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Nonlinear impact of Excess Working Capital on the firm performance

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Abstract

This research examines the influence of excess net working capital management on business performance in the non-financial/manufacturing industry of Pakistan. Does excess net working capital impact firm value? The relationship between net working capital and business value is explained through a concave association, which signifies that excess net working capital considered as overinvestment and deficit net working capital as underinvestment. To examine this impact, the study uses the net working capital rate as an independent variable, which is net working capital divided by total sales and measures its effect on firm performance measured by return on asset while controlling through variables, them being sales growth, firm size, age, cash flow, and leverage. Utilizing convenience sampling, the targeted population for this study is derived from data of 120 firms traded on the national exchange of Pakistan from 2016 to 2022 providing an overall holistic although generalized view of the market. Utilizing multiple regression models on the panel data, the results for which suggest that when net working capital exceeds an optimal point (overinvestment) and is positive, it negatively impacts firm performance. This result provides valuable insights, that being the existence of optimal levels of net working capital that can be beneficial in the manufacturing industry in regional context.

Keywords: *Net working capital, NWC, Working Capital Management, WCM, Working Capital Finance, WCF, Working Capital Investment, WCI, Net Working Capital Rate, NWCR, overinvestment, underinvestment, sale growth, leverage, cashflow*

1. Introduction

Companies employ collection of techniques to achieve and maintain financial stability, working capital is one such concept which relates to managing current assets and current liabilities, which includes cash, accounts receivables, accounts payable, and inventories. Effective control and efficient management of these components are vital for a business's financial welfare such as financial stability, supporting operational efficiency, driving profitability, managing risks, seizing growth opportunities and play a major role in avoiding business-related financial problems and trust among stake-

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holders. (Ramiah, Zhao & Moosa, 2014). Having such significance, the management tends to spend more time creating the perfect balance between risk and efficiency i.e., managing its working capital. The basic query that working capital management tends to remedy is "What is the optimum point of investment that causes maximum profit and efficient firm's performance?"(Baños, García & Martínez, 2012). Businesses tend to focus on developing an efficient working capital management system as it is vital in determining best operations outcome along as well as remaining solvent. Working capital is also a rich vein for financing firm's growth and development, as pointed out by Buchmann, Roos, Jung and Martin (2008) which concluded that the companies often tend to ignore or not take into account the ability of working capital as a potential source of financing to support the firm's development, further backed by Ek and Guerin (2011) signifying the potential for improving the efficiency and effectiveness of working capital in most firms, thus reducing the dependence on more traditional methods, like debt financing which pushes the firm towards possible insolvency. During insolvency, financial institutions take working capital into account and decide whether the firm in question is legally insolvent or not. This is why the importance of managing the working capital is more than it seems at first (Ramiah et al., 2014).

Significance of working capital and its management along with its influence on firm performance has been analyzed in various dimensions around the world (Ramiah et al., 2014; Wasiuzzaman, 2015; Akgün & Karatas, 2021). Studies like the one by Deloof (2003) shows a linear relation between WCM on business performance. Deloof (2003) proved presence of positively natured relation for net working capital and outcome of a business, which will encourage companies with higher current capital and volumize their sales number and expand sales discounts for timely payment. However, this created an illusion of forever increasing working capital without repercussions which is not possible and possibly creating adverse effect on the firm as proven by Baños et al., (2014). Earlier, Kieschnick, LaPlante, and Moussawi (2013) explained this by stating an opposing effect for companies in the US. According to their findings, each additional investment in working capital, if continued to increase, will lead to a reduction in excess profit margins, on average. Clearly, a "tripping" point existed after which further increasing working capital proved adversely towards performance which was exactly what Baños et al., (2014) and Mun and Jang (2015) had concluded, highlighting concavity between working capital and firm's performance while utilizing size and leverage as control variables. The point serves as a clear indication that a continuous growth of working capital is not a viable alternative, thereby establishing the potential occurrence of overinvestment, which inevitably leads to the degradation of the firm's overall performance. Similarly, investing beyond this threshold enhances the firm's performance, while halting investments prematurely also poses detrimental

effects, thereby highlighting the existence of underinvestment. Consequently, the existence of an optimal working capital volume becomes evident, where maximum profitability can be achieved. Surpassing this optimal level results in overinvestment in working capital, whereas falling short of it leads to the affliction of underinvestment in working capital.

The primary objective of this research is to examine the impact of both overinvestment and underinvestment in working capital on firm performance within the specific context of Pakistan. The aim of this study is to investigate the influence of excessive working capital on firm profitability by exploring potential nonlinear relationships between working capital and company performance, while considering additional control variables within the broader manufacturing industry of Pakistan. A sample of 100 companies and their data from the period of 2016-2020 was utilized to provide a comprehensive understanding of this concept within the Pakistani context. To gather the data, a convenience sampling method was employed, and a statistical regression analysis was used to analyze the collected data. The significance of this research lies in its inclusion of age as an additional controlling factor in examining the concave relationship. The inclusion of control variable adds complexity and nuance to the analysis. This comprehensive approach contributes to a more robust analysis and enhances the understanding of the underlying dynamics. Moreover, the study's significance stems from its use of data from a developing country with an evolving financial system, where empirical research is crucial for economic development and has been largely ignored. This study will enhance the contextual relevance of working capital management proving valuable for practitioners and policymakers operating in the region.

