Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

Dynamic Interaction Among Cash Conversion Cycle Components and Their Antecedents in Simultaneous Equations Modeling

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Abstract
The Cash Conversion Cycle (CCC) is a concept that businesses often use to demonstrate how successful they convert investments in inventory and resources into cash, and therefore, how effective the actual cash flow management is. While previous research has been conducted on individual components of the CCC, there are gaps in knowledge to prevent businesses from enhancing their working capital management. The aim of this study is to determine the interrelationship of the CCC components. The sample includes 126 non-financial Pakistani firms listed at the Pakistan Stock Exchange from 2010 to 2023. Then we analyze endogenous variables, included in the research, such as Days Inventory Outstanding (DIO), Days Receivables Outstanding (DRO), Days Payables Outstanding (DPO), and exogenous variables such as capital intensity, gross profit margin, sales surprise, firm size, and old assets. All three CCC components were simultaneously determined, using the Error Correction Three Stage Least Squares (EC3SLS) technique for panel data analysis. Variables such as Gross profit margin and capital intensity as well as the components of the cash conversion cycle are crucial in describing variations in inventory. In general, this study demonstrates the impact of various working capital components on business efficiency and confirms the impact of financial variables on the operations of the organization.

Keywords: Cash Conversion Cycle (CCC), Days Inventory Outstanding (DIO), Days Receivables Outstanding (DRO), Days Payables Outstanding (DPO), Capital Intensity, Sales Surprise, Working Capital Management, Gross Profit Margin, Firm Size, Old Assets

Introduction

Background to the Study

Effective working capital management is crucial for maintaining companies' financial stability, especially those listed on the Pakistani stock exchange. This involves balancing short-term assets and liabilities, essential for sustaining business operations and achieving profitability. According to Hill et al., (2010),

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

successful working capital management demands a thorough comprehension of industry-specific factors and broader economic conditions.

The Cash Conversion Cycle (CCC) is a critical financial metric that is an essential indicator of a company's ability to maximize resources and streamline operational processes. Comprising of three crucial components - Days Sales Outstanding (DSO), Days Inventory Outstanding (DIO), and Days Payables Outstanding (DPO) - the CCC provides a measure of financial health, displaying how quickly a company can transform its resources into cash. This cycle explicitly acknowledges the pivotal role of four core business activities: procurement or production, sales, collection, and payments (Wang et al., 2019). By considering these elements, companies can efficiently navigate the complex terrain of capital management and make informed decisions to augment their financial stability. However, as Zeidan and Shapir (2016) have highlighted, there is no universal model for optimizing working capital investments. Therefore, managing the components of the cash conversion cycle, such as inventories, accounts payable, and accounts receivable, is crucial to maximizing returns on working capital without running the risk of lost sales.

A lower DSO is advantageous to a company because it indicates that the company is collecting payments from its customers more quickly (Bauer, 2007). This immediate cash flow can be used for various purposes such as investing in new projects, expanding operations, or ensuring liquidity. However, extending credit sales to customers can introduce a level of risk, as there is always the possibility that some customers may default on their payments or delay them significantly, which could strain the firm's financial stability. The working capital management theory suggests that minimizing DSO leads to improved financial performance (Churchill and Mullins, 2001; Farris and Hutchison, 2002; Farris and Hutchison, 2003; Stewart, 1995). A shorter DSO means the firm can access cash faster, enabling it to seize opportunities and navigate through challenges more effectively. While shortening DSO is beneficial for the firm, it could potentially strain relationships with customers if not handled carefully. Firms often employ strategies such as offering early payment discounts to incentivize prompt payments without alienating their customer base, mitigating this risk.

This is essential to ensure adequate inventory levels to maintain customer satisfaction and loyalty. However, having too much inventory to keep in place can lead to a company's cash, which could be used elsewhere in the business. Inventory storage costs include insurance, depreciation, and storage fees, which is the reason. These disadvantages can be minimized by reducing inventory levels, so cash can be freed up and directed to creating the next steady income or enhancing the numbers at the existing ones, thus increasing sales and overall profitability. Given that the considerations for reducing inventory levels should be taken into consideration, so that the legacy supply chain is not disrupted and becomes inefficient (Tangsucheeva and Prabhu, 2013). Given these difficulties, research suggests that lower Days Inventory Outstanding (DIO), or shorter inventory holding periods, appear to be associated with higher liquidity and stronger financial performance for companies.

One such strategy companies can utilize in their efforts to improve liquidity by extending payment cycles; this is retaining cash for a longer period (Stewart, 1995). However, this method has its own shortcomings and consequences. If

ISSN Online: 3007-3154
ISSN Print: 3007-3146

payment suppliers are delayed, it may cause delays in the early payment discounts and the overall cost will increase. Furthermore, it can damage built over time trust and goodwill with suppliers and in turn negatively affects the company's operation efficiency (Fawcett et al., 2010). Extended payment cycles may also lead to disruption and delays in supply chains. If suppliers don't have enough cash, they may not be able to invest in their operations or meet their obligations (Raghavan and Mishra, 2011). It can lead to lower quality and reliability products or services. Extending payment cycles may provide a short-term liquidity gain, but it must be weighed against the potential consequences of supplier relations and supply chain stability. However, companies must balance the need for liquidity with the longer-term performance implications. There is a mixed effect in literature on its effectiveness.

Problem Statement

From a financial operations perceptive, working capital management is essential to any business since it includes the management of cash, inventory, accounts receivable, and accounts payable. However, there are numerous challenges that firms must overcome to excel in this area. The main concern is the vulnerability to cash flow insufficiency that would cause a company to not be able to meet its short-term financial objectives. It is possible that this could result in delayed payments from customers, unforeseen expenses, or a decline in sales. If there is not enough cash flow coming in, it can cause companies to miss growth opportunities, it can strain relationships and lead to late payments with suppliers, and it can create cash flow problems covering the growth and day to day operating cost of the business itself.

Similarly, firms often experience difficulties in having excessive working capital. When assets, such as inventory and accounts receivable, accumulate too much cash, these assets are not being utilized effectively. Having idle cash is essentially limiting the possibility of obtaining a higher return on the company reinvesting that cash in good opportunities. Furthermore, with increased inventory levels, the organization incurs additional costs such as storage fees, obsolescence, and depreciation, which are reflected in the profitability. The right harmony must be maintained in sustaining adequate liquidity and employing resources efficiently for effective working capital management.

The second most common method in business is extending credit to customers, which enables businesses to increase sales and develop customer relationships. However, if the company does so, it may be a risk of default or late payments that may cause significant pressure on the financial stability of the firm. This risk can be exacerbated by the economic downturn or a change in market conditions, which make it difficult for companies to predict and manage it. Furthermore, payments delays have an impact on not only inflows, but also cash flows, causing the business to perform the necessary tasks such as payments on time (Bauer, 2007).

Additionally, ensuring that the inventory levels and payment cycles are maintained within the supply chain is also important. Stockouts, such as loss of sales, or excessive inventory that results in higher costs can occur due to poor inventory management (Tangsucheeva and Prabhu, 2013). Payments to suppliers delayed weakening relationships and could even result in disruptions to supply

ISSN Online: 3007-3154
ISSN Print: 3007-3146

chains that could impact availability and quality of goods or services (Stewart, 1995). The balancing of these competing priorities against maintaining productivity is not a minor issue and requires ongoing monitoring and modification.

While these challenges are present, effective working capital management is essential for the financial health and profitability of a business. Optimizing cash flow, minimizing risk, and effective operations can enhance a company's profitability and its competitiveness in the marketplace. This can be achieved, but it requires an effort that involves a strategic approach along with close coordination among three components of CCC and a good understanding of the factors affecting dynamic working capital.

Businesses in the past have attempted to improve Cash Conversion Cycle (CCC) by reducing DSO, reducing DIO, or by extending DPO separately. This approach means that improving one side can also reduce other sides. A comprehensive and simultaneous approach for optimization of the CCC components is necessary to address the complex interconnection between CCC components. Pakistani firms struggle to interpret the interdependence of inventories, accounts receivable, and accounts payable, making it challenging to improve their CCC. Conventional regression analyses may not accurately capture these causal effects.

Gap Analysis

The conventional approach to managing the cash conversion cycle involves minimizing the time it takes to convert inventory and sales into cash (reflected in lower DIO and DSO) while extending the time it takes to pay suppliers (higher DPO). However, this standard practice is not consistently observed in Russia. In fact, research by Pirttilä et al., (2020) suggests that in Russia, there tends to be a prolonged DPO, meaning companies take longer to pay their suppliers. Surprisingly, this elongated DPO is associated with increased firm profitability. This phenomenon is particularly noticeable in the automotive industry. This raises intriguing questions about the generalizability of conventional cash conversion cycle strategies to the national level, especially in the context of Pakistan.

In 2018, Grobéty analysed 28 manufacturing industries in 39 countries, finding that industries having a longer Cash Conversion Cycle (CCC) display greater liquidity needs and where they grow faster in countries that have a higher domestic government debt level. The CCC and its components are vastly influenced by cultural differences, as found in Lorentz et al. (2012) and Farris and Hutchinson (2002). For example, Pirttilä et al., (2020) highlight differences between Russian and Western automotive industries, with CCC management strategies in supply chain relationships based on negotiation power and governance structures.

In addition, a contradictory impact of economic policy uncertainty (EPU) is found to impact CCC; however; it varies by the role of a firm in being a credit provider or a source of financing(Banerjee et al., 2021; Brandenburg, 2016; Dbouk et al., 2020). In addition, the impact of EPU on CCC differs across production stages in lifting economic uncertainty and industries(Dbouk et al., 2020; Kroes et al., 2018; Özbayrak and Akgün, 2006). Goodell et al., (2021) also found that increasing volatility in EPU is associated with a more volatile CCC and

ISSN Online: 3007-3154
ISSN Print: 3007-3146

a negative change in CCC, as firms attempt to bolster cash holdings to mitigate the effects of EPU volatility by shortening CCC.

