The Impact of Financial Constraints and Earnings Management on Working Capital Adjustment Speed: Evidence from Egypt

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Abstract

This study examines the target working capital level and the adjustment speed towards the target level in Egyptian firms. It also investigates the impact of financial constraints and earnings management on the speed of adjustment (SOA). The sample includes 45 non-financial EGX-100 firms from 2017-2022 with 270 balanced observations. The cash conversion cycle (CCC) is a dynamic measure used as a proxy for working capital management (WCM). A composite index for financial constraints is created using Exploratory Factor Analysis (EFA) from three measures, and Beneish M-Score is used as a proxy for earnings management. A two-step generalized method of moments (GMM) approach with partial adjustment models is used for data analysis.

Results show that firm characteristics and macroeconomic conditions affect the target working capital level, and the SOA toward the target working capital level is slow (33.1%). Results also found that financial constraints slow firms' SOA toward target working capital, decreasing from 33.1% to 27.3% with a 5.8% variance. Moreover, the negative impact of earnings management slowed working capital adjustment speed for manipulator firms from 33.1% to 27.6%, a 5.5% variance. The study results were further confirmed using alternative financial constraints and earnings management measures based on Altman's Z-score and Modified Jones Model. The study's findings strengthen an Egyptian working capital dynamics hypothesis.

Based on the existing literature, only a few studies have addressed optimal (or target) working capital levels. Further, limited attention was paid to how financial constraints and earnings management affect working capital adjustment speed, highlighting this study's novelty and significance.

Keywords: Optimal Working Capital, Speed of Adjustment, Financial Constraints, Earnings Management, Beneish *M-Score* Model.

ملخص الدراسة

تهدف الدراسة لاختبار مستوى رأس المال العامل المستهدف وسرعة التعديل نحو المستوى المستهدف في الشركات المصرية وتأثير القيود المالية وإدارة الأرباح على سرعة التعديل. تم استخدام عينة من 45 شركة غير مالية مقيدة في مؤشر EGX-100 خلال الفترة 2017-2022، تتكون من 270 مشاهدة متوافقة. تعد دورة التحويل النقدي (CCC) مقياسًا ديناميكيًا يستخدم كبديل لإدارة رأس المال العامل (WCM). تم إنشاء مؤشر مركب للقيود المالية باستخدام التحليل العاملي الاستكشافي (EFA) من ثلاثة مقاييس للقيود المالية. واستخدمت الدراسة Beneish M-Score كبديل لإدارة الأرباح. ولتحليل البيانات تم استخدام طريقة العزوم المعممة على خطوتين (GMM) مع نماذج التعديل الجزئي.

أظهرت النتائج أن خصائص الشركة وظروف الاقتصاد الكلي تؤثر على مستوى رأس المال العامل المستهدف. وان سرعة التعديل نحو مستوى رأس المال العامل المستهدف بطيئة عند (33.1%). كما أن القيود المالية تبطئ سرعة تعديل رأس المال العامل للشركات، حيث انخفضت من 33.1% إلى 27.3% بتباين قدره 5.8%. علاوة على ذلك، أدى التأثير السلبي لإدارة الأرباح إلى تباطؤ سرعة تعديل رأس المال العامل للشركات المتلاعبة من 33.1% إلى 27.6%، بتباين قدره 5.5%. تم تأكيد نتائج الدراسة باستخدام مقاييس بديلة للقيود المالية وإدارة الأرباح استنادًا إلى Altman's Z-score ونموذج جونز المعدل. وتعزز نتائج الدراسة فرضية ديناميكية رأس المال العامل للشركات المصرية.

استناداً إلى الأدبيات الموجودة، تناول عدد قليل من الأبحاث راس المال العامل الأمثل (أو المستهدف). علاوة على ذلك، تم إيلاء اهتمام محدود لكيفية تأثير القيود المالية وإدارة الأرباح على سرعة تعديل رأس المال العامل، مما يبرز حداثة هذه الدراسة وأهميتها.

الكلمات المفتاحية: رأس المال العامل الأمثل، سرعة التعديل، القيود المالية، إدارة الأرباح، نموذج Beneish M-Score.

1. Introduction

Managing working capital is essential because efficient use of fixed assets is only possible with adequate working capital, affecting profitability and firm value maximization (Samiloglu & Demirgunes, 2008). Working capital management (WCM) allows managers to effectively control current assets and liabilities, manage associated costs, and maximize earnings. Firm success requires efficient WCM (Altaf & Shah, 2017). Smith (1980) argued that a firm should manage their working capital efficiently since it influences profitability, risk, and, subsequently, the firm's worth. WCM highly depends on the firm essential business activity: purchase or production, revenue generation, receivables collection, and managing payment (Wang, 2019). Previous studies on WCM mainly focused on examining the relationship between WCM and firm performance (e.g., Ren et al., 2019; Kayani et al., 2020; Akbar et al., 2021; Seth et al., 2021; Kayani et al., 2023). However, scholars have not focused on many other working capital characteristics, their dynamics, and their impact on organizational success. Other relevant working capital issues like cash conversion cycle (CCC) determinants, target CCC, and speed of adjustment (SOA) towards the target level have been studied less.

Each firm has an optimal (or target) working capital level that balances benefits and risks. However, When a firm deviates from the target working capital, interruptions in a production process can occur when there is insufficient investment in working capital, and the risk of bankruptcy increases due to higher financing expenses resulting from increased working capital investment. Firms that deviate from their target working capital must incur adjustment costs to achieve their working capital. The existing literature shows a few partial adjustment model studies on this issue (e.g., Chauhan and Banerjee, 2018; Ahangar, 2020). Such studies show that firms eventually adjust their working capital toward target levels.

This study argues that the SOA will differ across firms because of the benefits and risks of many factors, including financial constraints and earnings management. Firms with lower financial constraints can adjust their working capital faster due to lower adjustment costs and better capital market access (Banos-Caballero et al., 2014). Chauhan and Banerjee (2018) examined the target working capital and adjustment speed for Indian manufacturing firms. They found that Indian firms have a target working capital but adjust slowly. Further, firms with higher earnings management may reduce WCM efficiency (Sawarni et al., 2023) and can adjust their working capital more slowly. Accordingly, this study seeks to examine how financial constraints and earnings management affect the speed of working capital adjustment in Egyptian firms through the following questions:

- To what extent do firm characteristics and macroeconomic conditions impact the speed of working capital adjustment in Egyptian firms?
- To what extent do financial constraints impact the speed of working capital adjustment in Egyptian firms?
- To what extent does earnings management impact the speed of working capital adjustment in Egyptian firms?

Objectives of the Study: This study aims to examine the influence of financial constraints and earnings management on the speed of working capital adjustment through the following sub-objectives:

- Examine the impact of firm characteristics and macroeconomic conditions on the speed of working capital adjustment in Egyptian firms.
- Examine the impact of financial constraints on the speed of working capital adjustment in Egyptian firms.
- Examine the impact of earnings management on the speed of working capital adjustment in Egyptian firms.

Significance of the Study:

Based on the existing literature, only a few research have addressed the target level of working capital. Baos-Caballero et al. (2012, 2014, 2016) and Aktas et al. (2015) examined and confirmed the presence of an optimal or target working capital level in Western economies. Likewise, Chauhan and Banerjee (2018) and Ahangar (2020) examined the working capital target level and the SOA for Indian firms. They also investigated the effect of financial constraints on the adjustment speed.

However, according to the existing literature, no study has examined this issue in Egypt or Middle Eastern countries. This study attempts to fill that gap. The study developed a new approach to test the validity of the dynamic approach for WCM in Egyptian firms.

The study contributes to the existing literature by evaluating the presence of an optimal level of working capital and the adjusting speed toward the target level in Egyptian firms. The study also examines how financial constraints and earnings management affect the speed of working capital adjustment.

Scope of the Study: The study uses the data of non-financial corporations listed in the EGX100 index. Only firms with complete data for all the study variables are included. The data covers 2017 to 2022, reflecting the most recent data available for the research period. The analysis excludes financial firms because they have inherent differences from non-financial firms that may result in incomparable characteristics.

The remainder of the study is structured as the subsequent section covers a brief literature review and the development of research hypotheses. Section three presents the methodology that explains the variables' measurement, clarifies the estimation approach employed, and specifies the study models. Section four discusses the statistical analysis results and their interpretation and hypothesis testing. Finally, the concluding section presents conclusions and recommendations.

2. Literature Review and Hypotheses Development

2.1. WCM

Firms with higher levels of working capital have lower levels of liquidity. Firms need effective WCM to manage resources for future expansion, meet short-term financial responsibilities, and reduce financial costs. However, optimizing working capital is not easy. Working capital reduction impacts its growth and prospective sales. Managing risks and earnings is a key to optimal working capital (Filbeck & Krueger, 2005). Therefore, firms must carefully assess their specific context and scenario to identify the appropriate working capital level. Firms make financial management decisions in three areas: working capital for a short-term investment, capital structure for long-term assets, and capital budgeting for long-term financing. WCM is more important to the firm since it impacts profitability and liquidity (Attari, 2012; Iqbal et al., 2020).