2. Theoretical Background and Hypothesis

2.1 WCM strategies, theories and policies

The significance of working capital management can be seen from its substantial share of total assets. Many arguments, in theory, exist to shed light on the association of working capital and business performance as it is a valuable source for financing and running daily operations. Working capital management (WCM) is necessary due to its impact on the profitability of a firm leading ultimately to its value (Smith, 1980). Working capital is an integral part of the company's financial system and thus managing it is vital (Altaf & Ahmad, 2019). The literature introduced various concepts, policies, and decisions that a firm might follow to manage its working capital Academic research points out two main directions, the first being working capital finance (WCF) along with working capital investment (WCI) (Altaf & Ahmad, 2019), and the second is conservative/aggressive working capital management policy.

A firm taking a WCI direction treats current assets as a short-term investment while using current liabilities as sources to finance them. It is a real challenge to achieve the needed balance between short-termed investments (current assets) and short-termed sources of finance (current liabilities). Altaf and Ahmad (2019) stated the vitality for managing to avoid deficits and increase profitability. They have confirmed that the selected policy for WCM influences the financial well-being of the firm. If a manager successfully achieves the balance between WCI and WCF, this is a working capital policy concluded. Adequate interpretation and implementation of the policy with working capital system in mind will directly influence the business risk and cost along with sustainability while increasing profit. This has been highlighted by many researchers (Salehi, Mahdavi, Dari & Tarighi, 2019; Peng & Zhou, 2019)

A WCM policy can either be more conservative or more aggressive. A conservative policy is characterized by pouring large funds into current assets which are financed by lower short-termed sources of current liabilities. On the other hand, the aggressive policy is assigning small funds in current assets which are funded by a large number of short-termed sources of finance, this is following the results concluded by Kayani, DeSilva and Gan (2019). Laghari and Chengang (2019) and Altaf (2019) concluded a trade-off between these policies to results in non-linearity between working capital and firm performance. This means net working capital has a concave (non-linear) relationship with firm profit. This is why a single WCM strategy chosen by the firm can highly dictate its return and risk relations (Baños et al., 2012).

Numerous studies have looked into the linear working capital and profit relationship in many industries and countries. The results are categorized into two main views.

One view state, that high working capital might increase firm value. This is particularly true for companies with a lower working capital level mostly due to working capital allowing businesses to expand by expanding sales and profits. Bulk inventories tend to reduce supply costs, provide protection against price variations, and risk of losing sales due to the presence of stocks (Deloof, 2003). The increased inventory levels also decrease the possibility of finishing the stock levels at an increasing rate. This also results in decreasing fixed costs such as supply chain costs as well as increasing potential accounts receivables which can accelerate sales amount as it gives the consumers the option to buy now and pay later. The big stock of supplies also equips the companies to provide better service to their customers. This Rationale has been supported by various studies such as Wasiuzzaman (2015), Abuzayed (2012), Moussa (2018), Deloof (2003), Ogundipe et al. (2012), Lee and Stowe (1993), Blinder and Maccini (1991), Mohamad and Saad (2010) and Lee and Stowe (1993). The mentioned studies had results supporting the concept of positive effect of working capital with firm profitability.

On the side, in competing view, if net working capital rises, it will harm the firm's performance. Literature includes many studies pointing out the opposite of what has been said above, saying a negative relation is there for firm performance when influenced by net working capital. Almeida and Eid (2014) and Deloof (2003), had reported such natured association i.e., negative association between working capital and value. Large investments in working capital need substantial financing, which is sourced through external creditors tend to increase a firm's bankruptcy probability. The excessive investment will likely harm firm performance. Resource-Based View explains that excess working capital can be seen as a resource that can positively or negatively impact firm performance. This perspective emphasizes the need to effectively manage working capital to leverage it as a source of competitive advantage such as maintaining high inventories to cater the demands but this inventory will incur high costs in for of storage, rents of the warehouse, insurance of goods, and security costs related to storage (Kim & Chung, 1990). A substantial capital will also have a big opportunity cost (Deloof, 2003) which is explained by the Trade-Off Theory as well.

Recently the literature shows that there is a trade-off between risk and profitability. Greater investment in current assets, lower the risk but lower will be profitability showing a "trade-off" between liquidity and profitability. This relationship is explained by the Trade-off theory which explains an existence of optimal level of net working capital for a manufacturing firm as excess working capital results in opportunity costs, reducing profitability due to investment in non-productive long-term asset hence supporting a concave effect, due to non-linearity, of net working capital and financial health. A negatively-natured relationship develops on a higher level of net working capital due to overinvestment while a positively natured relation is present at a low level of net working capital due to underinvestment, encouraging businesses to utilize different a framework to examine the costs and benefits associated with different levels of working capital, taking into account factors such as cash flow, financing costs, and the opportunity cost of capital. It can help to identify the threshold at which excess working capital becomes detrimental to firm performance. While the other theories, such as Agency Theory and Resource-Based View, may also provide valuable perspectives, the Trade-off Theory seems particularly suitable for analyzing the nonlinear impact of excess working capital on firm performance. Results found by Aktas, Croci and Petmezas (2015) support the theory stating that there should be a working capital level that is balanced and optimal, believing that the performance and value of a company rise with the increase in working capital until a certain level, after which the relationship is negative. This rise, reaching optimum and declining confirms an inverted U (non-linear/concave) relation between NWC and profitability that might cause agency costs and inefficiencies in firm performance, as highlighted by the Agency theory. Analysis for concavity relation is performed for working capital

utilizing the widely accepted NWC proxies and proxy for showing business financial health (ROA as proxy) (Mun and Jang, 2015). The answers conclude a concave/non-linear, significant (upside down U shaped) relation for working capital and profitability.