Days Inventory Outstanding (DIO) and Days Receivable Outstanding (DRO) are correlated with each other; however, the dependence between them is not quite straightforward and also depends on industry norms, company strategy, supply chain efficiency and market conditions (Wang et al., 2019). It is generally believed that there is a positive association between DIO and DRO, which means that firms which take longer periods to use their inventory also take longer periods to collect their receivables (Kolias et al., 2020). Second, this insight is critical for firms who need to address certain inefficiencies in the inventory management and accounts receivable collection in order to improve working capital performance and health.

According to the working capital management theory, one that minimizes DSO will incur better financial performance (Churchill and Mullins, 2001; Farris and Hutchison, 2002, Farris and Hutchison, 2003; Stewart, 1995). A shorter DSO allows the firm to access cash earlier and take advantage of the opportunities and also overcome challenges before they have a chance to impact working capital adversely. Extension of credit sales has, however, added risk of payment default or delay, which normally causes financial instability. On one hand, the excess inventory can tie up cash, especially carrying costs, while on the other hand, reducing levels can free up cash for investment elsewhere which leads to increased sales and profitability. It is important to manage carefully so as to disrupt the supply chain. According to Tangsucheeva and Prabhu (2013), research finds that these shorter inventory holding periods, which reduce DIO metrics, have positive effects on liquidity and financial performance in many businesses.

As noted by Stewart, (1995) firms could utilize the strategy of extending payment cycles to improve liquidity; however, extension of payment cycle strategy has some disadvantages including missing early payment discounts and damaging relationships with suppliers as suggested by Fawcett et al., (2010). Accordingly, Raghavan and Mishra, (2011) note that prolonged payment cycles can affect product quality and reliability and can also disrupt the supply chain.

There is little literature available in this regard except that it concentrates on individual DSO, DIO, or DPO analyses without relating the different DSO, DIO, and DPO components to form the larger framework of the CCC. But this lack of awareness of the benefits of having a complete understanding of your CCC makes it a knowledge gap that bars businesses from operating at their fullest potential. As our study addresses this remainder, we first study the simultaneous determination of all three CCC components. An advanced EC3SLS technique for panel data was used to evaluate the interaction effects of cash conversion cycle components in Pakistan. Our research addresses the relationships between DSO, DIO and DPO to provide solid insight that will aid businesses to enhance their working capital management practices and financial performance.

This study represents novelty in increasing the understanding and optimization of working capital management in industry. In the recent past, businesses have focused on components such as DSO, DIO and DPO separately , and worked on improving their CCC. Yet often such an approach does not describe the intricate dependencies amongst these items, leading to suboptimal end results.

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ISSN Print: 3007-3146

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Vol. 3 No. 1 (January) (2025)

Conducting this research helps bridge this knowledge gap indicating that a holistic and simultaneous approach to optimize the CCC is required. This study's findings highlight the complexity of CCC dynamics, contingent on several cultural, economic, and macroeconomic factors, with implications for working capital management and financial performance at a global level. Advanced techniques, namely EC3SLS regression modelling, are incorporated to develop the complex associations among DSO, DIO and DPO, and key results and practical implications for industry practitioners are offered.

Research Objective

The purpose of this study is to investigate the simultaneous determination of the cash conversion cycle among various non-financial companies listed in different sectors of the Pakistan Stock Exchange, employing the EC3SLS model.

To achieve this objective, the paper undertakes a number of crucial analyses. Firstly, it focuses on the relationship between Days Inventory Outstanding on Gross Profit Margin, Capital Intensity, and Sales Surprise. Secondly, the study examines the relationship between Days Receivable Outstanding and the Old assets within companies. Thirdly, the paper examines the relationship between Days Payable Outstanding and the size of firms. Lastly, the research utilizes these individual components to examine the holistic dynamics of the cash conversion cycle by simultaneously considering the relationship between inventory, receivables, and payables management.

Research Question

1. How does Days Inventory Outstanding impact Gross Profit Margin?
2. What is the relationship between Days Inventory Outstanding and Capital Intensity?
3. How does Days Inventory Outstanding affect Sales Surprises?
4. What is the relation between Days Receivable Outstanding and the Old assets?
5. What effect does Days Payable Outstanding have on the size of firms?
6. How do the individual components of cash conversion cycle (inventory, receivables, and payables management) interact with each other when analyzed simultaneously?

Significance

By analyzing all three CCC components simultaneously, businesses can adopt more effective strategies tailored to their operational circumstances. Furthermore, the research suggests that while extending DPO can boost liquidity and negotiation leverage, it must be balanced with considerations of DIO to prevent unintended consequences on inventory management and operational efficiency.

Moreover, the insights derived from this research provide effective guidance for industry practitioners seeking to enhance their working capital management practices. By analyzing the dynamic interactions between CCC components, businesses can make informed decisions regarding credit policies, inventory management, and supplier relationships. This strategic approach improves operational efficiency, enhances financial health and resilience, and positions companies for sustained growth and competitive advantage in dynamic market

ISSN Online: 3007-3154
ISSN Print: 3007-3146

environments.
Implications for business operations, financial health as well as strategic decision making follow. Optimizing the CCC can help businesses earn additional cash flow, which they can use to fund growth initiatives, reduce debt or make strategic acquisitions. Moreover, efficient working capital management adds to profitability, liquidity and general financial robustness with the ability to withstand market volatility and general economic downturns. This research examines the complex relationships between DSO, DIO, and DPO and provides industry professionals with the knowledge and tools to better understand these intense relationships in the CCC and improve the execution of working capital management practices. This research aims at promoting operational efficiency, financial health and sustainable growth of the industry.

Literature Review

Overview of Working Capital Management

Strategic management of working capital is very important to companies as working capital directly affects the profitability and liquidity of the company through monitoring of current liabilities and current assets. The Cash Conversion Cycle (CCC) must be examined from a holistic perspective by all Finance Directors to optimize financial performance and the smooth running of operations for enduring profitability.
In order to clearly understand the CCC, one must differentiate it by industry factors and utilize sophisticated analytical assessments on each individual component. With this knowledge in hand companies can more accurately make decisions, increase operational efficiency, appropriately manage risks, and ensure they are measuring the right key indicators. In addition, it serves as a basis for tailored research and development activities related to working capital management.
Moreover, effective working capital management is not only good for fundamental financial health but also sound management in terms of business as it avoids any possible pitfalls and sets companies up for more future success. Kayani et al., (2019) noted that successful working capital management has a positive influence on the financial performance of the firm since it enhances operations, the earnings as well as the overall profitability of the firm. Its objective is to decrease the cost of capital allocated to the working capital and to maximize the economic yield on current asset investments, with the focus on the operational working capital. Successful companies in working capital management get higher business performance and profitability; otherwise, poor working capital exposes them to financial insolvency, legal disputes, asset liquidation, and even bankruptcy.

Individual Components of the Cash Conversion Cycle (CCC)

According to Ahangar, (2020), a review of 339 journal articles has revealed the need for more research on the target cash conversion cycle, speed of adjustment, and determinants of CCC. According to another paper by Yazandafar et al., (2014) they consider the extent to which CCC affects the business profit of private Swedish small and medium-sized enterprises in a given period. A dynamic liquidity measure (Ahangar, 2020) highlights the variability of the cash

ISSN Online: 3007-3154
ISSN Print: 3007-3146

conversion cycle across firms and industries. Additionally, there has been a study to investigate the impact of the cash conversion cycle on the financial performance of the manufacturing firms in Bangladesh (Karim e al., 2023). Individually these studies help understand individual parts that make up the cash conversion cycle, while jointly these studies provide an overall understanding of the impact of the cash conversion cycle as a whole on firm performance.

Besides, Dogan et al.,(2020) analyzed the factors determining the cash conversion cycle and its effect on firm performance in 157 companies over a ten year period. In particular, the researchers developed models to evaluate the factors of cash holdings and to measure the impact of CCC on firm performance.

Yazandafar et al., (2014) examined the influence of CCC on SMEs' performance (i.e. profitability) in Swedish SMEs in a particular period. The conclusions made from the full analysis were confirmed when the authors found that cash conversion cycle components had an effect on firm profitability in each of the industries.

Finally, Karim et al., (2023) try to ascertain how the cash conversion cycle affects the financial performance in manufacturing firms in Bangladesh. The researchers conclude that cash conversion cycle functions as a liquidity management catalyst and profitability indicator.

Gross Profit Margin (GPM)

The relationship between Gross Profit Margin (GPM), and the cash conversion cycle (CCC) components has been extensively researched. Nijam (2016) conducted one comprehensive study in which they found a positive and significant correlation between CCC and profitability. Surprisingly, regression models that used accounts receivable outstanding days (AROD), accounts payable outstandings days (APOD), and inventory outstandings days (IOD) as predictor variables rather than CCC itself, accounted for a more robust explanation for nearly all profitability measures.

According to Deloof et al., (2014) and Gill et al., (2010), it was further discovered that CCC as a proxy for working capital management is also a strong determinant of profitability. It was found that companies with longer CCCs (profitable working capital cycle) are less profitable. In particular, decreasing the average collection period (inventory turnover and average accounts receivable in days) significantly contributed to a decrease in firm profitability.