Majeed et al. (2013) examined WCM using static and dynamic methods. The first strategy uses liquidity ratios: current and quick ratios built on the balance sheet. The CCC is the most dynamic time between raw material payment and accounts receivable receipt. CCC analyses liquidity using income statement and balance sheet data over time. CCC is based on three partial cycles: inventory days (IVD), accounts receivable days (RCD), and accounts payable days (PYD), which measure the efficiency of inventory, receivables, and payables, respectively (Bueniasz, 2011). CCC is a comprehensive WCM indicator because it accurately illustrates the time lag between procurement-based raw material spending and borrower assemblages for finished goods sales (Padachi, 2006). When CCC lasts longer, firms invest more in working capital. With a shorter lifespan, CCC increases sales and profitability (Attari, 2012). When working capital investment exceeds inventory earnings, CCC declines.

The CCC is frequently used to assess WCM efficiency because operating cash inflows and outflows result from working capital choices (Prasad et al., 2019). The CCC demonstrates how many days a firm has blocked funds in working capital (Tarkom, 2022). Thus, CCC is used as a measure of WCM. More sustainable firms have a shorter CCC (Barros et al., 2022). Lin and Wang (2021) and Akgun and Karatas (2021) demonstrate that CCC reduction increases profitability and valuation.

Consequently, managers must lower the CCC to enhance the firm's financial performance. This study focuses on the CCC as WCM's proxy. The greater a firm's efficiency in navigating the CCC, the greater its working capital efficiency (Garg et al., 2018). If working capital is managed efficiently, the business can free up cash to pay debts or reinvest.

2.2. Target CCC and SOA

Firms' current working capital may never reach their target level because they cannot precisely forecast revenues and purchases. Further, firms cannot predict bad debts or default rates, and retrieving delinquent accounts takes time and costs (Nadiri, 1969). Random or transient shocks, changes in production factor costs, or technology upgrades cause firms to vary from their working capital requirements (WCR) target. Maintaining working capital investments has relative costs and benefits; therefore, a firm may set a target CCC that balances them. A firm may adjust its CCC to attain the target CCC to balance benefits and risks. Thus, a firm may make adjustments to meet its target working capital. The SOA will be greater if the adjustment process is quicker, and vice versa.

Research on this issue shows that firms remain deviated from the target because their adjustment speed is too slow to reach the current level of CCC. Chauhan and Banerjee (2018) found that Indian manufacturing firms have target working capital but adjust slowly; Cuong and Cuong (2016) found that Vietnamese firms have a target CCC but adjust only 48% of working capital. Mathuva (2014) also observed that Kenyan firms have a target CCC and adjust it to 0.44. Chauhan and Banerjee (2018) and Cuong and Cuong (2016) found that target CCC adjustment is delayed. Banos-Caballero et al. (2014) state that Spanish firms have a target CCC and adjust towards it at 0.87. This study investigates the speed of working capital adjustment in Egypt.

Kwenda and Holden (2014) analyzed the firms listed on the Johannesburg Stock Exchange from 2001 to 2010. They used current assets to total assets (CATA) as a measure for working capital investment, and it was discovered that South African-listed firms aim to achieve the target of working capital investment level. Further, these firms adjust their target levels with an average adjustment coefficient.

Mathuva (2014) examined the adjustment speed to the target CCC. The study focused on 33 Nairobi-listed firms, covering 1993 - 2008. The results show that Nairobi-listed firms aim to achieve target levels of CCC. However, they revealed that these firms adjust toward their target levels relatively slowly, with an adjustment coefficient of 0.56.

Cuong and Cuong (2016) investigated the determinants of WCR and examined the speed at which a firm may adjust toward its target WCR. 112 Vietnam's SEAs firms from 2005–2014 were sampled. Current assets minus current liabilities were used as a proxy for a firm's WCR. WCR_TA deflates WCR by total assets to reduce the influence of firm size. The partial adjustment model and panel data regression analysis are employed. The results indicate that SEAs pursue the target working capital and adjust slowly toward them. The findings also suggest that access to external capital markets affects a firm adjustment speed. The WCR also increased significantly with the firm's sales growth and profitability. Increased firm size, fixed investment, external finance cost, and sales volatility are significantly lower WCR.

Otaify et al. (2022) employed fixed effect and dynamic panel models to analyze the impact of various factors, including business characteristics, macroeconomic factors, corruption control, and political uncertainty, on the cash holdings of Egyptian firms from 2011 to 2020. It is observed that business characteristics have a significant role in elucidating the disparities in firm cash ratios and departures from the target ratios. However, their investigation does not establish a significant influence of macroeconomic factors. Egyptian companies often choose to maintain liquid assets as substitutes for cash when managing their working capital, while they rely on debt as substitutes for cash when financing their operations. The findings derived from dynamic panel models suggest that Egyptian firms exhibit a partial adjustment strategy about their target cash levels, aligning with the trade-off theory.

Firms may deviate from their CCC while working capital cannot be adjusted immediately because its adjustment cost is substantially high (Peles & Schneller, 1989). Firms alter their CCC only when it benefits them rather than staying away from the target (Altaf & Shah, 2018). The current CCC can be adjusted by altering the CCC components: receivables, payables, and inventory. Since firms have a target CCC, they adjust their current CCC toward the target CCC speed. This phenomenon needs more attention in WCM literature.

2.3. Financial constraints and working capital adjustment speed

A firm, especially in emerging economies, requires effective WCM. These economies are smaller, growing firms and have inefficient capital markets. Emerging economies have higher interest rates and poor corporate governance; thus, firms frequently use internal funding sources as working capital (Allen et al., 2012). Rapid globalization forces emerging-market firms to compete with stronger players from developed economies. Thus, these firms must carefully manage their working capital. Many of these firms are in the early stages of their product lifecycle and face many future uncertainties; therefore, they may not always adopt an optimal WCM policy. Emerging market firms may not continuously aggressively pursue an optimal level of working capital, even if it exists, due to various operational or financial constraints and strategic concerns.

Firms adjust their WCR only if the benefits exceed the costs of deviation from the target requirements. Faster adjustment is possible for firms with easy access to capital markets (Banos-Caballero et al., 2013). Internal and external funding are not ideal alternatives (Banos-Caballero et al., 2013). Financial constraints arise from information asymmetries that make external funds more expensive than internal funds, sometimes prohibitively so (Whited & Wu, 2006). Financial constraints conflict with corporate investment (Farre-Mensa & Ljungqvist, 2016). Asymmetric information, agency concerns, and transaction costs, such as new shares or loan issues, make external finance more expensive (Jensen & Meckling, 1979).

Khan et al. (2016) examined WCM, financial constraints, and profitability. The sample included 110 Karachi Stock Exchange-listed Pakistani textile firms from 2005 to 2014, with 1335 firm-year observations. Panel model results show that firms with more (less) financial constraints have shorter (longer) net trade cycles. The study also found an inverted U-shaped association between working capital investment and firm performance. The study suggested that financial managers should aim for optimal working capital to maximize a firm's profitability. Any investment in working capital above this optimal threshold may negatively influence a firm's profitability.

Chauhan and Banerjee (2018) examined whether Indian manufacturing companies have an optimal working capital level and whether they meet it. The study sample includes 17,161 listed and unlisted Indian manufacturing firms with 1993–2015 yearly financial data from the Center for Monitoring of Indian Economy Prowess database, totaling 56,682 firm-year observations. The CCC measures WCM, and partial-adjustment dynamic panel models are employed to test its target behavior. The results reveal that Indian manufacturing firms' working capital does not match targets. The results also indicate that firm-specific features do not explain the lack of target-following propensity and appear to be a systematic issue across Indian firms. The results suggest that developing market firms may be unable to pursue optimal working capital due to financial constraints.

Laghari and Chengang (2019) examined the association between WCM and firm performance with financial constraints. They used data from 1,528 listed firms, with 16,802 observations of Chinese listed firms from 2005 to 2015. A two-step GMM approach is used for data analysis. The results show that working capital and corporate performance have an inverted U-shaped relationship, the same for financially constrained firms. Evidence indicates that high sales and discounts affect early payments at low working capital and opportunity cost and external finance cost at high working capital. Due to debt rationing and high external capital costs, financially constrained firms have lower optimal working capital levels. The findings also show that aggressive WCM is positively associated with higher firm values and that firms with Tobin's Q>1 have significantly lower optimum levels than firms with Q=1.

Likewise, Ahangar (2020) investigated the target working capital level and the SOA for Indian firms. It also examines the effect of financial constraints on the adjustment speed. The sample included 1936 Indian manufacturing firms from eight sectors covering 2000 – 2018. They used the two-step GMM approaches for data analyses. The results demonstrate that firms' adjustment speed from current to target working capital is slow, and this adjustment speed differs between sub-sectors. Furthermore, they discovered that firms less likely to be financially constrained adjust their working capital speedily than firms that face severe financial constraints.

Aflatooni et al. (2022) examined the speed of working capital adjustment and investigated the impact of firm access to external financial resources and bargaining power on the SOA. The sample comprises 137 firms from the Tehran Stock Exchange, covering 2003 to 2020, with 2,466 unbalanced observations. A two-step GMM approach with partial adjustment models is used for data analysis. The results indicate that a firm with greater access to external financing and stronger negotiation bargaining power has quicker working capital adjustment.

This study assumes that the SOA will vary by firm and rely on its financial constraints. Lower adjustment costs allow firms to adjust their target working capital faster. Since working capital variances may be linked to external finance, firms with stronger access to financial markets should respond more speedily.