A study conducted in a fellow South Asian country took Indian companies from the non-financial sector, confirmed non-linearity in relation of both variables (Altaf & Shah, 2017). Another paper used a Chinese sample of firms to conclude this non-linear relationship (concave) (Laghari & Chengang, 2019) however only utilizing segments of one industry in the data set. Mun and Jang (2015) had concluded, highlighting concavity between working capital and firm's performance while utilizing size and leverage as control variables. Recent paper by Akgün and Karatas (2021) has worked on a sample derived from the 28 countries of the European Union to test this relation between working capital and firm profitability (non-linear) to find the optimum point for investment and further cementing the idea of excess working capital and its repercussion on profitability and explore avenues of utilizing working capital as an internal source of financing, highlighted by theories like Financial Constraints Theory and Pecking Order Theory which both identify excess working capital utilization for funding growth projects rather than continuously investing in working capital or relying heavily on external sources of financing. Literature thus supports the evidence of existence of non-linearity.

2.2 Indicators of financial performance

Through an analysis of the existing literature, it has been observed that a number of authors have employed two key financial ratios, namely Return on Equity (ROE) and Return on Assets (ROA), as indicators of business profitability. In a recent study focusing on companies operating in the Middle East and Northern Africa, Ansary and Gazzar (2021) utilized both ROA and ROE to assess performance. Moreover, Jaworski and Czerwonka (2022) emphasized the relevance of ROA as a profitability proxy due to its relationship with net working capital rate (NWCR), which is directly linked to assets. The calculation of ROA involves dividing earnings before interest and tax (EBIT) by the total value of assets owned by the business. This indicator, Return on Assets, serves as a means of measuring the firm's performance. Since different firms possess varying sizes and consequently diverse net working capital (NWC), the use of NWCR (net working capital rate) as an independent variable allows for a relative comparison among different firms (Jaworski & Czerwonka, 2022). Specifically, NWCR is determined by dividing NWC by sales.

Based on the discussion, following theoretical framework can be presented.

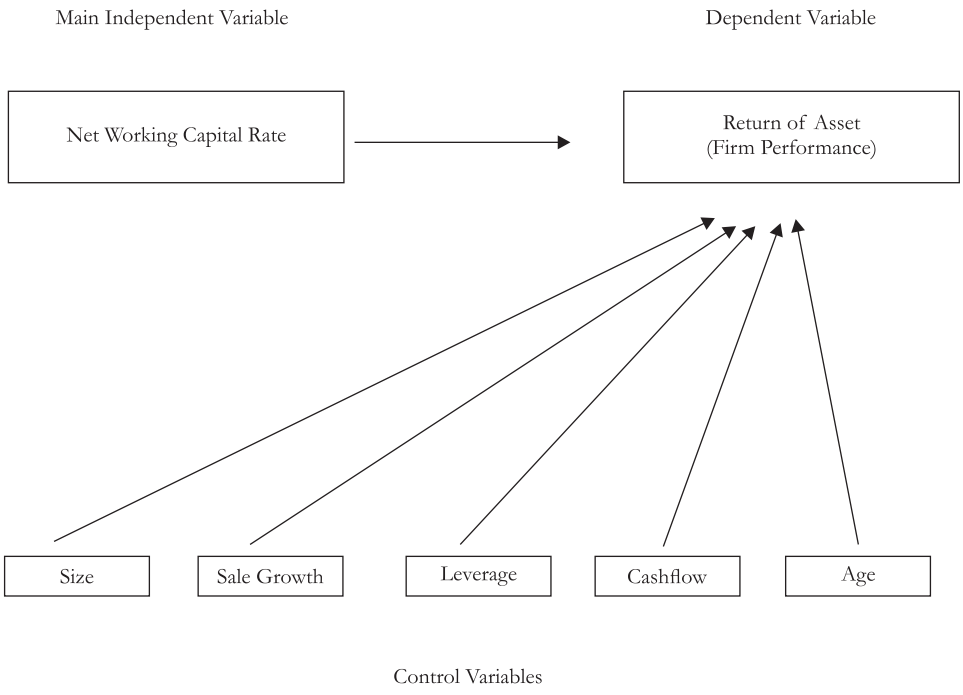

Figure 1: Theoretical Framework

Results of NWC on performance is mentioned in the prior literature for years, as presented in the preceding section. By comparing these opposite views, it is suggested that NWC has a non-linear relationship with performance. Mun and Jang (2015) study is an example such relationship.

In order to analyze and deduce the possibility of non-linear/concave relation in between NWC and business performance, it is hypothesized:

H1. "Statistically, there is a non-linear/concave effect of NWC and performance."

For finding how excess net working capital influence firm performance it is hypothesized:

H2. "Firms with positive NWC have a statistically negative effect on performance."

For finding how of deficit in net working capital influence firm performance it is hypothesized:

H3. "Firms with negative NWC have a statistically positive effect on performance."

Looking at the literature, the existence of non-linearity is deduced. To further study this relationship study utilizes three hypotheses aimed at examining the objective,

specifically, the influence or impact of surplus working capital on firm performance. Hypothesis 1 (H1) endeavors to analyze an optimal investment threshold, thereby acknowledging the possibility of both overinvestment and underinvestment scenarios. Hypothesis 2 (H2) directly investigates the direct effect of excessive net working capital on firm performance. Lastly, Hypothesis 3 (H3) seeks to validate the inverse relationship posited in H2, thus providing additional support for the main objective of this study.