In addition, variations in GPM were found to have an influence in predicting the efficiency of cash conversion and ultimately profitability. Firms with shorter CCCs of profitability were observed to be higher than those with elongated CCCs. The existence of a condensed CC enhances profitability and requires a firm to reduce its dependence on external financing sources which in turn lowers the cost of financing and interest. Hence, these factors make the company more profitable in adopting the strategy of a shorter CCC as mentioned by Karim et al., (2023).

Sales surprise (SS)

The cash conversion cycle is vulnerable to unforeseen changes in sales, which in turn impacts the important pieces such as the inventory turnover, accounts

ISSN Online: 3007-3154
ISSN Print: 3007-3146

receivable, and accounts payable. These variations drive changes in cash conversion cycle, which in turn translates to how well a company is able to control working capital and turn sales into actual cash flow. There is considerable agreement across the literature that the effect of such sales surprise is important on this CCC. For example, a recent study looking at the influence of sales surprises on inventory turnover highlights how sales surprises help determine a company's inventory turnover and its related impact on the complex process of the cash conversion cycle (Yousaf et al., 2023). Furthermore, a study on sales surprise management two operational defenses: operational slack and volume flexibility were found to reduce the occurrence of sales variations (Manikas et al., 2016). Findings from these situations highlight the multifaceted significance of unexpected sales fluctuations in the operations of the cash conversion cycle.

Capital Intensity (CI)

Some recent studies by Sano et al., (2021) and Gaur et al., (2005) have shown that inventory turnover is associated with capital intensity. Inventory velocity increases as capital intensity increases as a company's capital intensity rises. Optimization of working capital and smoothing of cash flow management depends on this link.

Firm size

A company's size as measured by total assets or sales revenue is a major factor driving profitability and the Cash Conversion Cycle (CCC). Consequently, research consistently shows that large firms tend to have better CCCs and more business profit. A shorter CCC will equate to higher profitability, and a longer CCC will have a negative impact on company's profitability (Yazandafar et al., 2014).

Attari et al., (2012) and Al-Abass, (2017) have conducted several studies based on this relationship previously, in industries such as textiles, transportation, tobacco and paper. According to these studies, the relationship between these factors may differ across different sectors. Hence, to comprehend the relationship between CCC, firm size and profitability, industry specific dynamics should be considered.

Old Assets

Working capital management is important and includes such things as investing in tangible fixed assets and managing the cash conversion cycle. But there are conflicting lines of reasoning as to exactly how these two factors correlate. According to a study conducted by Fazzari et al., (1993), there is a negative connection between fixed assets and the cash conversion cycle; Kieschnich et al., (2013) confirmed that firms possessing tangible fixed assets are likely to have a higher CCC because of a lower financial burden. Companies that have relatively more tangible fixed assets tend to cut cost as they raise funds for current assets investments. Ratio of tangible fixed assets to total assets is an important metrics measuring investment in tangible fixed assets.

A number of factors affect the management of cash conversion cycle, namely length of the production and sales cycles, credit policy and payment terms, efficiency of inventory management, coordination of inflows and outflows of

ISSN Online: 3007-3154
ISSN Print: 3007-3146

cash. Keeping in view these factors, companies can develop their working capital management and thereby improve their overall financial performance.

Cash holdings and customer trade credit are influenced critically by money market imperfections. Such imperfections affect how much cash firms are holding on the one hand, and how much credit firms are willing to extend to customers on the other hand. To what extent there is a positive relation between demand for trade credit or increase in accounts payable level and the growth potential for a business? The ratio of net fixed assets to be accumulated depreciation can also be used to approximate this relationship (proxy for growth opportunities in the business) (Kolias et al., 2020).

Accounts payable and receivable are important tools for running your business. Previous studies on this area have shown that the relation between the determinants of inventory, receivables, and payables management is complex. To measure and interpret the effects of the concurrent determination of cash conversion cycle pattern, a simultaneous financial planning model must be developed. The existence of interdependencies between inventory, receivables, and payables should be considered, because knowing how changes at the inventory, receivables and inventory levels affect the overall cash conversion cycle allows organizations to better assess their cash flows.

Theoretical Framework and Hypothesis Development

Theoretical Integration: Dynamic Capabilities Theory and Trade-Off Theory of Working Capital Management

The Dynamic Capabilities Theory focuses on a firm's capability to efficiently coordinate, integrate and recombine internal and outside resources in ever-changing business environments (Teece et al., 1997). This theory is useful for this study as it emphasizes the changing relationships between CCC (DIO, DRO, and DPO) (Song et al., 2019). It highlights the ways firms adapt their working capital management policies in response to the changing environment. External antecedents like capital intensity, sales surprise, and firm size are conditions that compel firms to show their dynamic capability in the management of their CCC (Eisenhardt & Martin, 2000). The concept that underpins this theory brings to the importance of agility in operational efficiency; for instance, management of inventory in supply chain on one hand, and ability to manage both receivables and payables in supply chain finance on the other.

The Trade-Off Theory of Working Capital Management shows that firms face trade-offs when managing working capital components; it points out the balance of liquidity and profitability proposed by Smith (1980) and Walker (1964). This theory is suitable for the current study because it focuses on the interaction between constituent parts of the CCC, which is crucial in managing these trade-offs (Aktas et al., 2015). For instance, increasing DPO may lead to a decrease in liquidity, but it can be influenced by suppliers or may lead to high cost, on the other hand, decreasing DRO may increase cash flow, but it may be a limitation to sales (García-Teruel & Martínez-Solano, 2007). Applying this theory helps to understand how these trade-offs occur over time and identify other factors such as the size of the company or its sales fluctuation that can be used to further adjust the chosen CCC components. This study extended the operational and strategic management of working capital management by integrating these two

ISSN Online: 3007-3154
ISSN Print: 3007-3146

theories.
Therefore, the two theories provide a solid theoretical framework for this research. The Dynamic Capabilities Theory highlights flexibility, which is necessary in CCC management (Teece et al., 1997; Eisenhardt & Martin, 2000) while the Trade-Off Theory explain fundamental financial balancing in working capital management (Smith, 1980; Walker, 1964).

Hypothesis development

Various inventory management theories and inventory observations in businesses of retail nature support that relationship between gross margins and inventory turnover is suggested. This correlation happens for a number of reasons. The first is that higher gross margins increase the optimal order quantity, which generates higher expected inventory levels (Nahmias, 2008; Cachon & Terwiesch, 2005). However, there is a cost tradeoff between underage and overage costs. Second, higher product prices could lead to a decrease in average demand, increase in safety stock levels and lower inventory turns (Gaur et al., 2005)
Similarly, higher priced products with shorter life cycles can complicate demand forecasting, resulting in slower inventory turnover. Improving transportation efficiency can shorten the lead time but may increase direct costs and therefore change gross margin (Johnston, 2014). Finally, there is a correlation, for the most part, of a higher GPM with a higher product quality, which results in slower inventory turns because of a longer product's stock life or lower obsolescence. This hypothesis is further supported by observations from retail businesses where managers typically set relatively low inventory turnover goals for products with high markups, that is, margins. Gaur et al., 2005; Rumyantsev & Netessine, 2007; Kolias et al., 2011; Shan and Zhu, 2013; Rajagopalan, 2013; Johnston, 2014; Lee et al., 2015; Gaur and Kesavan, 2015; Hançerlioğulları et al., 2016; Kwak, 2019; Breivik, 2019; Sano et al., 2020; and Yousaf et al., 2023) for retail and public firms across different industries: For this reason, firms are likely to have higher gross margins, and therefore will have a tendency to carry more inventory.
H1. DIO is negatively correlated with gross profit margin.
Capital intensity refers to the portion of a company's total assets that relate to fixed assets, for example warehouses, technology systems and logistics infrastructure. Investment in fixed assets absorbs a lot of capital and results in high capital intensity to a company. This investment in the retail sector is typically related to spending on logistics facilities, the infrastructure of the supply chain, warehouses, and information technology systems (Yousaf et al., 2023).
According to Cachon and Fisher, (2000) the level of capital intensity of retail organizations can significantly affect inventory productivity. A higher capital intensity perhaps signifies that the retailer has the appropriate infrastructure to competently manage inventory. This will result in improved operational efficiency, and turnover rates. Several research papers show that higher capital intensity has a positive effect on inventory productivity in retail organizations. These studies were conducted in various contexts, such as the US and Greek retail industries: The results by Gaur et al., (2005) and Gaur and Kesavan, (2015) do so in the US, while Kolias et al., (2011) do so for a large sample of European

ISSN Online: 3007-3154
ISSN Print: 3007-3146

firms, and examine US public firms in general (Rumyantsev and Netessine, 2007; Lee et al., 2015).

But there are studies that contradict these. According to Rajagopalan (2013), when additional variables are considered apart from those implied in the earlier research, the importance of capital intensity reduces. In addition, Johnston, (2014) found a reverse relationship between capital intensity and inventory turnover. Capital investment may not be an efficient way to improve inventory management. Accordingly, there is sufficient evidence indicating that capital intensity has a positive effect on the productivity of inventory in retail organizations, but also situations in which this relationship does not hold or in which other factors affect the relationship (Hançerlioğulları et al., 2016; Kwak, 2019; Breivik, 2019; Sano et al., 2020; Yousaf et al., 2023).

H2. DIO is positively correlated with capital intensity.

In some scenarios, DIO and sales surprise might be positive correlated, which means that firms with poor inventory management (high DIO) are more vulnerable to sales surprises because the inventory adjustment to market demand revisions is problematic. Alternatively, companies with low DIO will have less surprise with their sales as a result of highly efficient inventory management. But correlations change significantly depending on the particular characteristics of each industry, the condition of the market, and the business model. This hypothesis has been studied in various studies (Gaur et al., 2005; Rumyantsev & Netessine, 2007; Kolias et al., 2011; Rajagopalan, 2013; Johnston, 2014; Lee et al., 2015; Gaur and Kesavan, 2015; Hançerlioğulları et al., 2016; Breivik, 2019; Sano et al., 2020; Mahajan et al., 2023; and Yousaf et al., 2023).

