ECONSTOR
Make Your Publications Visible.

A Service of
ZBW
Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Sharma, Rakesh Kumar; Bakshi, Apurva; Chhabra, Sheena

Article

Determinants of behaviour of working capital requirements of BSE listed companies: An empirical study using co-integration techniques and generalised method of moments

Cogent Economics & Finance

Provided in Cooperation with:
Taylor & Francis Group

Suggested Citation: Sharma, Rakesh Kumar; Bakshi, Apurva; Chhabra, Sheena (2020) : Determinants of behaviour of working capital requirements of BSE listed companies: An empirical study using co-integration techniques and generalised method of moments, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 8, Iss. 1, pp. 1-30, https://doi.org/10.1080/23322039.2020.1720893

This Version is available at:
https://hdl.handle.net/10419/245274

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

https://creativecommons.org/licenses/by/4.0/

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

Cogent Economics & Finance

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/oaef20

Determinants of behaviour of working capital requirements of BSE listed companies: An empirical study using co-integration techniques and generalised method of moments

Rakesh Kumar Sharma, Apurva Bakshi & Sheena Chhabra |

To cite this article: Rakesh Kumar Sharma, Apurva Bakshi & Sheena Chhabra | (2020) Determinants of behaviour of working capital requirements of BSE listed companies: An empirical study using co-integration techniques and generalised method of moments, Cogent Economics & Finance, 8:1, 1720893, DOI: 10.1080/23322039.2020.1720893

To link to this article: https://doi.org/10.1080/23322039.2020.1720893

© 2020 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

Published online: 31 Jan 2020.

Submit your article to this journal

Article views: 1195

View related articles

View Crossmark data

Citing articles: 4 View citing articles

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=oaef20

Sharma et al., *Cogent Economics & Finance* (2020), 8: 1720893
https://doi.org/10.1080/23322039.2020.1720893

cogent economics & finance

FINANCIAL ECONOMICS | RESEARCH ARTICLE

Determinants of behaviour of working capital requirements of BSE listed companies: An empirical study using co-integration techniques and generalised method of moments

Rakesh Kumar Sharma[1]*, Apurva Bakshi[1] and Sheena Chhabra[1]

Received: 19 December 2018
Accepted: 19 January 2020

*Corresponding author: Rakesh Kumar Sharma, School of Humanities and Social Sciences, Thapar Institute of Engineering and Technology, Patiala, India
E-mail: rakesh.kumar@thapar.edu

Reviewing editor:
David McMillan, University of Stirling, United Kingdom

Additional information is available at the end of the article

Abstract: The paper investigates the determinants of working capital to forecast the future requirement of working capital of BSE-listed top 150 companies in India. The study is conducted by collecting the data of 150 top-performing BSE listed companies for the time period of 2009–2017. The ten firm-level explanatory variables and one dummy variable to characterize the nature of business i.e. manufacturing and service sector companies are used to discover the significant determinants of gross and net working capital of selected companies. The four alternative methods are used to verify and validate the results obtained from each other viz. Ordinary Least Square (OLS), fully modified OLS (FMOLS), dynamic OLS (DOLS) and generalized methods of moments (GMM). The empirical findings of four different methods indicate that tangibility, leverage, nature of business and board size are observed as significant factors to forecast the future requirements of net working capital. Return on common equity (ROCE), board size; indicate the positive

Rakesh Kumar Sharma

ABOUT THE AUTHORS

Dr. Rakesh Kumar Sharmais an Assistant Professor in the School of Humanities Sciences and Social Sciences at Thapar Institute of Engineering and Technology (Deemed University), Patiala where he has been a faculty member since 2012. He has published more than 25 research papers in national and international journals including ABDC listed and SCOPUS indexed journals of repute and presented more than fifteen research papers in various international and national conferences.

Dr. Apurva Bakshi, Assistant Professor (School of Humanities and Social Sciences, Thapar Institute of Engineering and Technology, Patiala) has been teaching at TIET for the past 13 years. His academic and research interests include Management and Strategy, Intellectual Propery Rights and Business Ethics.

Dr. Sheena Chhabra, Assistant Professor (School of Humanities and Social Sciences, Thapar Institute of Engineering and Technology, Patiala) has been teaching at TIET for the past 9 years. Her academic and research interests include Management and Finance especially Initial Public offerings.