2.3 Control Variables

The size of the firm is important as it shows how much a firm will grow (Wang, 2002). Mun and Jang (2015) highlighted size as also an important variable as it will impact the ability of the firm to engage with banks and other creditors to invest in assets as firm size effects firm performance due to economies of scale, market power, or access to resources. Sales growth shows how much the sales of firms have changed with time, highlighting business competitiveness indicating market demand which will impact manufacturing companies. As with the age of the firm, NWC tends to change mainly due to the development of "soft" power such as experience, maturity and reputation which influences performance. Leverage shows how much of the company is financed with debt, which is translated to assets (Laghari & Chengang, 2019). Leverage is also related to financial risk and cost of capital, affecting a manufacturing firm in generating profits. Cashflow states how much cash is firm generating, the financial flexibility, liquidity and it impacts NWC which could impact the manufacturer's operational capabilities and ultimately its profitability (Laghari & Chengang, 2019). Finally, the age of the firm since it was incorporated as a public limited company. With age, NWC rises or falls (Setianto & Adinda, 2019)

3. Methodology

In accordance with the preceding sections, the literature review encompasses an examination of the impact of net working capital on business performance, specifically focusing on profitability. The net working capital rate serves as the independent variable, while return on assets (ROA) acts as a proxy for firm performance and serves as the dependent variable (Tahu & Susilo, 2017). Additionally, several control variables have been considered, including firm size, sales growth, leverage, cash flow, and age. The subsequent section aims to clarify the nature of these variables, while also outlining the specific models employed to assess the relationship between the dependent and independent variables, taking into account the control variables. Furthermore, this section will provide insight into the sources of data and the methodologies employed in the data collection process.

3.1 Variable formation

The variable that is affected by the independent variables. The dependent variable used in this study is a proxy for firm performance i.e., Return on Asset (Wang, 2002). This financial ratio is calculated as follows:

$$Return\,on\,Asset = \frac{Earnings\,after\,tax}{Total\,Assets}$$

The variable that affects the dependent variable (Tahu & Susilo, 2017). The independent variable selected for this research is Net Working Capital. NWC is then divided by sales to derive the Net Working Capital Rate (Jaworski & Czerwonka, 2022). This is done to create relativity as different firms have different sizes and NWC varies greatly (Tsuruta, 2019). The steps for calculating NWC than NWCR is given below:

$$NWC = Current\,Assets - Current\,Liabilities$$

$$NWCR = \frac{NWC}{Sales}$$

Variables that are categorized as the control variables in a model are not of interest to the study objectives but they are categorized as controlled because they can influence the outcome. Control variables tend to improve the internal validity of a study by controlling the influence of extraneous and confounding variables. Whenever a cause-and-effect study is being conducted, control variables are included to help in ensuring that the results are solely caused by your experimental changes. The control variables used are stated below, along with their derivation:

1. Firm Size: size is used to develop a causal relationship (Laghari & Chengang, 2019). between NWCR and ROA assets. It provides relativity among the data sets The formula for calculating size is:

$$\log_n \left(Total\,Assets\right)$$

2. Sale Growth: this is a proxy used for company growth as that will directly affect the working capital of the firm, thus impacting working capital in some capacity as well. It is calculated by:

$$Sale\,Growth = \frac{Current\,Sales - Previous\,Sales}{Previous\,Sales}$$

3. Leverage: leverage affects working capital and its management (Laghari & Chengang, 2019). It is calculated as:

$$Leverage = \frac{Total\,Liabilites}{Total\,Assets}$$

4. Cash flow: it shows how operating cash flow is affected by assets (Laghari &

Chengang, 2019). Formula is:

$$Cash\ Flow = \frac{Operating\ Cash\ Flow}{Total\ Assets}$$

5. Age: level of NWC changes with time and the age of the firm (Setianto & Adinda, 2019). The age is taken from the day the firm was incorporated as a public limited company. To create relativity, a log of age is taken for analysis.

Multiple models of regression were used to analyze the collected panel data for the variables, explaining different hypotheses.

3.2 Statistical Models

To test *H1* hypothesis which states a possible presence of non-linearity in relation among working capital and profitability, a quadratic model is used to estimate the relationship:

Return on Asset

$$= \alpha + \beta 1 * NWCR + \beta 2 * NWCR \wedge 2 + \beta 3 * Size + \beta 4 * Sale\,Growth + \beta 5 * Leverage + \beta 6 * Cashflow + \beta 7 * Age + \varepsilon$$

For checking *H2*, the following model is utilized

Return on Asset

$$= \alpha + \beta 1 * pNWCR + \beta 2 * Size + \beta 3 * Sale\,Growth + \beta 4 * Leverage + \beta 5 * Cashflow + \beta 6 * Age + \varepsilon$$

For *H3*, model designed is as follows:

Return on Asset

$$= \alpha + \beta 1 * nNWCR + \beta 2 * Size + \beta 3 * Sale\,Growth + \beta 4 * Leverage + \beta 5 * Cashflow + \beta 6 * Age + \varepsilon$$

In the above regression models, the details regarding variables are given in the table below

Table 1: Variable Details

NWCR	Net working capital divided by sales of the firm
$NWCR^2$	Net working capital rate of a firm squared
pNWCR	Positive net working capital rate, taken from total NWCR by assigning a dummy to separate the slope coefficient for running the model.
nNWCR	Negative net working capital rate, taken from total NWCR by assigning a dummy to separate the slope coefficient for running the model.