H3. DIO is positively correlated with sales surprise.

The study is focused on the issues of working capital management, particularly the relationship between tangible Fixed Assets investing and cash conversion cycle (CCC) controlling. It emphasizes the role of these components in measuring the financial health of a company. Despite their role, the degree to which the CCC depends on these tangible fixed assets remains somewhat unclear because the findings of various studies disagree with one another. According to Fazzari and Petersen, (1993) the development could be a negative relationship in which case firms with a lot of investment in fixed assets could have a shorter CCC. On the other hand, Kieschnich et al., (2013) show that companies with more tangible fixed assets can have stretched CCC because of lower financial stability. The disparity in working capital dynamics means that covered processes occur in isolation from other elements of the working capital cycle and that these processes are not properly understood. In addition, it quantifies the different variables that can affect the CCC, all the way from credit policy to credit policy or cycle lengths of production and sales to cycle lengths of inventory and the way cash inflows and outflows are managed. Further, it describes how money market imperfections affect cash holdings as well as the provision of extended trade credit to customers and concludes that the presence of these imperfections may give rise to financial decisions. In addition, the notion brought up by Kolias et al., (2020) proposing that investing in tangible fixed assets can help control working capital management, and connects between CCC and factors which affect production, sales cycle and credit policies. Finally, it suggests a link between accounts receivable and old assets as an indicator of growth potential in a

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

company and that confirms the interrelation between tangible assets, working capital management and business growth outcome.

H4. DRO is positively correlated with old assets.

Gentry and De La Garza, (1990) explored the reasons why businesses do not only grant credit and found that among the factors influencing the level of company indebtedness to its suppliers, but the suppliers' willingness also to grant credit, and the customers' ability to repay debts promptly, have been considered. Another study by Petersen and Rajan, (1997) concluded larger firms are more likely to obtain trade credit because a large firm is perceived as a more reliable borrower and therefore, is at lesser risk to default in paying back trade credit on time. This means the size of a company is used to determine the amount of trade credit the company will receive.

H5. DPO is positively correlated with Firm size.

The research shows causal relationships between inventory, accounts receivable and accounts payable in the wholesale sector, exhibiting involves mutual endogeneity. Kolas et al. (2020). Both accounts payable and accounts receivable to each other. Most importantly, the study stresses differences in the reasons behind the effect of inventory on receivables in comparison to the effect of receivables on inventory.

The relationship between DIO and DRO is subject to change based on industry standards, market standards, company strategy, the efficiency of the supply chain system and the conditions of the market (Wang et al., 2019). A positive association between DIO and DRO might be common, suggesting a propensity for those firms with a long mean period for inventory turnover to also have a long mean period for recording receivables collections (Kolias et al., 2020).

Delaying payments to suppliers (DPO) and taking on higher inventory (DIO) when possible, both can extend the cash conversion cycle, benefiting short term liquidity and perhaps negotiation leverage. The interplay between all these factors gives companies options to increase operational efficiency, manage cash flow and strategically place within their industries. Nevertheless, the relationship between DPO and DIO is also shaped by industry specific factors and competitive strategies whereby companies change their DPO and DIO to comply with industry standards and win competitive edge (Chen et al., 2022; Seifert et al., 2016).

Days Sales Outstanding (DSO) and Days to Pay Accounts Payable (DTP) are negatively related, so a decrease in DSO often corresponds to a decrease in DTP, which means progress in financial efficiency in both receiving payments from customers and paying the bills. Trade credit, an important part of corporate finance, has many advantages, among which is the decrease of the volume of accounts payable as a way to increase the cash flow and the liquidity and creation of advantageous connections between the companies by running over the zones of the information gaps and uncertainty in respect to the goods quality. Furthermore, trade credit, with inventories, is critical to business daily operations as indicated by its significance in maintaining financial stability and operational continuity (Marques, 2010).

H6. CCC components are simultaneously determined.

Methodology

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

Sample

Public-listed non-financial firms that are listed on Pakistan stock exchange (PSX) are targeted from various sectors. According to the market capitalization, 170 firms were selected for the initial sample. To refine the data, some firms are excluded from the sample, such as those firms that are defaulted and bankrupt during the study period 2010 – 2023, and companies with the missing data are also removed from the initial sample. Following the exclusion criteria, the final sample of non-financial firms was composed of 126. The data spans from 2010 to 2023 and has been meticulously sourced from the State Bank of Pakistan and the official websites of companies. In order to conduct a thorough analysis, balanced panel data comprising 1764 observations was created, and EViews 10 software was used for this purpose. The sample firms were selected from a diverse range of sectors, as illustrated in the comprehensive Table 1 provided below.

Table 1: Sample per sector

Sr. No.	Sectors	No. of firms
1	Automobile	14
2	Cables and Electrical Goods	5
3	Cement	14
4	Chemicals	13
5	Engineering	5
6	Fertilizers	2
7	Food & Personal Care Products	11
8	Glass & Ceramics	6
9	Leather & Tanneries	2
10	Miscellaneous	3
11	Oil & Gas Exploration & Marketing Companies	6
12	Paper and Board	7
13	Pharmaceuticals	4
14	Power Generation & Distribution	5
15	Refinery	4
16	Sugar & Allied Industries	9
17	Textiles	13
18	Tobacco	2
19	Transport	1
	Total	***126***

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

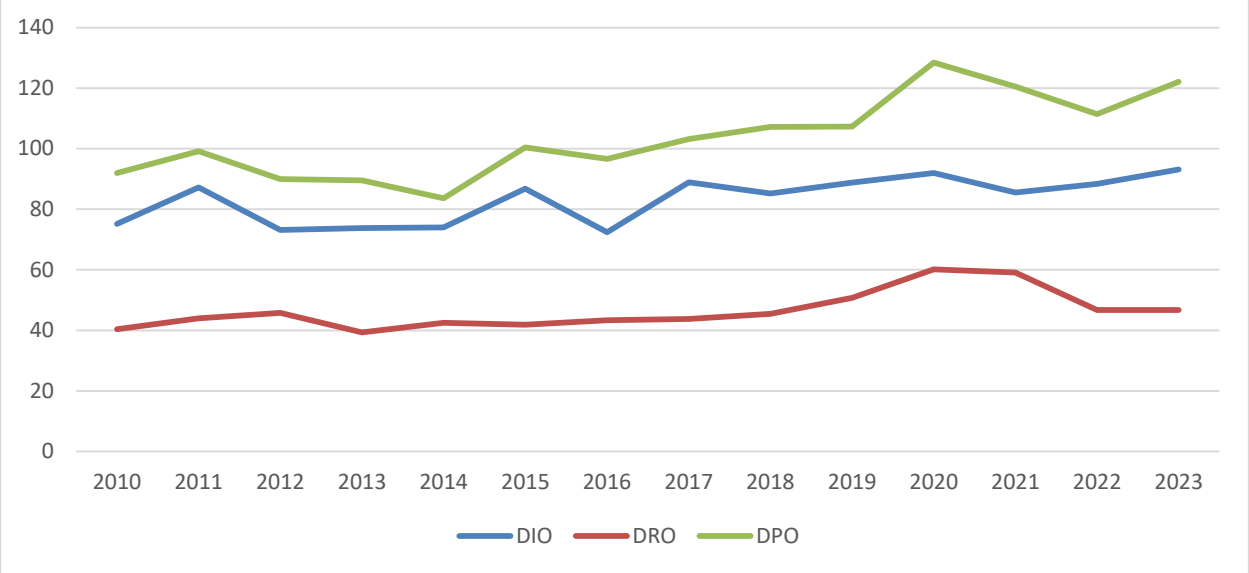

Figure 1 depicts the trend in the average values of Days Inventory Outstanding (DIO), Days Receivable Outstanding (DSO), and Days Payables Outstanding (DPO) from 2010 to 2023.

Variables and Measurement

In the following sections, we have mentioned endogenous, exogenous, and instrumental variables. The exogenous variables DIO, DPO, and DRO were studied, along with the endogenous variables, in the models presented below. Please refer to Table 2 for a detailed outline of the study variables and their measurements.