2.4. Earnings management and working capital adjustment speed

Earnings management is associated with managers' opportunistic behavior and asymmetric information problems, which cause over- or under-investment (Bzeouich et al., 2019). Such inefficient resource allocation decisions may result in inefficient investment (McNichols & Stubben, 2008). Earnings management allows managers to hide inefficiency so they may not bother to avoid inventory management inefficiency caused by excessive or inadequate investment.

Earnings management lowers earnings quality and increases information asymmetry. Agency theory demonstrates that managers may use information asymmetry to make inefficient decisions from the firms' perspectives (Jensen & Meckling, 1977). Where earnings management allows managers to conceal their weak financial performance, they may falsely report the accomplishment of their goals without actually achieving them and relieve themselves of the required effort by changing the "set goal" to "do their best," which requires actions only to accomplish what can easily be achieved. Goal-setting theory (Locke & Latham, 1990) states that when people aim to "do their best" instead of achieving the "set goal," their performance suffers. Earnings management propensity may cause managers to get complacent. A complacent manager may ignore the target level of working capital, causing a capital obstruction. Thus, earnings management may decrease WCM efficiency.

Sawarni et al. (2023) examined how earnings management affects WCM and its components. The study sample is balanced panel data from 461 non-financial listed firms in India from 2015 to 2021. Based on the Beneish Model, the *M-Score* is used as a proxy for earnings management. CCC was used as a proxy for WCM efficiency. Inventory days (IVD), receivable days (RCD), and payable days (PYD) represent the efficiency of inventory, receivables, and payables management, respectively. GMM and panel quantile regression are utilized for data analyses. The findings show that earnings management may reduce firms' WCM efficiency. Managers who use earnings management have longer CCC and poor inventory management. An alternative earnings management proxy based on the Modified Jones Model validated these findings. However, they ignore the speed of working capital adjustment.

Based on the prior studies aforementioned, it is concluded that:

- Only a few research have addressed the target WCM.
- The existing literature shows that only a few partial adjustment model studies on the speed of working capital adjustment (e.g., Chauhan and Banerjee, 2018; Ahangar, 2020). Such studies show that firms eventually adjust their working capital to target levels.
- Prior literature has rarely examined the influence of financial constraints on the speed of working capital adjustment in general. Recently, limited studies reviewed this relationship (Altaf & Shah, 2018; Chauhan & Banerjee, 2018; Laghari & Chengang, 2019; Ahangar, 2020). However, no studies have been conducted in Egypt or other Middle Eastern countries to investigate such a relationship. As a result, the literature still needs to examine such a relationship in Egypt.
- None of the prior studies examined the impact of earnings management on the speed of working capital adjustment in general

and in the Egyptian business environment. Therefore, it is a fertile research area.

Accordingly, it is argued that the SOA will differ across firms because of the benefits and risks of many factors, including financial constraints and earnings management. Firms with lower financial constraints can adjust their working capital faster due to lower adjustment costs and better capital market access (Banos-Caballero et al., 2013). Further, firms with higher earnings management may reduce WCM efficiency (Sawarni et al., 2023) and can adjust their working capital more slowly.

Based on the above discussion and existing theoretical principles, the study aims to identify the influence of a firm's characteristics and macroeconomic conditions that statistically impact the target working capital level. Further, the study hypothesized that financial constraints and earnings management statistically affect the speed of working capital adjustment through the following hypotheses:

H1: Firm characteristics and macroeconomic conditions have a statistically significant impact on the speed of working capital adjustment.

H2: Financial constraints have a statistically significant impact on the speed of working capital adjustment.

H2: Earnings management has a statistically significant impact on the speed of working capital adjustment.

3. Research Methodology

This section provides the research methodology employed in the study. It outlines the process of selecting the sample and data sources, describes the measurement of variables, clarifies the estimation approach used, and specifies the study models utilized.

3.1. Sample and Data Sources

The EGX-100 index firms were chosen as a proxy for the Egyptian context from 2017 to 2022. The EGX-100 index includes firms of the EGX30 and the EGX70 indices. As a result, it is assumed that EGX-100 index companies have good governance and reporting. The research sample was drawn from EGX-100 index companies under specified conditions as follows:

- Banking and non-banking financial firms are excluded as they have a particularly technical and accounting nature. They must follow their rules, which may differ from other firms.
- Firms continued with no occurrences of delisting or cessation during 2017 - 2022.
- Data required to measure variables is available from 2017 to 2022.
- The Egyptian pound is the currency used in the firm's financial reports.
- There must be at least three firms in the industry.

Thus, the research sample is a panel data set of 45 firms from 8 sectors for six years (2017 – 2022). It includes a total of 270 balanced observations. The data are available on the published financial statements on the Mubasher Info Egypt website: https://www.mubasher.info/countries/eg. Additionally, the minutes of meetings of the shareholders' general assembly and the board reports of firms from the Egyptian Stock Exchange website: https://www.egx.com.eg/en/homepage.aspx, as well as on the respective firm's website. Table (1) displays the distribution of the research sample across different sectors, indicating the number of observations in each sector. Furthermore, the data for macroeconomic variables were taken from the Egyptian economy's database, the Central Bank of Egypt.

Table (1): Sample and Composition

Sector	*Observations*	*% Observations*
Real estates	60	22
Health care and medicine	42	16
Building Materials	30	11
Food, drinks, and tobacco	36	13
Communications, media, and IT	18	7
Tourism and Leisure	24	9
Automotive and industrial products	18	7
Basic resources	42	16
Total	***270***	***100***

3.2. Variables Measurement

3.2.1. Working Capital Adjustment Speed (Dependent Variable)

Based on Bueniasz (2011), this study proxied WCM with the CCC. Inventory days (IVD), accounts receivable days (RCD), and accounts payable days (PYD) measure inventory, receivables, and payables efficiency. The variables are computed as follows:

$CCC = IVD + RCD - PYD$

Where:

$IVD = 365 * (Inventory \div Cost\ of\ goods\ sold)$

$RCD = 365 * (Accounts\ receivable \div Sales)$

$PYD = 365 * (Accounts\ payable \div Cost\ of\ goods$ sold)

Partial-adjustment dynamic panel models are employed to test target working capital behavior and estimate how firms adjust toward their optimal working capital (Ahangar, 2020). Such a Model assumes that each company has an optimal working capital (CCC^*_{it}) impacted by explanatory factors (X_{jit}) as follows:

$$CCC^*_{it} = \sum_{i=1}^{n} \alpha_n X_{jit} + + e_{it} \qquad (a)$$

Firms should always be at optimal working capital, with actual working capital (CCC_{it}) equal to optimal working capital (CCC^*_{it}) and $CCC^*_{it} = CCC_{it}$. This implies that the change in actual working capital from the previous to the current period should be the same as the desired change for firms to be at optimal at time t, assuming no adjustment costs or market imperfections, as shown below:

$$CCC_{it} - CCC_{it-1} = CCC^*_{it} - CCC_{it-1} \qquad (b)$$

When a firm deviates from the optimal working capital, this deviation is measured by the difference between optimal and actual working capital ($CCC^*_{it} - CCC_{it-1}$). Deviation from the optimal level of the working capital incurs the firm deviation costs. Therefore, it is promoted to adjust its working capital, measured by the change in working capital from year to year ($CCC_t - CCC_{t-1}$). The annual partial adjustment of working capital estimates the optimal working capital adjustment speed (λ_{it}). Previous research estimated adjustment speed using the typical partial adjustment model as follows:

$$(CCC_{it} - CCC_{it-1}) = \lambda_{it}\ (CCC^*_{it} - CCC_{it-1})\ ;\ 0 < \lambda < 1 \qquad (c)$$

Equation (c) can be reformulated as follows:

$$CCC_{it} = (1-\lambda_{it})\ CCC_{it-1} + \lambda\ CCC^*_{it} \qquad (d)$$

From Equations (a) & d), Equation (e) can be derived:

$$CCC_{it} = (1-\lambda_{it})CCC_{it-1} + \lambda_{it}\sum_{i=1}^{n}\alpha_n X_{jit} + e_{it} \qquad (e)$$

Equation (c) predicts convergence based on the adjustment parameter. If λ_{it} equals 1, the firm's optimal CCC level is reached at time t. if λ_{it} is less than 1, the adjustment from the prior period (t-1) to this period (t) is less than the target CCC. If λ_{it} exceeds 1, the firm over-adjusts and fails to meet the target CCC level, as λ_{it} represents the adjustment amount. Hence, a higher value indicates a faster target CCC adjustment. SOA to optimal working capital (λ_{it}) = [(1- Coef) CCC_{t-1}] for each model. The working capital adjustment speed (λ_{it}) is evaluated based on firm characteristics and macroeconomic factors.

3.2.2. Explanatory variables

3.2.2.1. Determinants of CCC

The target working capital model is a function of firm characteristics incorporating working capital benefits and risks. These variables might be obtained from firm-specific factors such as firm cash flow (*CFLW*), Leverage (Lev), size (*SIZE*), firm age (*Age)*, growth rate (*GR)*, tangibility (*PPE)*, profitability (*ROA)*, and macroeconomic factors such as the GDP growth rate (GDPGR). (Cuong & Cuong, 2016; Chauhan & Banerjee, 2018; Ahangar, 2020).