Size	Log natural of total assets
Sale Growth	Growth in company sales, compared to the previous year
Leverage	Sum of all liabilities divided by sum of total assets
Cashflow	Operating cash flow divided by total assets
Age	Natural log of age
β	the coefficient for regression of each variable
ε	error term for model

3.3 Panel Regression Model

The data necessary for calculating the variables of interest in this study were obtained from the annual reports of companies operating within the manufacturing industry of Pakistan. These financial reports were sourced from both the respective company websites and the data portal website of the Pakistan Stock Exchange. The variables of total assets, total liabilities, total equities, and total sales were extracted from the financial statements contained within these reports. To ensure accuracy, a thorough examination was conducted to cross-verify the collected data against the financial reports and the data provided by the Pakistan Stock Exchange. The target population for this study consists of manufacturing companies operating within Pakistan. A sample of 120 companies was selected from the manufacturing industry in Pakistan to gather the required data. Data was collected for the period spanning from 2016 to 2022. Convenience sampling, a technique based on the accessibility of data, was employed for the selection of the sample. However, measures were taken to ensure the inclusion of companies from various manufacturing sectors in order to enhance the generalizability of the findings.

4. Data Analysis

This research study focuses on examining the impact of net working capital investment, specifically overinvestment and underinvestment, on firm performance. The present section provides an overview of the descriptive statistics and the outcomes obtained from the regression analysis.

To evaluate the influence of net working capital on firm performance, eight key variables have been identified. The primary measure of firm performance is the return on assets (ROA), while the net working capital rate (NWCR) is considered the independent variable. The remaining variables are included as control factors to ensure the accuracy of the analysis. Together, these variables contribute to explaining the findings.

For this analysis, data was collected from a sample of 120 companies operating in the manufacturing sector of Pakistan. The data covers the period from 2016 to 2022, providing a comprehensive timeframe for analysis.

4.1 Descriptive statistics

In table 4.1, it is observed that the control variable age has the highest mean i.e., 40.10 among the variables followed by firm size, coming at a value of 19, this shows that companies have operated for a long time in the industry and have gained substantial size. Leverage comes after firm size with a value of 3.7634 after which sales growth comes with a value of 0.54990 NWCR with a value of 0.5499 stands closely behind sales growth. Cash flow comes second to last with a value of 0.07523 and the dependent variable, ROA comes last with -0.2961

Age shows the highest median value followed by firm size, exhibiting various ages exist in the dataset. Leverage comes after firm size. Sale growth comes after leverage, then comes cash flow. The second last median value variable is 0.46 and the last is ROA.

The highest standard deviation is exhibited by the leverage which is 23.530. This shows that high variation is involved in leverage which is related to an increased level of risk faced by the companies. Age has the second-highest value. This is due to different companies having different ages thus high variation from company to company. It is followed by NWCR, ROA, firm size, and lastly cash flow.

As shown in the table, the variable with the highest skewness is sale growth, this shows that the sale growth of the companies is highly positively skewed i.e., most variations in sale growth in the data. NWCR and Leverage also show high positive skewness. Cash flow and age show low positive skewness. Firm size shows low negative skewness (showing fairly normal distribution) while ROA shows high negative skewness exhibiting lowest variation.

After analyzing the values in the table, it is noticeable that variables ROA, sale growth, NWCR, and leverage have very high kurtosis implying very heavy tails. It shows that the distribution of these variables has a lot of data points in the tails of their distribution. It implies that variables are not normally distributed. Cash flow has relatively high kurtosis. On the contrary, firm size has a kurtosis value closer to 0, this indicates the firm size variable is fairly distributed. No outliers were noticed in the data and the results are comparable to the paper by Altaf and Shah (2017) which utilized data from India.

Table 4.1: Summary of Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Skewness	Ex. kurtosis
ROA	-0.2961	0.0460	7.1798	-22.280	494.60
NWCR	0.54990	0.0471	13.089	21.908	483.62
Firm Size by TA	19.000	22.440	3.2231	-0.58090	-0.79081
Leverage	3.7634	0.570	23.530	13.667	209.86
Cashflow	0.07523	0.055	0.17947	4.1363	51.871
Sale Growth	0.7236	0.0717	11.934	23.032	489.07
Age	40.12	36.000	22.290	2.6300	6.9765

4.2 Empirical Review

Three hypotheses are drawn to confirm the objective, i.e., the impact/effect of excess working capital on firm performance. H1 would help in analyzing an optimum investment point, which means there can be overinvestment and underinvestment. H2 would directly point to the effect of excess net working capital on firm performance. H3 would confirm the opposite of H2 thus further enforcing H2, which is the objective of this study.

Hypothesis 1

Dependent Variable: Return on Assets

Independent Variable: Net Working Capital Rate

Sample: 2016-2022

Model: Pooled OLS vs Fixed Effect vs Random Effect vs Weighted Least Square

The table above contains the results of the regression analysis using 4 models and it also shows the tests applied for the selection of the best model based on the best fit.

Beginning with Pooled OLS and Fixed-Effect model, they were compared based on a good fit. To find out the goodness of fit, the Chow test was used in the table to choose between Pooled OLS and the Fixed-Effect Model. This is done by looking at the p-value of the Chow test. Since the value is less than 0.05 (see table 4.2) this leads to null hypotheses rejection "Pooled OLS is good" and acceptance of the Fixed Effect Model as a preferred model for selected data. The data was also treated for the presence of an autocorrelation problem in the data. For this, the Durbin-Watson test was applied. Looking at the value of Durbin-Watson for Pooled OLS (See table