Table 2: Variables and their measurement

Variables type	Variables name	Abbreviation	Variable Measurement	Literature
Exogenous variable	Days Inventory Outstanding	$DIO_{i,t}$	$\frac{365 \times inventory_{it}}{cogs_{it}}$	Kolias et al., (2020)
	Days Receivable Outstanding	$DRO_{i,t}$	$\frac{365 \times recivable_{it}}{sales_{it}}$	
	Days Payable Outstanding	$DPO_{i,t}$	$\frac{365 \times payable_{it}}{cogs_{it}}$	
Endogenous Variables	Days Inventory Outstanding	$DIO_{i,t}$	$\frac{365 \times inventory_{it}}{cogs_{it}}$	
	Days Receivable Outstanding	$DRO_{i,t}$	$\frac{365 \times recivable_{it}}{sales_{it}}$	
	Days Payable Outstanding	$DPO_{i,t}$	$\frac{365 \times payable_{it}}{cogs_{it}}$	
	Days Inventory Outstanding	$DIO_{i,t-1}$	$DIO_{i,t-1}$	

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

	with a time lag			
	Days Receivable Outstanding with a time lag	$DRO_{i,t-1}$	$DRO_{i,t-1}$	
	Days Payable Outstanding with a time lag	$DPO_{i,t-1}$	$DPO_{i,t-1}$	
Instrumental Variables	Gross Profit Margin	$GPM_{i,t}$	$\frac{revenue_{it} - cogs_{it}}{revenue_{it}}$	(Gaur et al., 2005; Kolias et al., 2011; Rajagopalan, 2013; Johnston, 2014, Lee et al., 2015; Sano et al., 2021; Yousaf et al., 2023).
	Capital Intensity	$CI_{i,t}$	$\frac{net\ fixed\ assets_{it}}{net\ fixed\ assets_{it} + inventory_{it}}$	
	Sales Surprise	$SS_{i,t}$	$\frac{sales_{it}}{SalesPrediction_{it}}$	
	Firm Size	$Size_{i,t}$	Natural logarithm of Total Assets	(Petersen and Rajan, 1997; Banos-Caballero et al., 2010; Kolias et al., 2020); Sajid et al., 2023).
	Old Assets	$Oldassets_{i,t}$	$\frac{net\ fixed\ assets_{it}}{depreciation_{it}}$	(Ferrando and Mulier, (2013); Kolias et al., 2020)

Endogenous (Dependent) variable

This study analyses the internal factors that affect a company's working capital. Specifically, the variables being examined are the components of CCC, computed by adding the days inventory outstanding and the days receivable outstanding and then subtracting the days payable outstanding. DIO measures the time a company holds onto its inventory and is derived by dividing inventory by the cost of goods sold. Meanwhile, DRO indicates the time frame in which a company collects customer payments after a sale and is calculated by dividing accounts receivable by total sales. Lastly, DPO shows how long a company takes to pay off its financial obligations to suppliers and is determined by dividing accounts payable by total sales. These metrics have been previously used in research, such as in the study by Kolias et al., (2020). The following formulas can be used to calculate DIO, DRO, and DPO.

$$DIO_{it} = \frac{365 \times inventory_{it}}{cogs_{it}}$$

$$DRO_{it} = \frac{365 \times recivable_{it}}{sales_{it}}$$

$$DPO_{it} = \frac{365 \times payable_{it}}{cogs_{it}}$$

Where, the analysis spans the years (t = 2010, ..., 2019) for each firm $\boldsymbol{i}$, considering DIO, DRO, DPO, inventory, receivable, payable, cogs and sales

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

levels.

Exogenous (Independent) variable

The aforementioned endogenous variables are considered exogenous variables. Time lag analyses past value and historical trends affecting the current state of DIO, DRO, and DPO within the simultaneous system equations. The lagged measures, expressed as $DIO_{i,t-1}$, $DRO_{i,t-1}$ and $DPO_{i,t-1}$ is taken from Kolias et al., (2020).

Instrumental (Control) variables

This study's control variables are crucial in determining inventory, accounts receivable, and accounts payable management. The three determinants of inventory management for analyzing inventory levels include the Capital Intensity (CI), Gross Profit Margin (GPM), and Sales Surprise. The CIR measures the degree to which a company employs capital-intensive assets. It is calculated by dividing a firm's net fixed assets (capital expenditures) by the sum of inventory and net fixed assets.

$$CI_{it} = \frac{net\ fixed\ assets_{it}}{net\ fixed\ assets_{it} + \quad inventory_{it}}$$

Gross Profit margin (GPM) is defined as the ratio of sales minus cogs divided by sales.

$$GPM_{it} = \frac{revenue_{it} - \ cogs_{it}}{revenue_{it}}$$

Sales surprise (SS) measures the difference between actual sales and predicted sales (Sales Forecast). It reveals the extent to which a company's sales decline from market expectations.

$$SS_{it} = \frac{sales_{it}}{SalesPrediction_{it}}$$

As the sales prediction data are not publicly available, the evaluation relies on historical data and is executed using Holt's linear, exponential smoothing technique. The sales prediction of the firm is,

$$Sales\ Prediction_{it} = \ L_{i,t-1} + \ T_{i,t-1}$$

Where $L_{i,t-1}$ and $T_{i,t-1}$ are defined as,

$$L_{i,t-1} = \ \alpha.Sales_{i,t} + (1 - \ \alpha)\ (L_{i,t} + \ T_{it})$$
$$T_{i,t-1} = \ \beta.\left(T_{it} - \ L_{i,t-1}\right) + (1 - \beta)T_{i,t-1}$$

Constant weights $\alpha, \beta\ \{\alpha, \beta\ \epsilon\ [0.6, 0.4]\}$ are applied, with multiple values assessed to minimize the forecasting error. These measures including capital intensity ratio, gross profit margin and sales surprise drawn on the research studies (Gaur et al., 2005; Kolias et al., 2011; Rajagopalan, 2013; Rumyantsev and Netessine, 2007; Johnston, 2014; Lee et al., 2015; Kolias et al., 2020; Sano et al., 2021; Yousaf et al., 2023).

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

Where, the analysis spans the years (t = 2010, ..., 2023) for each firm ***i***, considering net fixed assets, inventory, receivable, payable, COGS, and sales levels.

According to Kolias et al., (2020), a key factor affecting accounts receivable is the degree of growth opportunities represented by old assets. The term "Old assets" reflecting the age of fixed assets, are calculated by dividing net fixed assets into accumulated depreciation.

$$Oldassets_{it} = \frac{net\ fixed\ assets_{it}}{depreciation_{it}}$$

Where, the analysis spans the years (t = 2010, ..., 2023) for each firm ***i***, considering net fixed and accumulated depreciation levels.

Additionally, Firm Size is the factor which influences accounts payable and is determined by natural logarithm of total assets. This calculation is in line with the studies (Petersen and Rajan, 1997; Banos-Caballero et al., 2010; Kolias et al., 2020; Sajid et al., 2023).

Models and Estimation technique

Upon reviewing the literature discussed earlier, we analyzed the models for Days Inventory Outstanding, Days Receivables Outstanding, Days Payable Outstanding, and their relevant determinants. These models shed light on the significance of time and various aspects of working capital management, and the most effective approach is to incorporate the time effect into the equation. As a result, we estimated DIO, DRO, and DPO as endogenous variables within the equations, determined simultaneously. Furthermore, log-linear models demonstrated the relationship between the determinants of working capital management.

S1 defines the equation of Days inventory outstanding as follows:

$$logDIO_{it} = F_i + \beta_{11}logDRO_{it} + \beta_{12}logDPO_{it} + \beta_{13}logGPM_{it} + \beta_{14}logCI_{it} + \beta_{15}logSS_{it} + \beta_{16}logDIO_{i,t-1} + u_{it}$$

S2 defines the equation of Days receivable outstanding as follows:

$$logDRO_{it} = R_i + \beta_{21}logDPO_{it} + \beta_{22}logDIO_{it} + \beta_{23}logOldassets_{it} + \beta_{16}logDRO_{i,t-1} + \eta_{it}$$

S3 defines the equation of Days payable outstanding as follows:

$$logDPO_{it} = P_i + \beta_{31}logDSO_{it} + \beta_{32}logDIO_{it} + \beta_{23}logSize_{it} + \beta_{16}logDPO_{i,t-1} + e_{it}$$

Despite these above-mentioned equations, coefficient with exogenous variable, control variable, and the error terms (residuals) u_{it} , η_{it} *and* e_{it} were used, incorporating factors such as the intercepts F_i , R_i and P_i. These intercepts illustrate distinct effects, such as variations in accounting techniques and managerial abilities, while maintaining the consistency of their firm-specific effects. To mitigate the influence of heterogeneity, subject-specific parameters were included.

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

We have previously discussed control variables and how endogenous variables incorporate a time lag as an explanatory factor in each equation. This sheds light on past values' impact on the endogenous variable's current values. It is important to note that working capital elements are evaluated simultaneously and exogenously in individual equations using inconsistent estimators, as Greene, (2003) outlined. Appropriate methods were employed to examine the systems of simultaneous equations.

When fixed effects occur, the study models were estimated through the first difference of observation or employing a mean-centering transformation. This research chose the first difference transformation due to several factors. Firstly, applying mean-centering transformation within a model variable where the explanatory variable is an endogenous variable with a time lag causes inconsistent coefficient estimation (Wooldridge, 2002). Secondly, the variable's value may change as new data is included each year, and due to the instrument stability assumption, this model is unsuitable for forecasting.

Therefore, by applying the first difference transformation to individual variables, the S1-S3 equation systems transformed into:

$$\begin{aligned}\Delta logDIO_{it} = {} & \alpha_{10} + \beta_{11}\Delta logDRO_{it} + \beta_{12}\Delta logDPO_{it} + \beta_{13}logGPM_{it} + \beta_{14}\Delta logCI_{it} \\ & + \beta_{15}\Delta logSS_{it} + \beta_{16}\Delta logDIO_{i,t-1} + \Delta u_{it} \\ \Delta logDRO_{it} = {} & \alpha_{20} + \beta_{21}\Delta logDPO_{it} + \beta_{22}\Delta logDIO_{it} + \beta_{23}logOldassets_{it} \\ & + \beta_{24}\Delta logDRO_{i,t-1} + \Delta\eta_{it} \\ \Delta logDPO_{it} = {} & \alpha_{30} + \beta_{31}\Delta logDRO_{it} + \beta_{32}\Delta logDIO_{it} + \beta_{33}logSize_{it} \\ & + \beta_{34}\Delta logDPO_{i,t-1} + \Delta e_{it}\end{aligned}$$