(1) Cash flow (CFLW):

The pecking order theory (Myers & Majluf, 1984) states that information asymmetry between insiders and external investors raises external fund costs. Firms with greater cash flow or financial flexibility tend to have higher working capital due to lower internal fund costs (Baños-Caballero et al., 2010). However, Chauhan and Banerjee (2018) find that firms with high cash flows manage their working capital more efficiently and have better net liquidity balances, resulting in lower CCC. This study predicts a positive relationship between cash flow and CCC. Cash flow is measured as [(net profit + depreciation) / total assets].

(2) Financial leverage (LEV):

Firms with a high debt ratio are riskier and more financially constrained, so they pay higher interest rates. Baos-Caballero et al. (2010) indicate that highly leveraged firms reduce net working capital levels to reduce interest expenses. However, Hatane et al. (2023) show that the CCC of Indian-listed manufacturing firms is positively associated with their leverage. This study predicts a negative relationship between the debt ratio and CCC. Leverage (LEV) is measured as (total liabilities / total assets).

(3) Firm size (SIZE)

Firm size usually increases working capital (Chiou et al., 2006). Larger firms are more diversified, have better capital market access, and can use these advantages to increase trade credits (Niskanen & Niskanen, 2006). Smaller firms face higher credit costs and fewer credit options. They use more trade credits and reduce inventories to lower CCC (Qurashi & Zahoor, 2017; Cuong & Cuong, 2016). In contrast, Baños-Caballero et al. (2010) found that size does not significantly impact CCC. Variable size is the total assets' natural logarithm.

(4) Firm age (Age)

The literature indicates that firm age is a factor in CCC due to its impact on financing and trade credit policies (BañosCaballero et al., 2010). In prior studies, firm age has been used to measure time spent building relationships with suppliers, customers, financers, and customer knowledge and reputation (Cuñat, 2007; BañosCaballero et al., 2010). Further, age may affect CCC because older firms require less working capital (Ahangar, 2020). The natural logarithm of firm age is used to calculate the variable.

(5) Growth opportunity (SGR)

Firms increase inventories to support sales growth (Blazenko and Vandezande, 2003). Growing firms use credit sales to boost sales, especially during weak demand. Slower-growing firms use trade credit because they have no other financing options (Hatane et al., 2023). Further, Baños-Caballero et al. (2010) show that growth opportunities do not significantly affect CCC. Sales growth is measured as ($sales_t$ - $sales_{-1}$ / $sales_{t-1}$).

(6) Asset tangibility (PPE)

Firms with more tangible assets can borrow faster and cheaper because they are collateral. Firms with more tangible assets may invest more in working capital. However, Baños-Caballero et al. (2010) argue that fixed assets compete with current assets for funds under financial constraints, lowering CCC. PPE ratio is measured as (Net Property/Plant/Equipment) / Total assets.

(7) Profitability (ROA)

Prior research shows an association between working capital components and firm profitability. Baños-Caballero et al. (2014) found that the relationship between WCM and firm profitability depends on financial constraints. Further, Alvarez et al. (2021) suggested that all working capital components are positively associated with profitability, suggesting that increasing each variable improves ROA and ROE. A profitable firm has fewer financial constraints and slowly becomes an industry leader with more bargaining power with customers and suppliers. Petersen and Rajan (1997) show that profitable companies get more supplier credit. Thus, profitable firms can operate with less net working capital (Çetenak et al., 2017; Haron & Nomran, 2016). Operating income/total assets is the profitability (ROA) ratio.

(8) Macro-economic conditions (GDPGR)

The literature suggests macroeconomic conditions determine CCC. Lamberson (1995) claims that any change in economic activity affects CCC, but the extent and type of impact depend on firm size and other factors. Recessions make it hard for firms to get external financing due to cash shortages (Chiou et al., 2006). Recessions reduced sales, which increased inventories. Customers also pay off their obligations more slowly during such periods. During a recession, firms keep more inventories and receivables, indicating that they reduce production (Chiou et al., 2006). prior studies show a positive correlation between macroeconomic conditions and CCC (Hatane et al., 2023; Qurashi & Zahoor, 2017; Wasiuzzaman & Arumugam, 2013). Reversed results have also been found. A negative relationship between macroeconomic conditions and CCC has been documented. Firms may reduce working capital investment during economic booms due to easy access to external financing (Mathuva, 2014). Macroeconomic conditions are measured using the gross domestic product growth rate.

3.2.2.2. Financial constraints

This study creates a composite index measure using three measures to assess a firm's financial constraints. These measures include Cleary (1999), Whited and Wue (2006), and Hadlock and Pierce (2010) indices.

(a) Cleary (1999) Index (FC_CL):

Cleary (1999) computes a firm-level financial constraint index using discriminant analysis and estimated specification fitted values. The level of a firm's financial constraints relies on several criteria, as shown below:

$$FC\_CL_{it} = 0.0437\ Current_{it} - 0.0011\ FCCov_{it} + 0.00466\ Slack/K_{it} - 0.0122\ NI_{it} - 0.1071\ SGR_{it} + 0.3876\ Debt_{it} \quad (1)$$

Where:

Current: is the current ratio (Current assets $_t$ / Current liabilities $_t$).

FCCov: is the fixed charge coverage ratio, calculated as (Operating Income after depreciation) / Total interest and preferred dividend).

Slack/K: is calculated as (Slack / net PPE), where PPE equals (Property, Plant, and Equipment / Total assets), and Slack equals (Cash + Short-term investments + Accounts receivable + Inventory - Notes payable).

NI: is calculated as (Net income / Net sales).

SGR: is a firm's sales growth rate, calculated as ($Sales_t - Sales_{t-1}$) / $Sales_{t-1}$.

Debt: is the debt ratio (Total liability / Total assets).

(b) Whited-Wu (2006) Index (FC_WW)

The Whited and Wu (2006) index measures a firm's financial constraints depending on its features. They built their financial constraints indicator as follows:

$$FC\_WW_{it} = -0.091\ CF_{it} - 0.062\ DIVPOS_{it} + 0.021\ TLTD_{it} - 0.044\ LNTA_{it} + 0.102\ ISGR_{it} - 0.035\ SGR_{it} \quad (2)$$

Where:

CF: Cash flow to total assets is measured as [(Net profit + Depreciation) / Total assets].

DIVPOS: A dummy variable equals one if a firm pays cash dividends and zero if it does not.

TLTD: is measured as (long-term debt / total assets);

LNTA: is the total assets' natural logarithm;

ISGR: is a firm's industry sales growth ratio, measured as (firm's industry sales $_t$ – firm's industry sales $_{t-1}$) / firm industry sales $_{t-1}$.

SGR: is a firm's sales growth ratio, calculated as ($Sales_t - Sales_{t-1}$) / $Sales_{t-1}$.

(c) Hadlock-Pierce (2010) Index (FC_HP):

Hadlock and Pierce (2010) argue that the probability of a firm facing financial constraints is primarily influenced by firm size and age. Thus, a firm-level financial constraints index is as follows:

$$FC\_HP_{it} = 0.737\ lnSize_{it} + 0.043\ (lnSize)^2_{it} + 0.040\ Age_{it} \quad (3)$$

(d) Financial constraints composite index (Comp_FC):

Exploratory Factor Analysis (EFA) calculates the composite index for financial constraints. EFA aggregates variables to create one variable (*Comp_FC*) from three measures, *FC_CL*, *FC_WW*, and *FC_HP*. The correlation matrix helps weigh each financial constraint variable. Before completing an EFA analysis to compute *Comp_FC* to generate an index comprising all three elements, the Kaiser-Meyer-Olkin (KMO) test and Bartlett test were used to test the normality of the data.

Panel A in Table (2) shows the KMO test statistic value of 0.577. EFA analysis can only be used if it is at least 0.5. Bartlett tests the null hypothesis with a 0.000 p-value. EFA analysis is possible since the null hypothesis is rejected.

Table (2): Exploratory Factor Analysis (EFA) of *Comp_FC*

Panel A: KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy			0.577
Bartlett's test sig.			0.000
Panel B: Anti-image Matrices			
Anti-image Correlation	***FC_CL***	***FC_WW***	***FC_HP***
FC_CL	.667[a]	-0.184	-0.504
FC_WW	-0.184	.569[a]	0.811
FC_HP	-0.504	0.811	.546[a]

Panel B in Table (2) displays that all MSA values in the shaded diagonal cells exceed 0.05, indicating that each variable's correlation with the other variables in the correlation matrix is sufficient to perform EFA.

The *Comp_FC* index is calculated by collecting information on the three factors for each company in the year and extracting the linear correlation coefficient matrix for each year. Then, Multiplying the factor's total weight in shaded diagonal cells by its numerical value yields the *Comp_FC* variable.

3.2.2.3. Earnings Management (*M-Score*)

This study used the *M-Score* based on the Beneish et al. (2013) model as a proxy of earnings management. This model was designed to identify and anticipate instances of earnings manipulations. Additionally, it served as a screening tool for enforcement agencies (Aris et al. (2013). It is also utilized to identify both manipulators' firms and those unlikely to be manipulators, using a threshold limit of -2.22. A firm is considered a manipulator if its score is above -2.22 and is classified as an unlikely manipulator if it falls below the threshold limit.