PUBLIC INTEREST STATEMENT

Efficiently managing working capital is a great challenge for every organization. Every organization intends to maintain the optimum level of working capital. Since the excessive working capital creates an idle fund and inadequate working capital interrupts the day to day operation of the business. For this purpose, it becomes much essential to investigate certain determinants to forecast determinants of working capital to forecast the future requirement of working capital. The study has been conducted after taking into consideration the recent historical economic reforms in the eminent Asian's emerging economy. The study investigates many authentic determinants of working capital after employing four alternative econometric techniques to forecast the future requirement of working capital. The study will be mainly lucrative to policymakers to design optimum level of working capital and academician as it adds significantly to the existing body of knowledge

cogent • oa

© 2020 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

association with gross working capital. On the other hand, tangibility, nature of business and size of the firm show a negative relationship with gross working capital requirements. The findings from different methods have resulted in similar significant determinants to predict the future requirement of the net and gross working capital. The outcome of the study will be useful for management authorities for maintaining the optimum level of working capital and to forecast future requirements of working capital.

Subjects: Economics; Finance; Accounting

Keywords: networking capital; gross working capital; net tangible; leverage; asymmetric information; sargan test; generalised method of moment; dynamic OLS; fully modified OLS
JEL classification: M40; G30; G31; G32

1. Introduction

In recent years Indian economy has experienced tremendous growth. During 2014–2017, gross domestic product (GDP) has remained quite high and there was a huge jump in the BSE and NSE Sensex values. It was due to combined performance of the manufacturing and service sectors. After 2014, Indian economy witnessed historical economic reforms. These reforms affected the different sectors of the Indian economy in a significant manner. Demonetization in 2016 affected the manufacturing and service sectors. In 2017, the implementation of Goods and Services Tax Act also affected both these sectors. The present government has brought favorable policy to boost the growth of various sectors. Recently in 2019, the government slashed the corporate tax rates. These developments have encouraged researchers to explore different areas. Investigating the determinants of working capital is one such area. The working capital influences the day to day operation of the business. To maintain an optimum level of working capital to enhance the performance of the business is certainly the prime concern of every company's decision-makers. Since we know that inadequate or excessive working capital are both dangerous for the company's financial health. Inadequate levels of working capital hinder day to day operations of the business and excessive working capital creates idle funds. Every organization wants to avoid these two situations. Every company wants to keep an adequate level of current assets to meet the expenses of day to day operations. It is thus essential to investigate the key determinants of working capital requirements. The present study tries to answer the following research questions: (1) what are the key determinants of gross and networking capital after the historical economic reforms in India. (2) How these determinants are helpful to management authorities for maintaining an optimum level of working capital. To find the answer to these questions, the study is carried out using four alternative techniques to identify the key determinants of working capital.

Liquidity always remains the prime concern for all the undertakings whether dealing with the manufacturing or service sector. All the firms would like to maintain that level of liquidity which will enable them to carry on day to day transactions smoothly. Usually, manufacturing companies need more liquid assets as these companies have to incur various expenses in day to day basis. Efficient management of liquid assets or current assets helps the firm to increase profitability and sustain itself in the business world for a longer period of time. The problem of liquidity may put obstacles for doing different types of business activities which results in a decline in productivity as well as the performance of the business. Similarly, there should not be excessive working capital as it remains idle and puts the burden on business which ultimately affects profitability. A firm's net working capital position influences its ability to obtain debt financing as many loan agreements with financial institutions require a firm to maintain a minimum net working capital position (McGuigan, Moyer, Rao, & Kretlow, 2012). The management of current assets is similar to that of fixed assets in the sense that both affect return and risk. The management of fixed assets and current assets differs in significant ways: First for managing fixed assets time plays a vital role, so discounting and compounding techniques play a very important role in capital budgeting and

a minor one in the management of current assets. The second: high level of current assets, specifically cash strengthen the liquidity position of the company but also reduces the profitability as excessive working capital result in idle capital. Third, the level of current assets and fixed assets depends upon future sales, but only current assets can be adjusted due to fluctuation in sales in the short run. (Pandey, 2007).