The symbol Δ is used to represent the first differences in individual variables. These equations are known as structural equations, where the parameters analyzed are the structural parameters. This formulation illustrates the relationship between each endogenous variable and exogenous variable, resulting in the reduced form of equations S4, S5, and S6, which are outlined as follows:

$$\begin{aligned}S4{:}\ \Delta logDIO_{it} = {} & \gamma_{10} + \gamma_{11}\Delta logDRO_{i,t-1} + \gamma_{12}\Delta logDPO_{i,t-1} + \gamma_{13}\Delta logDIO_{i,t-1} + \\ & \gamma_{14}\Delta logSize_{it} + \gamma_{15}\Delta logOldassets_{it} + \gamma_{16}\Delta loGPM_{it} + \\ & \gamma_{17}\Delta logCI_{it} + \gamma_{18}\Delta logSS_{it} + \upsilon_{it} \\ S5{:}\ \Delta logDRO_{it} = {} & \gamma_{20} + \gamma_{21}\Delta logDRO_{i,t-1} + \gamma_{22}\Delta logDPO_{i,t-1} + \gamma_{23}\Delta logDIO_{i,t-1} + \\ & \gamma_{24}\Delta logSize_{it} + \gamma_{25}\Delta logOldassets_{it} + \gamma_{26}\Delta logGPM_{it} + \\ & \gamma_{27}\Delta logCI_{it} + \gamma_{28}\Delta logSS_{it} + \theta_{it} \\ S6{:}\ \Delta logDPO_{it} = {} & \gamma_{30} + \gamma_{31}\Delta logDRO_{i,t-1} + \gamma_{32}\Delta logDPO_{i,t-1} + \gamma_{33}\Delta logDIO_{i,t-1} + \\ & \gamma_{34}\Delta logSize_{it} + \gamma_{35}\Delta logOldassets_{it} + \gamma_{36}\Delta logGPM_{it} + \\ & \gamma_{37}\Delta logCI_{it} + \gamma_{38}\Delta logSS_{it} + \omega_{it}\end{aligned}$$

The system's structural equations parameter α_1 to α_{34} influence the structural coefficients of γ_{10} to γ_{38}. An over-identification occurs in the system of three equations due to the order condition test. Various techniques, including

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

generalized methods of moments (GMM), full information maximum likelihood (FIML), and three-stage least square methods with instrumental variables, can be used to analyze the system of equations. Three-stage least square is considered equivalent to FIML when residuals are normally distributed, providing efficient estimators for over-identified equations and associated residuals. The error terms of the system equations S4-S6 are likely to be autocorrelated and heteroskedastic, as in many panel data analyses involving financial and accounting variables.

In this study, a GMM model with instrumental (control) variables is used. The evaluation of this technique is dynamic compared to other methods, with normality being a satisfactory condition (Greene, 2003). These instrumental variables are included in the system equation as exogenous variables. While this estimation technique is commonly used in the field of simultaneous equation systems, the modification on panel data was initially established by Baltagi, (1981), resulting in the introduction of the three-stage least squares estimation method, known as EC3SLS (error components three-stage least squares). Prucha, (1985) proposed the FIML estimation model, and Cornwell et al., (1992) analyzed the effectiveness of different estimators, observing the occurrence of random or fixed effects.

Endogeneity

In order to account for endogeneity, which may arise as a result of the simultaneous determination of CCC components in the model, the study employs the Error Correction Three Stage Least Squares (EC3SLS) method. The use of this approach enables the correction of endogeneity by incorporating both long–run equilibrium relationships and short–run adjustments within the system of equations to correctly model the endogenous relationships between the variables (Wooldridge, 2002; Kolias et al., 2020).

Multicollinearity

The explanatory (endogenous) variables were assessed for multicollinearity by computing Variance Inflation Factors (VIFs). It was found that the VIF values were within acceptable limits (usually below 5), thus there are no major multicollinearity concerns for the model. The reason for this is to avoid having the relations among the endogenous variables overly correlated and therefore destroying the integrity of the estimated coefficients (Lind et al., 2012; Gujarati, 2003; Mwangi, 2016).

Descriptive Statistics

Table 3: Descriptive Statistics

Variables	Observations	Mean	Maximum	Minimum	Std. De
$\Delta logDIO_{it}$	1764	-0.019	1.000	-5.823	0.250

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

$\Delta logDRO_{it}$	1764	0.008	79.054	-88.186	1.074
$\Delta logDPO_{it}$	1764	-0.012	1.000	-4.237	0.200
$\Delta logSize$	1764	0.000	1.000	-0.108	0.031
$\Delta logOldassets_{it}$	1764	-0.007	8.604	-11.558	0.529
$\Delta logGPM_{it}$	1764	-0.029	1.000	-16.609	0.761
$\Delta logCI_{it}$	1764	-0.278	1.000	-60.310	2.106
$\Delta logSS_{it}$	1764	-53.434	144.739	-93277.500	2221.131

Note(s): Variables description is discussed in Table 2.
Source(s): Created by authors

Table 3 displays the descriptive statistics for the components that make up working capital. The average $\Delta logDIO_{it}$ is -0.019, with a standard deviation of 0.250, indicating a low degree of variation. Similarly, $\Delta logDRO_{it}$ has a mean of 0.008, with a standard deviation of 0.6994, indicating a moderate degree of variability. Additionally, $\Delta logDPO_{it}$ has a mean value of -0.012, with a low standard deviation of 0.200. $\Delta logSize_{it}$ has a mean value of 0.000, with a low variability standard deviation of 0.031. $\Delta logOldassets_{it}$ has a mean value of -0.007, with a standard deviation of 0.529, showing a moderate variability. $\Delta logGPM_{it}$ has a mean of -0.029, with a standard deviation of 0.761, implying high variability. $\Delta logCI_{it}$ has a mean value of -0.278, with a higher standard deviation of 2.106. Lastly, has a mean value of $\Delta logSS_{it}$ is -53.434, with a standard deviation of 2221.131, showing an extremely high variability.

Correlation Matrix

Table 4: Correlation Matrix

	$\Delta logDIO_{it}$	$\Delta logDRO_{it}$	$\Delta logDPO_{it}$	$\Delta logCI_{it}$	$\Delta logGPM_{it}$	$\Delta logSS_{it}$
$\Delta logDIO_{it}$	1					
$\Delta logDRO_{it}$	-0.017	1				
$\Delta logDPO_{it}$	0.102	0.023	1			
$\Delta logCI_{it}$	0.481	0.004	-0.026	1		
$\Delta logGPM_{it}$	-0.064	-0.014	-0.082	0.016	1	
$\Delta logSS_{it}$	-0.01	0	-0.015	-0.004	0.006	1

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

$\Delta logOldassets_{it}$	0.042	-0.001	0.077	-0.041	-0.014	0
$\Delta logSize_{it}$	0.13	0.015	0.104	-0.071	0.007	0.003

Note(s): Variables description is discussed in Table 2.

Source(s): Created by authors

The correlations matrix in Table 4 shows the correlation between various components of working capital, such as $\Delta logDIO_{it}$, $\Delta logDRO_{it}$, $\Delta logDPO_{it}$, $\Delta logCI_{it}$, $\Delta logGPM_{it}$, $\Delta logSS_{it}$, $\Delta logOldassets_{it}$, and $\Delta logSize_{it}$. Among these, $\Delta logDPO_{it}$ (r = 0.102), $\Delta logCI_{it}$ (r = 0.481), $\Delta logOldassets_{it}$ (r = 0.042), and $\Delta logSize_{it}$ (r = 0.130) demonstrated positive correlations with $\Delta logDIO_{it}$, whereas $\Delta logDRO_{it}$ (r = -0.017), $\Delta logGPM_{it}$ (r = -0.064) and $\Delta logSS_{it}$ (r = -0.010) shows a negative correlations with $\Delta logDIO_{it}$. Additionally, $\Delta logDPO_{it}$ (r = 0.023), $\Delta logCI_{it}$ (r = 0.004), $\Delta logSS_{it}$ (r = 0.000), and $\Delta logSize_{it}$ (r = 0.015) shows a positive correlations with $\Delta logDRO_{it}$, while $\Delta logGPM_{it}$ (r = -0.001) and $\Delta logOldassets_{it}$ (r = 0.042) shows a negative correlations with $\Delta logDRO_{it}$. Furthermore, $\Delta logOldassets_{it}$ (r = 0.077) and $\Delta logSize_{it}$ (r = 0.104) shows a positive correlations with $\Delta logDPO_{it}$, in contrast $\Delta logCI_{it}$ (r = -0.026), $\Delta logGPM_{it}$ (r = -0.082) and $\Delta logSS_{it}$ (r = -0.015) presents a negative correlations with $\Delta logDPO_{it}$. Likewise, $\Delta logCI_{it}$ has a positive correlation with $\Delta logGPM_{it}$ (r = 0.016), on the other hand has a negative correlations with $\Delta logSS_{it}$ (r = -0.004), $\Delta logOldassets_{it}$ (r = -0.041) and $\Delta logSize_{it}$ (r = -0.071). Moreover, $\Delta logGPM_{it}$ has a positive correlations with $\Delta logSS_{it}$ (r = 0.006) and $\Delta logSize_{it}$ (r = 0.007) but has a negative correlation with $\Delta logOldassets_{it}$ (r = -0.014). Although, $\Delta logSS_{it}$ has a positive correlations with $\Delta logOldassets_{it}$ (r = 0.000) and $\Delta logSize_{it}$ (r = 0.003). Lastly, $\Delta logOldassets_{it}$ has a positive correlation with $\Delta logSize_{it}$ (r = 0.044).

Estimation of Models with Simultaneously Determined System Equation for Components of Working Capital

By employing the estimated coefficients (b_{11}, b_{12}, b_{21}, b_{22}, b_{31}, and b_{32}) in system structural equation S1 – S3, which permits us to conclude the relationship between inventories accounts receivable and accounts payable.

The estimated coefficients of the endogenous variable in all three structural equations are found to be statistically significant, which suggests that the working capital manager simultaneously determines decisions about the level of inventories, receivables, and payables. The simultaneous determination of coefficients allows us to determine the cause-and-effect relationship between various components of working capital.