The Beneish model's eight variables determine if a firm manipulated earnings. This model detects financial fraud. *M-Score* is a quantifiable measure of earning management. A higher *M-Score* indicates a greater likelihood of a company engaging in earnings management. The Beneish 8-factor Model is calculated as in the following Equation:

$$M\text{-}Score = -4.84 + 0.920\,DSRI + 0.528\,GMI + 0.404\,AQI + 0.892\,SGI + 0.115\,DEPI - 0.172\,SGAI - 0.327\,LVGI + 4.679\,TATA \quad (4)$$

Where:

DSRI: refer to Days' Sales in Receivables Index and measured as (Receivables $_t$ / Sales $_t$) / (Receivables $_{t-1}$ / Sales $_{t-1}$)

GMI: is the Gross Margin Index and is measured as (Gross Margin$_t$/Gross Margin$_{t-1}$), Where the Gross margin is (Sales - COGS)/sales.

AQI: is Asset Quality Index and measured as [1-{(PPE$_t$+CA$_t$)/Total assets$_t$}] / [1-{ (PPE$_{t-1}$+CA$_{t-1}$)/Total assets$_{t-1}$}] Where PPE denotes net property, plant and equipment. CA represents current assets.

SGI: refer to the Sales Growth Index and measured as (Sales $_t$ - Sales $_{t-1}$) / Sales $_{t-1}$

DEPI: is the Depreciation Index and measured as {Depreciation $_{t-1}$ / (Depreciation $_{t-1}$ + PPE $_{t-1}$)}/ {Depreciation $_t$ / (Depreciation $_t$ + PPE $_t$)} where PPE is net property, plant, and equipment.

SGAI: is the Sales, General, and Administrative Expenses Index and is measured as (SGA $_t$ / Sales $_t$) / (SGA $_{t-1}$ / Sales $_{t-1}$).

LVGI: is the Leverage Index and is measured as (Current liabilities $_t$ / Total assets $_t$) / (Current liabilities $_{t-1}$ / Total assets $_{t-1}$).

TATA: is Total Accruals to Total Assets and measured as (Net operating income $_t$ - Operating cash flow $_t$) / Total assets $_t$

A higher *M-Score* indicates a greater likelihood of a company engaging in earnings management. The study variables' codes, definitions, and measurements are presented in Table (3).

Table (3): Variable Definitions and Measurement

Code	Description		Measurements	
Dependent Variables				
λ_{it}	SOA toward optimal working capital		[(1- Coef) CCC_{t-1}] for each model $CCC = IVD + RCD - PYD$ Where: $IVD = 365 * (Inventory \div Cost\ of\ goods\ sold)$ $RCD = 365 * (Accounts\ receivable \div Sales)$ $PYD = 365 * (Accounts\ payable \div Cost\ of\ goods$ sold)	Chan (2014)
Independent Variables				
CFLW	Cash flow	**Determinants of CCC**	[(Net profit + Depreciation) / Total assets].	Cuong & Cuong (2016); Ahangar (2020)
LEV	Financial leverage		Total liabilities $_t$ / Total assets $_t$	
SIZE	Firm size		Total assets' natural logarithm	
Age	Company Age		The natural logarithm of firm age.	
SGR	Sales growth		Measured as (Sales $_t$ – Sales $_{t-1}$ / Sales $_{t-1}$)	
PPE	Tangibility		(Net Property/Plant/Equipment) / Total assets	
ROA	Return on assets		Net profit / Average total assets	
GDPGR	Macroeconomic conditions		Gross domestic product growth rate	
Comp_FC	Financial constraints		A composite index by combining the three measures of (FC_WW, FC_HP, and FC_CL - equations 1, 2, &3) using Exploration Factor Analysis (EFA) as presented in Table (2) (Elhabashy, 2023a & 2023b)	
M-Score	Earnings management		Based on the Beneish et al. (2013) model, as presented in Equation (4).	

3.3. Estimation approach

GMM is a standard panel data statistical analysis method when the study model is dynamic, which means that Y_{t-1} is one of the independent variables in the study models. It can control unobservable heterogeneity, provide more information, generate a wider range of outcomes, improve overall efficiency, does not require a normal data distribution, and reduces the presence of collinearity among variables (Hsiao, 2022). Furthermore, an improved approach to modeling technical efficiency involves incorporating complex models (Bond et al., 2001). The econometric literature suggests using the GMM to address endogeneity from the persistence and use of the lagged CCC variable as an independent variable and the lack of consistency in other panel data models. Consequently, the two-step GMM dynamic panel estimation is employed as an estimation methodology for all the models.

3.4. Models Specification

Three models were developed using the dynamic partial adjustment model, one for each hypothesis. Model (1) is formed to test the effect of a firm's characteristics and macroeconomic conditions on the speed of working capital adjustment. The target working capital model is a function of firm characteristics incorporating working capital benefits and risks. These variables might be obtained from firm-specific factors such as a firm cash flow (*CFLW*), Leverage (Lev), size (*SIZE*), firm age (*Age)*, growth rate (*SGR)*, tangibility (*PPE)*, profitability (*ROA)*, and macroeconomic factors such as the GDP growth rate (*GDPGR*). The magnitude of the SOA is represented by (λ_{it}). CCC_{it} and $CCCi_{t-1}$ are the actual CCC of firm i in year t and t–1, respectively. Thus, from Equations (a & e), Equation (f) can be derived as follows:

$$CCC_{it} = \alpha + (1-\lambda_{it})\, CCC_{it-1} + \lambda_{it}\alpha_1\, CFLW_{it} + \lambda_{it}\alpha_2\, Lev_{it}\, \lambda_{it}\alpha_3\, SIZE_{it} + \lambda_{it}\alpha_4\, Age_{it} + \lambda_{it}\alpha_5\, SGR_{it} + \lambda_{it}\alpha_6\, PPE_{it} + \lambda_{it}\alpha_7\, ROA_{it} + \lambda_{it}\alpha_8\, GDPGR_{it} + \lambda_{it} e_{it} \qquad (f)$$

Equation (f) can be rewritten to derive Model (1) as follows:

Model (1)

$$CCC_{it} = \alpha + (1-\lambda_{it})\, CCC_{it-1} + \beta_1\, CFLW_{it} + \beta_2\, Lev_{it} + \beta_3\, SIZE_{it} + \beta_4\, Age_{it} + \beta_5\, SGR_{it} + \beta_6\, PPE_{it} + \beta_7\, ROA_{it} + \beta_8\, GDPGR_{it} + u_{it}$$

Where $\lambda_{it}\alpha_j = \beta j$ as j = 1, 2, …..,8 and $\lambda_{it} e_{it} = u_{it}$

Model (1) predicts convergence based on the adjustment parameter. If λ_{it} equals 1, the firm's optimal CCC level is reached at time t. if λ_{it} is less than 1, the adjustment from the prior period (t-1) to this period (t) is less than the target CCC. If λ_{it} exceeds 1, the firm over-adjusts and fails to meet the target CCC level, as λ_{it} represents the adjustment amount. Hence, a greater value indicates a faster target CCC adjustment. The working capital adjustment speed (λ_{it}) is evaluated based on firm characteristics and macroeconomic factors using model (1), which equals [(*1- Coef) CCC_{it-1}*].

Model (2) tests the hypothesis (H2) that financial constraints impact working capital speed by repeating model (1) with its independent variables and adding the financial constraints to Model (1) as a moderate variable to re-estimate the SOA. Thus, the influence is measured by the difference (increase or decrease) in adjustment speed according to model (2) vs model (1)'s estimate, as follows:

Model (2)

$$CCC_{it} = \alpha + (1-\lambda_{it})\, CCC_{it-1} + (1-\lambda_{it})\, Comp\_FC * CCC_{it-1} + \beta 1\, CFLW_{it} + \beta_2\, Lev_{it} + \beta_3\, SIZE_{it} + \beta_4\, Age_{it} + \beta_5\, SGR_{it} + \beta_6\, PPE_{it} + \beta_7\, ROA_{it} + \beta_8\, GDPGR_{it} + u_{it}$$

Model (3) tests the hypothesis (H3) related to the influence of earnings management on the working capital adjustment speed, which was assessed by repeating model (1) with its independent variables (firm characteristics, macroeconomic factors, and earnings management variables) and re-estimating the adjustment speed. As a result, the influence is quantified as the difference (increase or reduction) in the adjustment speed according to model (3) compared with the estimate according to model (1), as follows:

Model (3)

$$CCC_{it} = \alpha + (1-\lambda_{it})\, CCC_{it-1} + (1-\lambda_{it})\, M\text{-}Score * CCC_{it-1} + \beta 1\, CFLW_{it} + \beta_2\, Lev_{it} + \beta_3\, SIZE_{it} + \beta_4\, Age_{it} + \beta_5\, SGR_{it} + \beta_6\, PPE_{it} + \beta_7\, ROA_{it} + \beta_8\, GDPGR_{it} + u_{it}$$

The models' codes, definitions, and measurements are presented in Table (3).

4. Empirical Results and Discussions

This section presents the findings of the empirical study and discusses the testing of the hypotheses through various statistical analyses, and the results are interpreted.

