: 99% (***)

The COVID-19 crisis had a negative and significant effect on the DAR variable. In addition to economic sanctions against Iran's settings, the pandemic caused financial distress among businesses (Alipour 2011; Moradi et al. 2021), leading to cost-cutting measures, such as reducing DAR. Besides, COVID-19 accelerated the adoption of digital technologies, including e-invoicing and online payment systems, and this shift in payment methods can contribute to a reduction in DAR. Consistent with the financial theory of working capital

management (McInnes 2000), the negative association between the variables of dividends and tangibility with DAR can be explained fully. In fact, firms with more dividends try to have lower DAR as they prioritize collecting payments from customers more efficiently to distribute dividends to shareholders. Additionally, Iranian firms with higher tangible assets tend to have lower DAR, for they have more collateral to secure loans and can negotiate better credit terms with suppliers, allowing them to manage their cash flow more effectively.

Table 16. The results of the thirteenth model.

Variable	Coefficient	Std. Error	T-Statistic	p-Value	MM-Estimation
C	279.8343	85.8249	3.2605	0.0011 ***	66.7982 ***
COVID-19	−25.9911	20.8482	−1.2466	0.2127	−47.9354
Firm Risk	119.5587	584.1905	0.2046	0.8378	99.1869
Firm Size	−3.9296	5.1421	−0.7642	0.4448	−1.0754
Firm Age	−0.7663	0.5645	−1.3574	0.1748	−0.1164
Sale Growth	−13.8079	6.5051	−2.1226	0.0339 *	−0.1705 ***
Tobin Q	0.3801	1.7869	0.2127	0.8315	1.0185
Tangibility	−66.8849	40.9203	−1.6345	0.1024	−13.5514
Dividends	−518.9359	63.4090	−8.1839	0.0025 ***	−254.8943 ***
GDP	21.0162	34.6696	0.6061	0.5445	18.6221
Year Index	Yes				
Industry Index	Yes				

Dependent Variable: DAP; Method: OLS Regression; Adjusted R-squared: 0.1341; F-statistic: 37.8430; Prob. (F-statistic): 0.0053; Probability of F-Limer Test: 0.4995; Probability of Heteroskedasticity Test (White): 0.1603; Durbin–Watson Stat: 2.1762; Probability of Breusch–Godfrey Test: 0.6693. Note: Confidence level (*): 98%; confidence level: 99% (***).

The coronavirus pandemic had no significant effect on the DI variable. Since the COVID-19 pandemic led to global supply chain disruptions, causing many businesses to reevaluate their inventory management practices, Iranian firms may have adjusted their inventory levels to mitigate the impact of these disruptions, resulting in a lack of significant change in days inventory. Also, as COVID-19 created uncertainty in consumer demand, making it challenging for firms to accurately forecast their inventory needs, Iranian firms may have maintained their inventory levels to buffer against demand fluctuations, leading to a limited impact on days inventory. However, no significant change in days inventory was found in the Iranian market. Iranian enterprises may have chosen to keep their days inventory stable to accommodate potential fluctuations in customer demand, thereby avoiding stockouts or excess inventory during uncertain times. As for the control variables, the negative connection between sales growth and DI may be because of the desire to enhance liquidity, improve operational efficiency, and reduce the costs of firms. Similarly, the more companies pay dividends, the more their policies are adopted to turn their inventory into cash in a shorter time. Furthermore, we found that firms with more tangible assets decrease the inventory conversion period, for they have smaller costs of financial distress than firms with fewer tangible assets (Harc 2015). Iranian manufacturing companies that have a high proportion of tangible assets use these assets to produce their goods. These firms may also have already found a stable source of return, which provides them with more internally generated funds and discourages them from turning to external financing.

The COVID-19 pandemic and firm risk did not have any significant impact on the DAP variable. Iranian firms may have faced challenges in changing their DAP due to international sanctions, which could have limited their access to financial services and credit. The COVID-19 crisis led to a global economic slowdown, which may have affected Iranian firms' ability to change their DAP. Iranian companies appear to have focused on conserving cash and maintaining their liquidity rather than actively managing their DAP. Finally, there is a negative linkage between sales growth and dividends and DAP.

Companies that have experienced better sales growth have sought to reduce DAP because timely accounts payable processing can lead to stronger supplier relationships, which may encourage suppliers to offer more favorable payment terms and discounts. As sales grow, companies may need to strike a delicate balance between their inflow and outflow, ensuring that they can collect payments from customers while also paying suppliers on time. The same scenario was experienced by the Iranian manufacturing companies that paid more dividends. Firstly, paying dividends can signal to creditors that the company is financially stable and can afford to share its profits with shareholders, and this financial stability may encourage creditors to extend more favorable credit terms. Secondly, companies that pay dividends may be perceived more favorably by investors, as they are sharing their profits and providing a steady stream of income. This positive perception can lead to better access to capital and lower financing costs, which can indirectly help companies manage their DAP. Thirdly, dividends are subject to taxes, and companies may choose to pay out dividends to reduce their tax burden. By doing so, they can free up cash that can be used to pay off accounts payable and reduce their DAP.