Table 4.2: Empirical Results, H1, Dependent Variable: ROA

Variables	Pooled OLS		Fixed Effect		Random Effect		Weighted Least Square	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
const	-2.731	0.361	-67.06	<0.000***	-2.74	0.384	-0.178	0.002***
NWCR	-0.129	0.661	1.730	<0.000 ***	-0.139	0.69	0.035	<0.000 ***
$NWCR^2$	0.00015	0.681	-0.006	<0.000***	0.00015	0.66	-0.0001	0.69
Firm Size	0.210	0.04 **	5.68	<0.000 ***	0.290	0.045 **	0.0076	0.021**
Sale Growth	0.0078	0.73	0.201	<0.000 ***	0.0079	0.79	-0.003	0.46
Leverage	-0.0245998	0.0102 **	-0.0230487	0.0307 **	-0.0245998	0.0099 ***	-0.00354716	0.2015
Cashflow	1.74245	0.3318	1.65011	0.3200	1.74245	0.3313	0.416853	<0.0001 ***
Age	-0.523893	0.3605	-14.9378	0.0007 ***	-0.523893	0.3601	0.000600433	0.9575
Durbin Watson	0.99		1.76		1.76		NA	
R-Squared	0.036		0.598		NA		0.375	
F-statistic (p-value)	0.07 (1.84e-27)				NA		2.97e-39	
Chow Test for differing group intercepts (F-test statistic (p-value))					4.931 (4.62e-027)			
Wald Test for Heteroskedasticity					1.789e+007 (0)			
Breusch-Pagan test (Chi-Square test statistic (p-value))					0.136 (0.76102)			
Hausman test (Chi-Square test statistic (p-value))					579.698 (5.35746e-119)			
***Significant-at-1%, **Significant-at-5%, *Significant-at-10%								

4.2) it is evident that a problem of autocorrelation is present in the selected panel. Thus, due to the problem of auto-correlation the results of the Pooled OLS model are invalidated. Correspondingly, the significant results evident from the Chow test that Fixed Effect Model is superior to Pooled OLS model (see table 4.2). The data were also analyzed for heteroskedasticity. Wald Test was applied for this purpose. The results were significant (see table 4.2) concluding the data has heteroskedasticity. Due to the presence of heteroskedasticity, the results of the Fixed Effect Model were invalidated. Thus, further tests were needed to find the best model based on the goodness of fit.

Next, the Breusch Pagan test was applied to identify whether Pooled OLS is preferred or Random Effect Model is better. Applying the test gave the values with a p-value greater than 0.05 (see table 4.2) which means the null hypothesis "Pooled OLS is good" was accepted which resulted in the preference of Pooled OLS over the Random Effect model. Breusch Pagan Test's insignificance showed the superiority of Pooled OLS over the Random Effect Model. However, as evident in the data (see table 4.2), Pooled OLS suffers from the problem of auto-correlation which resulted in the invalidation of Pooled OLS Model.

Finally, the Hausman test was applied to the panel data to detect whether the Random-Effect Model is a better fit or the Fixed Effect Model is a better choice. Looking at the p-value of the Hausman test, it was less than 0.05 (see table 4.2) which means rejecting the null hypothesis "Random Effect is good" which means acceptance of the Fixed Asset Model as a superior over the Random Effect Model. The significant results exhibited by Hausman Test confirmed that Fixed Effect Model is a better model fit than Random Effect Model. Although the result of the Hausman test shows Fixed Effect Model is preferred over Random Effect Model, it is clear from the data (the result of the Wald Test) and the prior discussion that the data exhibits heteroskedasticity which means the Fixed Effect Model results were invalidated. The Weighted Least Square test was the only remaining test that depicts consistent and significant results. It is consistent since this model resolves the issue of auto-correlation existing in the data.

In order to see non-linearity/concavity in between net working capital and performance (ROA), it was expected to bare a positive and significant NWCR coefficient along with a negative $NWCR^2$ coefficient in the model. Square is taken to conclude a non-linear relation (Osama & Heba, 2020). From the table, it was evident that the NWCR has a significant and positive coefficient value and the NWCR square has a negative coefficient value. Thus, the results are matching the expectations, and H1 is hereby accepted implying the nonlinear relationship between the net working capital and firm performance. This suggests a possibility of net working capital level optimization i.e., a firm can overinvest and underinvest in net working capital which

can either positively or negatively affect the firm's performance, specifically in the manufacturing industry. Thus, implying an optimum level of net working capital for a manufacturing organization exists. Meaning net working capital effects firm performance in manufacturing industry. These results were consistent with the literature that concludes the presence of a favorable level of working capital. Studies by Wang, Akbar and Akbar (2020), Afrifa (2016) and another by Laghari and Chengang (2019) bore similar outcomes. Firm size has a significantly positive influence on ROA as the p-value of firm size is less than 0.05 (see table 4.2). Sales growth and leverage had a negative and insignificant effect on ROA (see table 4.2). Cash flow has a positive and significant effect on ROA while age had a positive and insignificant effect on ROA because its p-value was more than 0.05(see table 4.2). R-squared has a value of 33% for the Weighted Least Square Model. F-statistic p-value shows model significance (see table 4.2).

Hypothesis 2

Dependent Variable: Return on Assets

Independent Variable: Net Working Capital Rate

Sample: 2016-2022

Model: Pooled OLS vs Fixed Effect vs Random Effect vs Weighted Least Square

Table 4.3 contains the result of the Regression Models applied along with the tests applied for finding the best model based on good fit when a positive independent variable is taken in the model.

Table summarizes various regression models, with the independent variable being positive NWCR. The Durbin Watson test reveals autocorrelation issues in the Pooled OLS model, leading to its invalidation. The Chow test compares Pooled OLS and Fixed Effect Model, with a significant value indicating the superiority of the Fixed Effect Model. The Wald test detects heteroskedasticity, with a significant p-value (less than 0.05), rejecting the hypothesis of homoscedasticity. This invalidates the Fixed Effect Model. The Breusch Pagan test results in an insignificant p-value (more than 0.05), leading to the acceptance of Pooled OLS over the Random Effect Model. However, the Pooled OLS model is also invalidated due to autocorrelation. The Hausman test supports the superiority of the Fixed Asset Model over the Random Effects Model, with a p-value less than 0.05. Nevertheless, the presence of heteroskedasticity invalidates the Fixed Effect Model. Finally, the Weighted Least Square test provides consistent and significant results, resolving the issue of autocorrelation in the data and thus best fit.