4.1. Descriptive Analysis

Table (4) displays descriptive statistics for all variables considered in the analysis, as follows:

- The average length of CCC is 82.69 days, with a StdDev of 85.12 days ranging between -138.52 and 508.30 days. The Min and Max show that the CCC of sample firms varies widely across firms.
- The mean value of the *Comp_FC* was 5.77, with StdDev of 3.37, with a range between (0.88) and (17.07), showing that the financial constraints are distinct and align with previous studies. It also indicates that the level of *Comp_FC* of sample firms varies widely.
- The mean of the *M-Score* is -3.02, with a StdDev of 5.22 and a range between -59.35 and 42.63, showing that the earnings manipulation is distinct and aligns with previous studies. It also indicates that the level of *M-Score* of listed firms highly varies across firms.

Table (4): Descriptive Statistics

Variables	*Obs*	*Mean*	*Std.Dev*	*Min*	*Max*	*Skew*	*Kurt.*
CCC	270	82.69	85.12	-138.52	508.30	3.15	14.97
CCC_{t-1}	270	64.20	72.35	-136.52	496.03	3.09	14.66
Comp_FC	270	5.77	3.37	0.88	17.07	1.44	4.71
M-Score	270	-3.02	5.22	-59.35	42.63	-2.02	75.74
CFLW	270	0.075	0.086	-0.171	0.316	2.23	7.60
Lev	270	0.576	0.199	0.130	1.263	16.34	268.0
SIZE	270	22.08	1.55	18.83	25.82	0.39	2.58
Age	270	2.80	0.74	0.00	5.38	-1.25	5.04
PPE	270	0.33	0.23	0.01	1.42	0.76	3.72
SGR	270	0.27	0.69	-0.95	5.66	3.79	25.57
ROA	270	0.051	0.083	-0.308	0.296	2.83	11.60
GDPGR	270	4.75	1.17	3.30	6.60	0.22	1.66
*Z-Score**	270	2.33	1.68	-0.93	9.33	1.17	4.82
*EM***	270	***Dummy***		***Freq.***		***Ratio***	
		Coded 0		167		61.9%	
		Coded 1		103		38.1%	

*Z-Score** and *EM*** are alternative financial constraints and earnings management proxies based on the *Z-score* (Altman, 1968) and Modified Jones Model (Dechow et al., 1995), respectively, for robustness check.

- The study sample's cash flows (*CFLW*) range from -0.171 to 0.316, with a mean of 0.075 and a StdDev of 0.086. It also shows that the level of *CFLW* of listed firms varies greatly across firms.
- The study sample's financial leverage (*Lev*) ranges from 0.130 to 1.263, with a mean of 0.576 and a StdDev of 0.199. These values indicate that, on average, the study sample is heavily indebted. Financial leverage greater than (1) indicates that some firms have negative equity.
- The sample data's *ROA* ranges from -0.308 to 0.296, with an average of 0.051. The average firm size (*SIZE*) is 22.08, ranging from 18.834 to 25.82. Large firms dominate the study sample. Sales growth (*SGR*) for the sample firms ranges from -0.95 to 5.66, with a mean of 0.27 and a StdDev of 0.69, showing considerable disparities between sample firms.

4.2. Regression Analysis - Tests of Hypotheses

As mentioned above, the two-step GMM dynamic panel estimation tests the hypotheses. It increases the efficiency of least squares estimators in heteroskedasticity or serial correlation (Wooldridge, 2002). According to GMM, model estimators are characterized by unbiasedness, consistency, and efficiency (Arellano & Bond, 1991; Blundell & Bond, 1998).

Some validity tests were performed to ensure the reliability of the results and determine the estimated model's quality. (1) The Variance Inflation Factor (VIF) test ensures that there is no multicollinearity among the study's independent variables when VIF values are less than (10) and Tolerance values (1/VIP) for each variable are greater than (0.10). (2) The White test was conducted to ensure that no heteroscedastic errors exist in the regression analysis if the p-value of the test is more than 5% significance level. (3) The Arellano-Bond test Ar (1) & Ar (2) were conducted to ensure that the residuals are not serially correlated from the first order and second order, respectively, if the p-value of the test is more than 5% significance level. (4) The Sargan test is used to assess the validity of overidentifying restrictions in a dynamic panel data model specification; if the p-value of the test is more than a 5% significance level, it indicates the validity of overidentifying restrictions. The statistical analyses used to test the study hypotheses are as follows:

4.2.1. Testing Hypothesis (H1)

To test hypothesis (H1), a dynamic multiple regression analysis was conducted with the two-step GMM approach to determine the factors related to the firm's characteristics and macroeconomic conditions affecting the working capital level. The speed of working capital adjustment was also calculated using model (1), which equals [(1- Coef) CCC_{t-1}]. The VIF, White, Arellano-Bond, and Sargan tests were used to assess the validity of the estimated model, as shown in Table (5).

Table (5): Firm characteristics, macroeconomic conditions, and working capital adjustment speed

CCC	*Coef.*	*t-value*	*p-value*	*Sig*	*VIF*	*1/VIF*
CCC_{t-1}	0.669	59.25	0.000	***	1.293	0.773
CFLW	-99.928	-2.60	0.013	**	4.955	0.202
LEV	0.294	0.36	0.723		1.012	0.989
SIZE	-116.015	-8.92	0.000	***	1.155	0.865
Age	-122.546	-6.36	0.000	***	1.188	0.842
SGR	-232.804	-22.55	0.000	***	1.021	0.980
PPE	79.827	0.66	0.515		1.306	0.766
ROA	6.58	0.12	0.904		4.896	.204
GDPGR	8.001	2.32	.025	**	1.038	.963
Constant	3100.492	9.22	0.000	***		
SOA%	**33.1**(1)					

Test	*Test- Statistic*	*p-value*
F-test	405.084	0.000
White test	14.43	0.692
Arellano-Bond test (1)	-1.73	Pr > z = 0.084
Arellano-Bond test (2)	1.28	Pr > z = 0.199
Sargan test	7.72	0.738

**** p<.01, ** p<.05, * p<.1*

(1) calculated as [(1- Coef) CCCt-] = (1- 0.669)

Table (5) shows that:

- Table (5) shows model significance used as a whole, as the F-test reached (405.084) using the two-step GMM dynamic panel estimation. The findings show that the model is statistically significant at the 0.01 significance level, suggesting that the regression model is accepted. Similarly, the model's independent variables do not suffer from the problem of multicollinearity as each variable's value of (VIF) is less than (10). Likewise, the White test indicates no heteroskedasticity issues with the study model as the test p-value is more than 0.05, which indicates the model's validity. Further, the Arellano-Bond tests Ar (1) & Ar (2) indicate that there is no autocorrelation for the first- and second-order residuals, respectively, which may affect the accuracy of the results of the study model, as the p-value of the test is more than 0.05. Sargan test significance level is more than 0.05; thus, the null hypothesis cannot be rejected, indicating the validity of subsets of the instrument variables.

- There is a positive effect (a significance level of at least 0.05) for the lagged CCC variable (CCC_{t-1}) and GDP growth rate (*GDPGR*) on the level of working capital. Further, a firm cash flow (*CFLW*), size (*SIZE*), firm age (*Age*), and growth rate (*SGR*) have a significant negative effect on the level of working capital at a 1% significance level. Profitability (*ROA*), financial leverage (*LEV*), and tangibility (*PPE*) do not influence the level of working capital. Such results support Hypothesis (H1) that Firm characteristics and macroeconomic conditions significantly impact the target level of working capital. Then, the model's regression equation is as follows:

$$CCC_{it} = \mathbf{3100.492} + \mathbf{(0.669)\ CCC_{it-1}} - \mathbf{(99.928)\ CFLW_{it}} + (0.294)\ Lev_{it} - \mathbf{(116.015)\ SIZE_{it}} - \mathbf{(122.546)\ Age_{it}} - \mathbf{(232.804)\ SGR_{it}} + (79.827)\ PPE_{it} + (6.58)\ ROA_{it} + \mathbf{(8.001)\ GDPGR_{it}}$$

- The positive association between lagged working capital (CCC_{t-1}) and the current working capital (*CCC*) reflects the proposed model's dynamism. Firm size (*SIZE*) negatively affects CCC, consistent with (Qurashi & Zahoor, 2017; Cuong & Cuong, 2016). Large firms tend to invest less in working capital than small firms because they can restrict credit. This result contradicts (Wasiuzzaman & Arumugam, 2013).

- Further, cash flows firm *(CFLW)*, firm age (*Age*), and growth opportunity (SGR) negatively affect CCC. It is interpreted that high cash flows manage their working capital more efficiently and have better net liquidity balances, resulting in lower CCC (Chauhan & Banerjee, 2018). Further, older firms require less working capital (Ahangar, 2020). Companies with higher growth potential may have lower CCC (BañosCaballero et al., 2010). The literature suggests two causes. Trade credit is high-growth firms' primary source of working capital financing (Cuñat, 2007). Second, to maintain growth, companies may offer more trade credit to customers during low demand (Emery, 1987). Rapid sale firms may experience liquidity issues and face bankruptcy.
- Macroeconomic conditions and CCC have been found to have a positive relationship, consistent with (Qurashi and Zahoor, 2017). Recessions make it hard for firms to get external financing due to cash shortages (Chiou et al., 2006). The recession lowers sales, which raises inventories. Customers also pay off their obligations more slowly during such periods. During a recession, firms keep more inventories and receivables, indicating that they reduce production.
- The results showed that Egyptian firms continue to adjust their working capital to achieve the optimal working capital level; the SOA was estimated (33.1%) based on the proposed model. This means that the SOA to the optimal working capital may differ depending on the institutional environment in which they operate, reflected in firm characteristics and macroeconomic conditions.