The study utilized an EC3SLS regression model to analyze panel data, simultaneously assessing endogenous and exogenous variables with control variables to test hypotheses. The results, presented in Tables 5,6 and 7, offer

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

valuable insights into the relationships among various components of working capital, providing a significant contribution to the study. Additionally, the outcomes derived from the estimation of reduced form equations S4 – S6 further add to the significance of our findings.

Table 5: Results of Simultaneously Identified System Equations for Working Capital Components

Inventories Equation S1: Endogenous Variable $\Delta logDIO_{it}$		
Variables	**Coefficient**	**t-Statistic**
Intercept	-0.025*	-5.246
$\Delta logDRO_{it}$	-0.001*	-2.297
$\Delta logDPO_{it}$	0.111*	2.020
$\Delta logGPM_{it}$	-0.017*	-2.682
$\Delta logCI_{it}$	0.054*	5.198
$\Delta logSS_{it}$	0.000	0.090
$\Delta logDIO_{i,t-1}$	0.094*	9.483
Observation	1764	
R-squared	0.301	
Adj. R-squared	0.298	
Standard Error	0.209	
Receivable Equation S2: Endogenous Variable $\Delta logDRO_{it}$		
Variables	**Coefficient**	**t-Statistic**
Intercept	0.008	0.108
$\Delta logDPO_{it}$	0.469	1.336
$\Delta logDIO_{it}$	-0.293	-1.361
$\Delta logOldassets_{it}$	-0.012	-0.336
$\Delta logDRO_{i,t-1}$	-0.008	-0.385
Observation	1764	
R-squared	0.000	
Adj. R-squared	-0.001	
Standard Error	3.739	
Payables Equation S3: Endogenous Variable $\Delta logDPO_{it}$		
Variables	**Coefficient**	**t-Statistic**
Intercept	-0.029*	-6.376
$\Delta logDRO_{it}$	0.001	1.831
$\Delta logDIO_{it}$	0.052	1.638
$\Delta logSize_{it}$	0.500	1.198
$\Delta logDPO_{i,t-1}$	0.084*	11.702
Observation	1764	
R-squared	0.114	
Adj. R-squared	0.111	
Standard Error	0.193	
Note(s): *p < 0.05 and variables details (measurement) are given in Table 2		
Source(s): Created by authors		

Table 5 shows the outcomes of the estimations from a model involving system

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

equations that simultaneously identify various components of working capital.

The Impact of Days Inventory Outstanding on Days Receivable Outstanding and Days Payable Outstanding

In Model S1, endogenous variable is $\Delta logDIO_{it}$, and exogenous variable includes $\Delta logDRO_{it}$ and $\Delta logDPO_{it}$, along with four instrumental variables: $\Delta logGPM_{it}$, $\Delta logSS_{it}$, $\Delta logCI_{it}$ and $\Delta logDIO_{i,t-1}$. The coefficient of determination, R-squared, is 0.301, indicating that the regression model explains 30.1% of the variation. The results indicate that variables are significant at 5%. $\Delta logDRO_{it}$, $\Delta logDPO_{it}$, $\Delta logGPM_{it}$, $\Delta logCI_{it}$, and $\Delta logDIO_{i,t-1}$ were significantly associated with $\Delta logDIO_{it}$, while other variables remain unchanged. Whereas 1% increase in $\Delta logDRO_{it}$ leads to an -0.1% decrease in $\Delta logDIO_{it}$,this shows that $\Delta logDRO_{it}(\beta = -0.001, p < 0.05)$ has a negative relationship with $\Delta logDIO_{it}$. However, 1% increase in $\Delta logDPO_{it}$ leads to an 11% increase in $\Delta logDIO_{it}$, this shows that $\Delta logDPO_{it}$ $(\beta = 0.111, p < 0.05)$ has a positive relationship with $\Delta logDIO_{it}$. Moreover, 1% increase in $\Delta logGPM_{it}$ causes a -1.7% decrease in $\Delta logDIO_{it}$, and shows that $\Delta logGPM_{it}$ $(\beta = -0.017, p < 0.05)$ has a negative relationship with $\Delta logDIO_{it}$. Furthermore, a 1% increase in $\Delta logCI_{it}$ generates a 5.4% increase in $\Delta logDIO_{it}$, this also shows that $\Delta logCI_{it}$ (β = 0.054, p < 0.05) has a positive effect on $\Delta logDIO_{it}$. Lastly, $\Delta logDIO_{it}$ the impact of one-year dependent lagged variable $\Delta logDIO_{i,t-1}$ $(\beta = 0.094, p < 0.05)$ is positive, which indicates that 1% increase in $\Delta logDIO_{i,t-1}$ leads to an 9.4% in $\Delta logDIO_{it}$. Based on these results, hypotheses H1 and H2 are supported by this study, while H3 are not supported.

The Impact of Days Receivable Outstanding on Days Payable Outstanding and Days Inventory Outstanding

In Model S2, an endogenous variable is $\Delta logDRO_{it}$ and the exogenous variables are $\Delta logDPO_{it}$ and $\Delta logDIO_{it}$, along with two instrumental variables: $\Delta logOldassets_{it}$ and $\Delta logDRO_{i,t-1}$. The R-squared is 0.00, indicating that only 0% of the variation is explained by the regression model. In the case of, $\Delta logDRO_{it}$ all variables are not significant. Based on these findings, hypotheses H4 is not supported by this study.

The Impact of Days Payable Outstanding on Days Receivable Outstanding and Days Inventory Outstanding

In Model S3, an endogenous variable is $\Delta logDPO_{it}$ and the exogenous variable $\Delta logDRO_{it}$ and $\Delta logDIO_{it}$, along with two instrumental variables $\Delta logSize_{it}$ and $\Delta logDPO_{i,t-1}$. The R-squared is 0.114, indicating that the regression model explains 11.4% of the variation. The effect of one-year dependent lagged variable $\Delta logDPO_{i,t-1}(\beta = 0.084, p < 0.05)$ is positive, which indicates that 1% increase in $\Delta logDPO_{i,t-1}$ leads to an 8.95 % in $\Delta logDPO_{it}$, while other variables show insignificant relationship. According to these results, hypotheses H5 is not supported by the study.

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

Table 6: Summary of the relationship between DIO, DRO and DPO

	DRO→DIO	DPO→DIO	DIO→DRO	DPO→DRO	DIO→DPO	DRO→DPO	DIO↔DRO	DIO↔DPO	DRO↔DPO
Non-Financial Firms	x	X	-	x	+	x	x	x	x

Note: + represents the existence of a positive relationship; – represents the existence of a negative relationship; × represents no relationship; √ represents there is a bidirectional causal relationship between representatives

In summary, Table 6 provides an overview of the relationship between DIO, DRO, and DPO among non-financial firms in Pakistan. Based on empirical findings, a causal link does exist between these variables. However, further investigation is needed to fully understand the association between DRO and the other two variables. There is no bidirectional relationship exist among DIO , DRO and DPO.

Table 7: Estimation Results for Reduced Form Equations

	***S*4: $\Delta logDIO_{it}$**		***S*5: $\Delta logDRO_{it}$**		***S*6: $\Delta logDPO_{it}$**	
Variables	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**
Intercept	-0.029*	-5.801	-0.015	-0.168	-0.031*	-6.611
$\Delta logDRO_{i,t-1}$	0.004	0.907	-0.010	-0.428	0.028*	6.537
$\Delta logDPO_{i,t-1}$	0.013*	2.300	0.062	0.724	0.066*	10.068
$\Delta logDIO_{i,t-1}$	0.090*	9.519	0.040	0.549	0.0113	1.499
$\Delta logSize_{i,t}$	1.167*	6.045	1.695	0.990	0.4913	1.083
$\Delta logOldassets_{i,t}$	0.022*	2.939	-0.011	-0.336	0.0243	1.559
$\Delta logGPM_{it}$	-0.018*	-2.858	-0.064	-0.653	-0.015*	-2.669
$\Delta logCI_{it}$	0.056*	5.172	0.007	0.544	-0.002	-0.811
$\Delta logSS_{it}$	0.000	-1.003	0.000	0.872	0.000	0.203
Observation	1764		1764		1764	
R-squared	0.302		0.000		0.122	
Adj. R-squared	0.317		-0.003		0.118	
Standard Error	0.206		3.744		0.188	

Note(s): *p < 0.05 and variables details are given in Table 2.
Source(s): Created by authors

Table 7 provides the estimation results of reduced-form equations, where each component of working capital (endogenous variable) is expressed as a function of the exogenous variable to obtain the reduced form of the equation. The endogenous variable are $\Delta logDIO_{it}$, $\Delta logDRO_{it}$ and $\Delta logDPO_{it}$, and the exogenous variables includes $\Delta logDRO_{i,t-1}$, $\Delta logDPO_{i,t-1}$, $\Delta logDIO_{i,t-1}$,

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

$\Delta logSize_{it}$, $\Delta logOldassets_{it}$, $\Delta logGPM_{it}$, $\Delta logCI_{it}$ and $\Delta logSS_{it}$. The results of the EC3SLS model enable us to determine the various components of the CCC while examining the effects of the exogenous variables and the simultaneous impact of endogenous variables. The endogenous variables are statistically significant at 5%, respectively, in models S4 – S6.