For further investigation of the relationship between NWC and firm performance,

Table 4.3: Empirical Results, H2, Dependent Variable: ROA

Variables	Pooled OLS		Fixed Effect		Random Effect		Weighted Least Square	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
const	-6.74842	0.5391	-60.3390	0.0005 ***	-2.74842	0.3297	-1.296	0.0007 ***
pNWCR	0.0023	0.9216	-0.175974	<0.0001 ***	-0.00241723	0.9215	-0.0192	<0.0001 ***
Firm Size	0.212	0.0395 **	5.75112	<0.0001 ***	0.207262	0.0390 **	0.00781	0.0142 **
Leverage	-0.0256	0.0100 ***	-0.0221535	0.0453 **	-0.0246556	0.0097 ***	-0.00401	0.0314 **
Cash Flow	4.6835	0.3493	2.28735	0.1837	1.67435	0.3489	0.5756	<0.0001 ***
Sales Growth	0.004	0.8138	0.177182	<0.0001 ***	0.00643094	0.8137	-0.00012	0.650
Age	-0.5712	0.3485	-17.1551	0.0002 ***	-0.536272	0.3480	0.00250	0.87
Durbin Watson	0.9878	1.539545	1.539545	NA				
R-Squared	0.0278		0.508886		NA		0.331680	
F-statistic (p-value)	0.037 (1.11e-22)				NA		2.48e-40	
Chow Test for differing group intercepts (F-test statistic (p-value))					6.909 (3.88503e-042)			
Wald Test for Heteroskedasticity					1.0574e+012 (0)			
Breusch-Pagan test (Chi-Square test statistic (p-value))					0.278 (0.64243)			
Hausman test (Chi-Square test statistic (p-value))					699.21 (1.10981e-112)			
***Significant-at-1%, **Significant-at-5%, *Significant-at-10%								

H2 uses positive NWCR as a proxy to check the linear relationship between positive NWC and firm performance using ROA as a proxy. Weighted Least Square Model is used to test H2. In table positive NWCR is introduced as an independent variable. For H2 to be accepted, pNWCR should have a negative significant coefficient. The coefficient is negative and significant (see table 4.3) thus supporting H2 and thus H2 is accepted. This means that pNWCR harms ROA (firm performance) implying overinvestment in NWC negatively affects firm performance mainly due to the inability of the firm to maintain long-term assets as most of the firm's resources are poured into NWC and thus depletes the firm profits, as there ability to manufacture goods for generating sales severely hindered signaling how net working capital impacts firm performance. These results match similar results from the literature that reported a significantly negative relationship between NWC and performance (Dong & Su, 2010). Firm size and cash flow have a positive significant relationship with ROA while leverage has a significantly negative relationship with ROA. Sales growth and age have insignificant results with ROA. R-squared has a value of 33% for the Weighted Least Square Model. F-statistic p-value shows model significance (see table 4.3)

Hypothesis 3

Dependent Variable: Return on Assets

Independent Variable: Net Working Capital Rate

Sample: 2016-2022

Model: Pooled OLS vs Fixed Effect vs Random Effect vs Weighted Least Square

As for positive NWCR, in table 4.4, four types of regression models were used with negative NWCR introduced as the independent variable in the selected panel data. The Durbin Watson test reveals auto-collinearity in the data, which invalidates the Pooled OLS model. Comparing the Pooled OLS and Fixed Effect Model using the Chow test (see table 4.4) shows a significant value, rejecting the null hypothesis "Pooled OLS is good" and accepting the alternative, indicating that the Fixed Effect Model is superior. The Wald test for heteroskedasticity yields a significant result with a p-value less than 0.05 (see table 4.4), rejecting the null hypothesis of homoscedasticity and confirming the presence of heteroskedasticity. This invalidates the Fixed Effect Model. The Breusch Pagan Test is then applied to determine the best fit between Pooled OLS and Random Effect Model. The results show insignificance with a p-value greater than 0.05 (see table 4.4), suggesting acceptance of the null hypothesis "Pooled OLS is good." However, Pooled OLS suffers from auto-correlation issues, leading to the invalidation of the model. Lastly, the Hausman test is conducted to compare the Random Effects Model and the Fixed Asset Model. The p-value of the Hausman test is

Table 4.4.: Empirical Results, H3, Dependent Variable: ROA

Variables	Pooled OLS		Fixed Effect		Random Effect		Weighted Least Square	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
const	-1.490	0.415	-65.202	0.0003 ***	-4.90	0.1310	-0.252	<0.0001 ***
nNWCR	0.00825	0.99	0.0698	0.783	0.00925	0.96	0.0314	<0.0001 ***
Firm Size	0.252	0.031 **	8,13144	<0.0001 ***	0.2052	0.04 **	0.0783	0.0019 ***
Leverage	-0.02407	0.001 ***	-0.0257719	0.021 **	-0.02406	0.001***	-0.0012	0.064 *
Cash Flow	0.00636	0.640	0.121903	<0.0001 ***	0.0066	0.5139	-0.004	0.245
Sales Growth	1.693	0. 526	2.06236	0.240	1.683	0.532	0.432	<0.0001 ***
Age	-0.570	0.59	-18.9002	0.0001 ***	-0.570	0. 494	-0.0003	0.981
Durbin Watson	0.9978		1.187502		1.1302		NA	
R-Squared	0.0489		0.436767		NA		0.347663	
F-statistic (p-value)	0.073 (2.50e-14)				NA		6.98e-43	
Chow Test for differing group intercepts (F-test statistic (p-value))					2.89902 (8.95001e-014)			
Wald Test for Heteroskedasticity					1.3038e+007 (0)			
Breusch-Pagan test (Chi-Square test statistic (p-value))					0.1533 (0.766411)			
Hausman test (Chi-Square test statistic (p-value))					369.2 (3.14525e-083)			
***Significant-at-1%, **Significant-at-5%, *Significant-at-10%								