The results show that Egyptian firms have a target working capital but adjust slowly, with only 33.1% of working capital. Such findings are consistent with Cuong and Cuong (2016) and Mathuva (2014), who found that the SOA of working capital in Vietnamese and Kenyan firms was 48% and 44%, respectively.

4.2.2. Testing Hypothesis (H2)

Model (2) estimated working capital adjustment speed as [(1-Coef) CCC_{t-1}] to test hypothesis (H2) that financial constraints impact the speed of working capital adjustment. Table (6) shows the VIF, Arellano-Bond, Sargan, and White tests used to evaluate the estimated model's quality and validity.

Table (6): The impact of financial constraints on working capital adjustment speed

CCC	*Coef.*	*t-value*	*p-value*	*Sig*	*VIF*	*1/VIF*
CCC_{t-1}	0.727	19.87	0.000	***	5.205	0.192
$Comp\_FC*CCC_{t-1}$	-0.008	-0.890	0.381		5.93	0.169
CFLW	-91.982	-2.29	0.027	**	4.959	0.202
Lev	0.3	0.31	0.757		1.012	0.988
SIZE	-115.146	-8.64	0.000	***	1.481	0.675
Age	-139.552	-5.95	0.000	***	1.21	0.826
SGR	-230.392	-21.50	0.000	***	1.026	0.975
PPE	-27.617	-0.22	0.829		1.323	0.756
ROA	-8.174	-0.14	0.889		4.903	0.204
GDPGR	7.891	1.39	0.171		1.041	0.961
Constant	316.833	10.47	0.000	***		
SOA%	**27.3**					

Test	*Test- Statistic*	*p-value*
F-test	484.092	0.000
White test	17.05	0.641
Arellano-Bond test (1)	-1.73	Pr > z = 0.083
Arellano-Bond test (2)	1.26	Pr > z = 0.207
Sargan test	8.48	0.587

**** p<.01, ** p<.05, * p<.1*

Table (6) shows that:

- The F-test from a two-step GMM dynamic panel estimate indicates the model's relevance. The regression model is significant at a 0.01 significance level, suggesting that the regression model is accepted. Multicollinearity does not affect the model's independent variables, as VIF values for each variable are less than 10. Likewise, the White test shows no heteroskedasticity issues with the study model as the test p-value is more than 0.05, which indicates the model's validity. According to the Arellano-Bond test Ar (1) & Ar (2), the first- and second-order residuals have no autocorrelation, as the p-value is more than 0.05. Sargan test significance level is more than 0.05; thus, the null hypothesis cannot rejected, indicating the validity of subsets of the instrument variables.

- There is a positive effect (a significance level of at least 0.1) for the lagged *CCC* variable (CCC_{t-1}) on the level of working capital. Further, a firm cash flow (*CFLW*), size (*SIZE*), firm age (*Age*), and growth rate (*SGR*) have a significant negative effect on the level of working capital at a 5% and 1% significance level. Profitability (*ROA*), financial leverage (*LEV*), and tangibility (*PPE*) do not influence the level of working capital. Then, the model (2) regression equation is as follows:

$$CCC_{it} = \mathbf{316.833} + \mathbf{(0.839)CCCit_{-1}} - (0.008)Comp\_FC*CCC_{it-1} - \mathbf{(91.982)CFLW_{it}} + (0.3)Lev_{it} - \mathbf{(115.146)SIZE_{it}} - \mathbf{(139.552)\ Age_{it}} - \mathbf{(230.392)SGR_{it}} - (27.617)PPE_{it} - (8.174)ROA_{it} + \mathbf{(7.891)GDPGR_{it}}$$

The results support Hypothesis (H2) that the financial constraints impact the speed of working capital adjustment. Because of the negative effects of financial constraints, the SOA decreased from 33.1% to 27.3%, with a variance of 5.8%, based on the estimated Model (2). These findings indicate that highly financially constrained firms adjust their working capital more slowly than less constrained firms. Such findings are consistent with Laghari and Chengang (2019), Ahangar (2020), and Aflatooni et al. (2022), who argue that financially constrained firms have lower optimal working capital levels due to debt rationing and high external capital costs. However, the findings contradict Chauhan and Banerjee (2018), who found that working capital in Indian manufacturing firms does not match targets. Their findings suggest that due to financial constraints, developing market firms may be unable to pursue optimal working capital.

4.2.3. Testing Hypothesis (H3)

Multiple regression analysis was conducted using the two-step GMM dynamic panel estimation to test the hypothesis (H3) that earnings management impacts the speed of working capital adjustment. The speed of working capital adjustment, which equals [(1- Coef) CCCt-1], was also estimated using Model (3). The quality and validity of the model were assessed using VIF, White, Arellano-Bond, and Sargan tests, as presented in Table (7).

Table (7): The impact of earning management on working capital adjustment speed

CCC	*Coef.*	*t-value*	*p-value*	*Sig*	*VIF*	*1/VIF*
CCC_{t-1}	0.724	30.54	0.000	***	1.296	0.772
$M\text{-}Score*CCC_{t-1}$	-0.006	-1.51	0.138		1.012	0.989
CFLW	-55.492	-4.87	0.000	***	4.955	0.202
LEV	-0.011	-4.12	0.000	***	1.012	0.989
SIZE	4.843	0.69	0.495		1.158	0.864
Age	-46.323	-3.48	0.001	***	1.188	0.842
SGR	-341.795	-19.19	0.000	***	1.022	0.978
PPE	193.735	3.21	0.002	***	1.306	0.766
ROA	37.892	2.89	0.006	***	4.896	0.204
GDPGR	11.05	5.05	0.000	***	1.041	0.961
Constant	91.239	0.61	0.546			
SOA%	**27.6**					

Test	*Test- Statistic*	*p-value*
F-test	680.391	0.000
White test	14.21	0.699
Arellano-Bond test (1)	-1.73	Pr > z = 0.083
Arellano-Bond test (2)	1.26	Pr > z = 0.207
Sargan test	5.08	0.886

**** p<.01, ** p<.05, * p<.1*

Table (7) indicates that:

- The regression model is significant at a 0.01 significance level, suggesting that the regression model is accepted. Multicollinearity does not affect the model's independent variables, as VIF values for each variable are less than 10. Likewise, the White test shows no heteroskedasticity issues with the study model as the test p-value is more than 0.05, which indicates the model's validity. According to the Arellano-Bond test Ar (1) & Ar (2), the first- and second-order residuals have no autocorrelation, as the p-value is more than 0.05. Sargan test significance level is more than 0.05; thus, the null hypothesis cannot be rejected, indicating the validity of subsets of the instrument variables.

- There is a positive effect (a significance level of at least 0.01) for the lagged CCC variable (CCC_{t-1}), tangibility (PPE), profitability (ROA), and GDP growth rate (GDPGR) on the level of working capital. Further, a firm cash flow (*CFLW*), financial leverage (*Lev*), firm age (*Age*), and growth rate (*SGR*) have a significant negative effect on the level of working capital at a 1% significance level. Firm size (*SIZE*) does not influence the level of working capital. Then, the Model (3) regression equation is as follows:

$$CCC_{it} = 91.239 + \mathbf{(0.724)CCC_{it-1}} - (0.006)M\text{-}Score^{*}\ CCC_{it-1} - \mathbf{(55.492)CFLW_{it}} - \mathbf{(0.011)Lev_{it}} + (4.843)SIZE_{it} - \mathbf{(46.323)Age_{it}} - \mathbf{(341.795)SGR_{it}} + \mathbf{(193.735)PPE_{it}} + \mathbf{(37.892)ROA_{it}} + \mathbf{(11.05)GDPGR_{it}}$$

The findings support Hypothesis (H3) that earnings management impacts the speed of working capital adjustment. Based on the estimated model (3), the SOA decreased from 33.1% to 27.6% due to the negative impact of earnings management, with a variance of 5.5%. These findings indicate that manipulator firms adjust their working capital at a slower speed than non-manipulator firms.

4.3. Robustness Tests

Additional analysis is conducted on basic analysis models to ensure the robustness of the results. This study assesses whether different methods of key variable measurement lead to significant variations in the essential models. Thus, *Z-score* and *EM* are adopted as alternative financial constraints and earnings management proxies, respectively. *Z-score* is measured based on Altman (1968), as specified in Equation (5), and *EM* is measured based on the Modified Jones Model (Dechow et al., 1995), as follows:

4.3.1. Alternative measurement of financial constraints (*Z-Score*)

An alternative measurement of a firm financial constraint is computed based on Altman (1968), as shown in Equation (5):

$$Z - score = 1.2WC + 1.4RE + 3.3EBIT + 0.6MVE + 0.999S \quad (5)$$

Where:

WC : working capital / total assets

RE : retained earnings / total assets

EBIT : earnings before interests and taxes / total assets

MVE : market value of equity / total liabilities

S : sales / total asset

4.3.2. Alternative measurement of Earnings management (*EM*)

An alternative measure of earnings management is estimated using the modified Jones model (Dechow et al., 1995) as follows:

A. Total accruals are calculated as net profit minus cash flows from operations.

$$TACC_{it} = NIBE_{it} - OCF_{it}$$

B. Calculating the absolute value of discretionary accruals as a percentage of total assets at period t-1 (accruals subject to management's discretion) in three steps:

1. Build a regression model at the level of each sector using the following regression equation:

$$TACC_{it}/A_{it-1} = \beta_0 + \beta_1\ (1/A_{it-1}) + \beta_2\ (\Delta REV_t - \Delta REC_t)/A_{it-1} + \beta_3\ (PPE_{it}/A_{it-1}) + e$$

Where

TACC is the total accruals calculated in (A)

A_{it-1} = total assets in period t-1

ΔREV = net sales revenue in year t minus in year t-1

ΔREC = net receivables in year t minus in year t-1

PPE = Net Property/Plant/Equipment / Total assets.