Here are some significant findings from these estimates. In Model S4, the R-squared is 0.302, indicating that the regression model explains 30.2% of the variation. The impact of $\Delta logDIO_{i,t}$ on $\Delta logDIO_{i,t-1}$ and $\Delta logDPO_{i,t-1}$is positive, which is consistent with the previous research conducted by Kolias et al., (2020). While the findings indicate a positive association between $\Delta logsize_{it}$ and $\Delta logDIO_{i,t}$, resulting in a finding consistent with Kolias et al., (2020). Furthermore, there is a positive association between $\Delta logOldassets_{it}$ between $\Delta logDIO_{i,t}$ aligns with the findings of Kolias et al., (2020). The negative relationship between $\Delta logGPM_{it}$ and $\Delta logDIO_{it}$ are in line with prior studies (Kwak, 2019; Sano and Yamada, 2020; Yousaf et al., 2023). Lastly, the significantly positive association between the $\Delta logCI_{it}$ and $\Delta logDIO_{i,t}$ is aligned with the existing literature, including studies (Gaur et al., 200); Kolias et al.,(2011); Lee et al., 2015 ; Gaur et al., 2015 ; Sano et al., 2020; and Yousaf et al., 2023).

In Model S5, the R-squared is 0.000, indicating that 0% of the variation is attributed to the regression model. All exogenous variables were not significantly related to $\Delta logDRO_{it}$.

In Model S6, the R-squared is 0.122, indicating that the regression model explains 12.2% of the variation. The findings indicate a positive association between $\Delta logDRO_{i,t-1}$and $\Delta logDPO_{it}$, which contradicts the findings of Kolias et al., (2020), who observed a negative association between these variables. Furthermore, the impact of $\Delta logDPO_{i,t}$ on $\Delta logGPM_{it}$ is negative, which contradicts with the previous research conducted by Kolias et al., (2020). According to these results, hypothesis H6 is partially supported by this study.

Summary of Hypothesis Testing

Hypotheses	Statement	Results
H1	DIO is negatively correlated with gross profit margin.	Supported
H2	DIO is positively correlated with capital intensity.	Supported
H3	DIO is positively correlated with sales surprise.	Not Supported
H4	DRO is positively correlated with old assets.	Not Supported
H5	DPO is positively correlated with Firm size.	Not Supported
H6	CCC components are simultaneously determined.	Partially Supported

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

Discussion

The study focused on determining the simultaneous determination of cash conversion cycle components. Firstly, it identified a relationship between DIO, GPM, and CIR, suggesting that companies with longer inventory turnover cycles tend to allocate a higher proportion of their cash into the business and reduced gross profit margin. Lastly, the study did not find a bidirectional positive association between intermediaries of CCC.

The hypothesis proposing a negative correlation between DIO and GPM was supported by our study. Several reason account for this significant relationship. Firstly, lower GPM can decrease the optimal order quantity, resulting in lower expected inventory levels (Nahmias, 2008; Cachon & Terwiesch, 2005). Secondly, decreased product prices increase average demand, resulting in diminished safety stock levels and decreased inventory turnover (Gaur et al., 2005). Additionally, another study has highlighted transportation costs as an additional factor influencing GPM (Johnston, 2014).

Our study revealed that DIO is positively correlated with CI, which supports our hypothesis. In line with our finding Cachon and Fisher, (2000) asserted that increased capital intensity within retail enterprises can substantially increase their inventory productivity. A higher CI suggests that a retailer may possess a robust infrastructure for efficiently managing inventory, leading to improved turnover rates and operational efficiency. Another research also indicated that higher CI suggested that the company's management in construction and manufacturing industries should enhance investment in tangible assets such as warehouses, land, information technology, basic infrastructure, and machinery, such investments have positive impact on inventory turnover (Yousaf et al., 2023). This positive relationship was consistent with prior literatures, including studies by Gaur et al., (2005), Kolias et al., (2011), Lee et al., (2015), Gaur et al., (2015), and Sano et al., (2020).

This study did not support the hypothesis of a positive correlation between DIO and SS. Gaur et al., (2005) indicated that companies experiencing SS less than one are overestimating their demand. A decrease in SS implies that the actual demand falls short of the companies' predictions for that period. Consequently, an unexpected decrease in demand results in high inventory levels for the company and a decrease in inventory turnover for that period, and vice versa. However, these study findings contradict those of previous authors such as Rumyantsev & Netessine (2007), Kolias et al., (2011), Rajagopalan (2013), Johnston (2014), Lee et al., (2015), Gaur and Kesavan (2015), Hançerlioğulları et al., (2016), Breivik (2019), Sano et al., (2020); Mahajan et al., (2023), and Yousaf et al., (2023).

Furthermore, our research did not find support for the hypothesis that DRO is negatively correlated with old assets consistent with the findings of Kolias et al., (2020) which demonstrated that DRO is significantly associated with Old assets. The reason for this consistency is that their study had smaller mean data for the days utilizing CCC, in comparison to our study. Another study shed light on how economic uncertainty affects firm operations as firm holds more inventory than the usual practice (Dbouk et al., 2020; Kroes et al., 2018; Özbayrak and Akgün, 2006). Therefore, firms with more need of liquidity may experience conventional CCC to improve the firm’s operation (Kieschnich et al., 2013).

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 1 (January) (2025)

In addition, our study demonstrated that DPO is positively correlated with firm size, in line with Kolias et al., (2020) findings, indicating that longer-term DPOs can benefit larger companies by allowing them to retain cash reserves before settling payments with suppliers, thereby enhancing cash flow management, and providing flexibility for other business activities. This finding aligns with the conventional approach to CCC management, where companies often prioritize extending DPO over DIO and DRO. This strategy is aimed at optimizing operational efficiency and ensuring sufficient liquidity. However, when companies excessively delay payments to suppliers (resulting in prolonged DPO), it can strain trust within their partnerships. Essentially, if one company consistently delays payments to another, it may raise concerns about reliability and commitment, potentially damaging the relationship. In essence, these findings suggest that while strictly adhering to conventional CCC management practices can improve short-term liquidity, it may come at the cost of eroding trust over the long term in business partnerships (Raghavan and Mishra, 2011).
Lastly, our study supported the hypothesis that cash conversion cycle components are simultaneously determined, consistent with findings by Seifer et al., (2016); Kolias et al., (2020), and Chen et al., (2022), implying a complex relationship between DIO and DPO, where changes in one component can impact others differently. Managing DIO and DRO components of the Cash Conversion Cycle (CCC) involves making trade-offs. Companies must strike the right balance to ensure optimal working capital efficiency without compromising their financial stability. This study holds significant relevance in optimizing cash flows, particularly in situations where firms face cash shortages at a country-wide level.

Conclusion

In summary, our study provides new insights about the inherent complexity of the Cash Conversion Cycle (CCC) and its elements: the Days Sales Outstanding (DSO), the Days Inventory Outstanding (DIO) and the Days Payables Outstanding (DPO) in the context of international business operations. Using advanced EC3SLS technique for panel data, based on data for 126 non-financial firms in Pakistan for 2010 - 2023, we have found significant interdependencies among these elements.
Our results make a case for the simultaneous consideration of DSO, DIO, and DPO in determining the CCC. In addition, the research did not identify significant bidirectional relationships amongst the CCC components.
Finally, our study points to the importance of contextual factors, principally at the country level, in affecting CCC dynamics. Take, for example, the case of Russia, where a lengthy DPO aligns with rising firm profitability, as indicators from national-level determinants including cultural norms and industry practices may not always conform to typical CCC strategies (Pirttilä et al., 2020). Further results show that capital intensity and firm size are crucial determinants for the efficiency of cash conversion cycle.
Country specific considerations can be incorporated into working capital management strategies to improve the efficiency of CCC and with the effect of increasing overall financial performance when operating in international markets. Together this research helps fill the existing knowledge gap and

ISSN Online: 3007-3154
ISSN Print: 3007-3146

provides actionable insights to empower organizations to better manage CCC in a globalized world.

Implications

This study indicates how the cash conversion cycle along with its components affects company financial performance. Working capital efficiency is determined by a firm's DIO, DSO and DPO. In the environments that can potentially change the environments and affect the inventory levels, DIO serves as a strategic tradeoff between GPM and CIR (Song et al. 2019; Aktas et al. 2015). This study extended the theories of DC theory, and TO theory of working capital management, both in the underdeveloped countries. Management of these components drives a competitive edge, better liquidity, lower costs of financing, and higher operational efficiency.

Our study focuses on non-financial firms in Pakistan and their working capital management practices. However, it draws attention to the need to efficiently deal with short term assets and liabilities for the normal conduct of daily activities.

This research has implications for financial practitioners and policymakers. The insights drawn from this study enable professionals to make appropriate decisions with regards to working capital management, and policymakers can leverage the obtained findings to design policies around working capital.

The paper also investigates the effects of GPM and CI on working capital components. GPM and CI are found to have a strong relationship with these components, which underpin their main role in specifying the working capital dynamics for the firm under study.

Limitations

The limitation of the study dealt with the simultaneous determination of the components of the cash conversion cycle. A major issue is the importance of generalizability, for while study findings may be context specific, limiting application to different industries, different time periods or even different geographic regions. The complexities arise due to the dynamic nature of the business environment, where change is part of the business with changes in conditions, regulations and market dynamics calling the time sensitivity of the study results into question.

The other obstacle is unobserved factors and omitted variables since there may be influences on the cash conversion cycle and associated variables that need to be observed and associated with a bias outcome. However, given the multitudes of possible interactions and decision making processes at play in human behavior within organizations, these have to be fully captured by quantitative measures and thus require qualitative insights. By understanding these limitations, we can provide valuable insight for future work in this area and ongoing literature development specific to this area.

The EC3SLS (Error Correction Three-Stage Least Squares) method is also discussed with concerns relating to its choice. EC3SLS is intended to be valid when endogeneity problems arise, but the bias that occurs when unobserved variables affecting all endogenous and all exogenous variables are present needs to be handled carefully.

ISSN Online: 3007-3154
ISSN Print: 3007-3146

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