5. Conclusions

Overall, the research literature indicates that the COVID-19 pandemic has led to significant changes in working capital management strategies for manufacturing firms, with many facing challenges related to cash flow, operational costs, and profitability (Zimon and Tarighi 2021; Tarkom 2022; Hamshari et al. 2022; Wadesango et al. 2022; Pant et al. 2023). In this study, our findings confirm that the COVID-19 crisis caused Iranian manufacturing companies to adopt working capital investment policies and also seek to increase the current ratio (CR) and cash to current assets (CTCA) ratio, while avoiding the policies of WC financing, operating cycle (OC), and receivables turnover. It is important to maintain a balanced approach to financial management during these challenging times. In fact, the COVID-19 crisis in the Iranian market led Iranian companies to primarily employ conservative working capital strategies because they tend to maintain a stronger financial position and improve their liquidity, which is crucial for surviving the economic uncertainty caused by the pandemic. The Iranian market is also known as a high-risk market due to severe economic sanctions, leading to an increase in a firm's total risk. In this regard, the results show that there is a positive association between a firm's total risk and WC investment policy, net working capital (NWC), cash to current assets (CTCA) ratio, and cash conversion efficiency (CCE). Similar to the COVID-19 crisis, the higher the firm risk, the more conservative the strategies that Iranian companies adopt. As a whole, our findings are consistent with the liquidity preference theory, providing a sound rationale for the adjustments in financial ratios observed in response to the COVID-19 crisis and firm risk, reflecting a strategic shift towards enhancing liquidity, managing risks, and ensuring financial resilience. Upon examining the details, it becomes apparent that certain company-specific characteristics, as well as other factors, play a significant role in determining the chosen working capital strategy. For instance, there is a negative relation between GDP with quick ratio (QR) and net working capital (NWC), while GDP affects WC financing strategy positively. This implies that in markets with a strong economic situation, companies require less liquidity and tend to adopt more aggressive working capital strategies to improve their profitability.

The more tangible assets Iranian manufacturing companies have, the less they use WC investment and financing strategies, current ratio, quick ratio, net working capital, operating cycle, and cash conversion cycle, because tangible assets, such as property, plant, and equipment, are not easily liquidated and may not be fully available to meet short-term liabilities. However, due to the liquidity challenges associated with PPE, firms with higher tangible assets have increased their cash to current assets ratio and cash-to-sales ratio to compensate for the lower liquidity of these assets and ensure they can meet their short-term obligations. Actually, this conservative approach helps companies navigate through periods of low cash inflows or unexpected expenses, safeguarding their ability to

function effectively and meet financial commitments. Furthermore, since there is a positive connection between sale growth and current ratio, quick ratio, and net working capital, firms that have experienced better sale growth seem to adopt a conservative approach and prioritize financial stability and risk aversion over expansion. On the other hand, the negative effect of sale growth on days inventory (DI) and days accounts payables (DAP) is because optimizing the firm's liquidity and minimizing risk in the face of increased sales activity. In other words, higher sales growth can lead to the need for more working capital to support increased operations. By decreasing the days inventory ratio, a firm can minimize the amount of capital tied up in inventory, thus freeing up cash for other uses. Similarly, decreasing the days account payables ratio allows the firm to pay off its payables more quickly, which can enhance its creditworthiness and reduce the risk of a short-term liquidity crunch. Finally, larger Iranian firms have smaller net working capital ratios and a higher ratio of operating cash flow to sales due to their stronger financial position, greater resources, and expertise in optimizing operations, resulting in increased efficiency and reduced need for working capital. Furthermore, larger firms can achieve economies of scale in their operations, enabling them to generate more cash from sales.

On the whole, the research findings have theoretical and practical applications for various market groups. First, regulators and policymakers in both developing and developed markets can use these findings to assess the impact of external shocks on firms' working capital management and consider appropriate support measures or policy adjustments. Moreover, creditors can utilize these insights to reassess their credit risk models and lending criteria, considering the changes in working capital investment strategies and operating cycle duration observed in Iranian manufacturing firms. Our findings also give the message to companies operating in other emerging markets that they can adopt conservative working capital strategies to maintain a stronger financial position and improve liquidity during economic uncertainty. However, the specific strategies adopted by companies may vary depending on the economic conditions and policies of each country. Future researchers could conduct comparative studies across different markets, both developing and developed, to assess the generalizability of the impact of external shocks on working capital management strategies. This could provide valuable insights into the commonalities and differences in the responses of firms to crises across various market contexts. We also recommend that researchers consider conducting longitudinal analyses to track the evolution of working capital management strategies in response to prolonged external shocks, such as the COVID-19 pandemic. This will offer a deeper understanding of how firms adapt their strategies over time and the lasting implications of such adaptations. Most importantly, given that the current study period in Iran coincides with a financial crisis resulting from sanctions, and that the calculation of variables may differ between studies, future scholars are advised to exercise caution when generalizing or comparing the results presented in this investigation.

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