2. Using the parameters of the model at a sectoral level (regression coefficients β_1, β_2, & β_3) calculated in (1) to estimate the value of non-discretionary $NDACC_{it}$ as follows:

$$NDACC_{it} = \beta_1\ (1/A_{it-1}) + \beta_2\ (\Delta REV_{it} - \Delta REC_{it} / A_{it-1}) + \beta_3\ (PPE_{it} / A_{it-1})$$

3. The total accruals minus non-discretionary accruals calculate the ratio of each firm's discretionary accruals *DACCit*.

$$DACC_{it} = TACC_{it}/A_{it-1} - NDACC_{it}$$

Absolute discretionary accruals ratio values express the extent of earnings management. The higher value indicates that the company is more involved in earnings management practices. That means that the variable is a dummy, which takes one if the ratio of discretionary accruals is greater than the sector median and zero otherwise.

Table (8) findings show that even using different measures for the alternative key variable, they still align with the results presented in Table (6) and Table (7). Panel A in Table (8) indicates that the SOA is 27.3% in the essential model and 24.3% in the additional model. That implies that the financial constraints have a similar effect on the speed of working capital adjustment in both essential and additional models, which aligns with our prediction.

Furthermore, Panel B in Table (8) indicates that the SOA is 27.6% in the essential model and 22.4% in the additional model; this shows that both models impact the speed of working capital adjustment in the same direction. This implies that an alternative earnings management proxy based on the Modified Jones Model validated the findings.

The alignment, in the same direction, between the results presented in Table (8) and the results presented in Table (6) and Table (7) leads to confidence in the integrity of this study's results.

Table (8): Additional analysis results

	Essential Model		*Additional Model*	
CCC	***Coef.***	***p-value***	***Coef.***	***p-value***
Panel A: Test of Hypothesis (H2) – Financial Constraints				
CCC_{t-1}	0.727***	0.000	0.757***	0.000
Comp_FCCCC_{t-1}*	-0.008	0.381		
Z-ScoreCCC_{t-1}*			-.0250	0.231
CFLW	-2.29**	0.027	-63.525***	0.000
LEV	0.31	0.757	-.006	0.292
SIZE	-8.64***	0.000	-5.173	0.457
Age	-5.95***	0.000	-50.068***	0.001
SGR	-21.50***	0.000	-332.578***	0.000
PPE	-0.22	0.829	179.917***	0.002
ROA	-0.14	0.889	53.682***	0.001
GDPGR	1.39	0.171	9.669***	0.001
Constant	10.47***	0.000	327.515*	0.057
SOA%	**27.3**		**24.3**	
F-test (p-value)	484.092 (0.000)		222.908 (0.000)	
White test	17.05 (0.641		15.89 (0.683)	
Arellano-Bond test (1)	-1.73 9 (0.083)		-1.81 (0.083)	
Arellano-Bond test (2)	1.26 (0.207)		1.33 (0.207)	
Sargan test	8.48 (0.587)		7.76 (0.652)	
Panel B: Test of Hypothesis (H3) – Earnings Management				
CCC_{t-1}	0.724***	0.000	0.776***	0.000
M-ScoreCCC_{t-1}*	-0.006	0.138		
EMCCC_{t-1}*			-0.245***	0.001
CFLW	-55.492***	0.000	-62.086***	0.000
LEV	-0.011***	0.000	-0.027**	0.000
SIZE	4.843	0.495	-0.71	0.965
Age	-46.323***	0.001	0.996	0.949
SGR	-341.795***	0.000	-317.551***	0.000
PPE	193.735***	0.002	206.508**	0.033
ROA	37.892***	0.006	47.737***	0.002
GDPGR	11.05***	0.000	9.741***	0.002
Constant	91.239	0.546	63.236	0.839
SOA%	**27.6**		**22.4**	
F-test (p-value)	680.391 (0.000)		567.547 (0.000)	
White test	14.21 (0.699)		13.52 (0.793)	
Arellano-Bond test (1)	-1.73 9 (0.083)		-1.88 (0.076)	
Arellano-Bond test (2)	1.26 (0.207)		1.39 (0.173)	
Sargan test	5.08 (0.886)		13.40 (0.202)	
**** p<.01, ** p<.05, * p<.1*				

5. Summary and Conclusions

This study investigates the influence of a firm's characteristics and macroeconomic conditions on the SOA of working capital towards the target level for Egyptian firms. In addition, it investigates the impact of financial constraints and earnings management on the SOA.

This study uses data from non-financial firms included in the EGX100 index. Only firms with complete data for all variables analyzed in the study are included. The data covers the period from 2017 to 2022, providing the most up-to-date information for the research period. The analysis excludes the financial firms as they have inherent differences from non-financial firms, which could lead to incomparable attributes. Thus, the study sample includes 45 non-financial firms, with 270 balanced observations spanning 2017 to 2022.

The CCC is used as a proxy for WCM. A composite index for financial constraints is created using EFA from three measures: Whited and Wu (2006), Hadlock and Pierce (2010), and Cleary (1999). Beneish's M-Score of eight factors is used as a proxy for earnings management. Then, three models of the dynamic partial adjustment model were developed, one for each hypothesis. Multivariate linear regression analysis is applied using the two-step GMM dynamic panel estimation to test the hypotheses. The GMM dynamic panel estimation is considered more appropriate when the study model is dynamic. This means that Y_{t-1} is one of the derived variables available in the study models, which is the case in this study.

The study's findings strengthen an Egyptian working capital dynamics hypothesis. Results show that adjustment behaviors toward the optimal working capital vary in a firm's characteristics and macroeconomic conditions. The study results showed a positive effect of the lagged CCC variable (CCC_{t-1}) and GDP growth rate (GDPGR) on the speed of working capital adjustment. Further, a firm cash flow (CFLW), size (SIZE), firm age (Age), and sales growth rate (SGR) have a significant negative influence on the adjustment speed of working capital. Thus, the SOA (SOA) was estimated based on the proposed model (33.1%).

Results also suggest that financial constraints cause firms to adjust more slowly toward optimal working capital, as the SOA decreased from 33.1% to 27.3%, with a variance of 5.8%. Further, manipulator firms adjust their working capital at a slower speed than non-manipulator firms, where the SOA decreased from 33.1% to 27.6% due to the negative impact of earnings management, with a variance of 5.5%.

Other alternative proxies for financial constraints and earnings management are utilized to check the robustness of the study's findings. Z-score (Altman, 1968) and modified Jones model (Dechow et al., 1995) are adopted as proxies for financial constraints and earnings management proxies, respectively. Results show the alignment in the same direction between the results presented, leading to confidence in the integrity of this study's results.

The study contributes to the literature as only a few research have addressed the target WCM. Prior literature has rarely examined the influence of financial constraints on the speed of working capital adjustment in general (Altaf & Shah, 2018; Chauhan & Banerjee, 2018; Laghari & Chengang, 2019; Ahangar, 2020; Aflatooni et al., 2022). No studies have examined this relationship in Egypt and other Middle Eastern countries. As a result, the literature still needs to investigate such a relationship in Egypt. Further, none of the prior studies examined how earnings management affects working capital adjustment speed in general and Egypt. It is a fertile research area.

The current study recommends increased interest in the optimal working capital level and indicators because of their importance in firm growth and their continuity in the business market. In addition, it is recommended to encourage firms to reach the optimal working capital level to increase their value and profitability. Further, it recommended increasing firm officials' awareness by following effective commercial credit policies that reduce the financing period for external financing in a way that does not affect the quality and strength of the relationship, whether with suppliers or customers, as this positively impacts a firm's profitability. Also, an effective system of incentives and rewards should be implemented based on financial analysis results related to working capital indicators to detect any defect that could harm a firm's profitability. Another recommendation for investors is to properly allocate resources across companies with solid financial positions and non-manipulator firms.

Future research can examine the effects of corporate governance efficiency and managerial ability on the speed of working capital adjustment. Investigating the impact of corporate governance efficiency on the relationship between managerial entrenchment and the speed of adjusting the working capital structure is also recommended. Future research could also focus on the potential governance role of audit quality on the SOA toward optimal working capital and its impact on investment efficiency. Studying the effect of accounting-based earnings quality measures (accruals quality, persistence, predictability, and income smoothing) on the SOA to the optimal working capital is recommended. In addition, future research should focus on the impact of market-based earnings quality measures (accounting conservatism, value relevance, and timeliness) on the SOA to the optimal working capital.

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