less than 0.05 (see table 4.4), indicating the rejection of the null hypothesis "Random Effect is good" and acceptance of the Fixed Asset Model as superior. The significant results from the Hausman test confirm that the Fixed Asset Model is a better fit than the Random Effects Model. However, considering the presence of heteroskedasticity in the data (as observed in the result of the Wald test) and the prior discussion, the Fixed Effects Model is invalidated.

The Weighted Least Square test was the only remaining test that depicts consistent and significant results. It is consistent because this model resolves the issue of auto-correlation existing in the data

H3 is a further extension of the discussion by using nNWCR as a proxy to check the linear relationship between negative NWC and firm performance using ROA as a proxy. Weighted Least Square Model is used to test H3. In table 4.4 negative NWCR is introduced as an independent variable. For H3 to be accepted, nNWCR should have a positive significant coefficient. The coefficient is positive and significant (see table 4.4) thus supporting H3 and thus H3 is accepted. This means that nNWCR has a positive effect on ROA (firm performance) implying underinvestment in NWC positively affects firm performance mainly due to the ability of a firm to invest in long-term assets as it has more resources available for manufacturing good, vital for sales thus enhancing its profits. Lower NWC means more cash is afloat which helps in reducing risk and enables the firms to capitalize on market conditions such as sudden price reduction of raw materials needed for manufacturing. Corsten and Gruen (2004) concluded the result which matches the one above. Firm size and sales growth are significant with a positive coefficient. Leverage, cash flow, and age are insignificant with a negative coefficient. R square is 34% for Weighted Least Square. F-statistic p-value shows model significance (see table 4.4).

5. Conclusion

Managing working capital, which includes current assets and liabilities, is crucial for a company's financial well-being. Studies have shown that there is an optimal level of investment in working capital that maximizes profit and improves firm performance. While some research suggests a positive relationship between net working capital and firm profitability, others argue that additional investment in working capital can reduce profit margins. Recent developments have shown a non-linear relationship between working capital and firm performance, indicating that overinvestment or underinvestment in working capital can negatively impact a firm's financial performance. This conclusion has been supported by the literature. Academic research suggests two main approaches for managing working capital: working capital financing (WCF) and working capital investment (WCI), and conservative or aggressive policies. WCI

involves investing in current assets using current liabilities, that make up the working capital of a firm, the focus of this research.

This study analysed the non-linear relationship between excess working capital and firm performance to determine the optimal level of net working capital (NWC) that maximizes profit and minimizes risk. Data from 120 manufacturing companies in Pakistan was collected for the period 2016-2022. The results showed a non-linear relationship between NWC and firm performance, with a significant positive coefficient for NWC and a negative coefficient for NWC^2. This indicates the presence of an optimal point for NWC investment, with overinvestment or underinvestment adversely affecting firm performance. Firm size and cash flow were also found to have a positive impact on return on assets (ROA), indicating their influence on NWC. Furthermore, the impact of overinvestment in NWC on firm performance was examined by analyzing the relationship between positive NWC and return on assets (ROA). The results showed a significant negative relationship, indicating that overinvestment in NWC can negatively affect firm performance by depleting profits and hindering the maintenance of long-term assets. Firm size and cash flow had a positive impact on ROA, while leverage had a negative impact, suggesting that an increase in liabilities can increase risk and lower profitability. Underinvestment in NWC, or negative NWC, was found to have a positive impact on ROA due to the reduced use of liabilities to finance current assets and the ability to invest in long-term assets. Firm size and sales growth were also found to have a positive impact on firm performance clearly stating that more investment, after the optimal point will result in excess net working capital (overinvestment) which will negatively impact firm performance, and thus answering the fundamental question of this paper.

Contributions have been made towards understanding the impact of working capital management on firm performance. However, there are limitations to the findings. The data was collected from a developing nation and may not be applicable to developed nations. The sample was derived from convenience sampling and could be improved with better sampling techniques. Firm performance was measured using only one proxy, and the data taken in account belonged to the manufacturing industry as a whole, which includes diverse sectors therefore, limitations should be considered when interpreting the results. To address the limitations of this study, it is recommended to expand the research to include data from both developing and developed countries. The present study exclusively concentrates on the non-financial/manufacturing sector of Pakistan, thereby restricting the direct applicability of its findings to alternative industries or countries. Consequently, it is advisable for future research endeavors to investigate related associations within diverse industry contexts and geographical regions or nations, thereby supporting the generalizability

of the findings and their external validity. By doing so, a more comprehensive interpretation of the relation between net working capital management and business performance shall be achieved. More precise sampling techniques and sector-specific data collection can improve the accuracy of the results. The impact of overinvestment and underinvestment in NWC can be further explored using different performance proxies, such as return on equity and Tobin's Q along with increasing the horizon of the sample with inclusion of more diverse sectors will no doubt expand the findings.

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