Working capital management should be more effective as it prevents the company from liquidity crises and also affects profitability, solvency position, and survival of the company (Mukhopadhyay, 2004). Effective working capital management depends upon the planning and controlling of current assets and current liabilities. As it is the most important factor responsible for the elimination of the risk of failure to meet short term obligations and additionally to avoid excessive investment in the assets (Eljelly, 2004). Working capital mainly manages the optimal difference between its components i.e. cash, receivables, payables and inventory, etc which is the cause of the success of any business (Filbeck & Krueger, 2005).

The developing economies generally face the problem of underutilization of resources. While fixed capital and working capital are both contributors to the total capital of the developing country, *working* capital makes utilization of the production capacity generated by the fixed assets possible (Vijayakumar & Venkatachalam, 1996).

2. Background and hypothesis development

An organization is required to maintain a certain level of working capital. This is also required for taking loans from financial institutions. Organizations focus on inventory management for improving their working capital performance. This helps them in reducing the working capital investment. There are several factors that impact working capital management (Wasiuzzaman & Arumugam, 2013). Working capital management is done by monitoring the current assets and current liabilities of the organization (Atseye, Ugwu, & Takon, 2015). This is required for the proper functioning of daily operations and maintaining sufficient cash flow. Working capital investments should be kept minimum otherwise they decrease the profitability of the organization (Manoori & Muhammad, 2012). It is the responsibility of managers to maintain an optimum level of working capital in order to minimize risks (Atseye et al., 2015). The literature review has been arranged as per the different determinates used in the present study.

2.1. Leverage

Working capital has a negative relationship with leverage. An organization opts for external financing when it does not have sufficient internal financing. An organization with more debt has less working capital (Atseye et al., 2015; Salawu & Alao, 2014). The organization has less money for day-to-day operations when it has to pay debts. In such a scenario, the organization is expected to utilize the working capital in an efficient manner. Thus, organizations with high debt ratios are cautious about working capital (Wasiuzzaman & Arumugam, 2013).

In the present study, leverage has been measured through the debt to equity (D/E) ratio. It is expected that leverage (LEV) has a negative relationship with both types of working capital used in the current study i.e., gross working capital and net working capital. Alternative Hypothesis (H_{1a}): Leverage has a significant negative influence on the level of working capital.

2.2. Growth opportunities

There are contradictory arguments regarding the relationship between working capital and the growth of an organization. There are studies that demonstrate a positive relationship between sales growth and working capital (Manoori & Muhammad, 2012; Wasiuzzaman & Arumugam, 2013). An organization that expects growth in sales will increase its level of inventory and short-term investments. This will lead to an increase in working capital. Thus, growth in sales leads to increased working capital (Wasiuzzaman & Arumugam, 2013). This positive relationship between working capital and sales growth was also observed in a study related to Nigerian manufacturing firms (Salawu & Alao,

2014). But, several studies have also established a negative relationship between the revenue growth rate of an organization and working capital (Wasiuzzaman & Arumugam, 2013).

Revenue growth has been used as the proxy of immediate investment or growth opportunities for the selected companies used in the study. The same measure was also used by(D'Mello, Krishnaswami, & Larkin, 2008). Revenue for the current period or t period has been divided by revenue of the previous period i.e., t-1 period. Then, the natural logarithm of the calculated value has been taken to find the revenue growth rate of BSE listed 150 companies including BSE Sensex 30 companies. There is an absolute consensus regarding the type of relationship of revenue growth rate with two different types of working capital measures used in the present research. An alternative hypothesis has been built in the following way:

Hypothesis (H_{2a}): Growth opportunity has a significant impact on the level of Working capital.

2.3. Asymmetric information

It is difficult for less transparent organizations to obtain external financing. Information asymmetry is lower for organizations with more tangible assets. Organizations with higher information asymmetry have to focus more on internal resources. There is a negative relationship between information asymmetry and working capital. Thus, organizations with a high level of asymmetric information have lower working capital (Wasiuzzaman & Arumugam, 2013).

Hill, Kelly, and Highfield (2010) measure asymmetric information as the book-to-market ratio (MTB), especially in connection with the long-term investment opportunities of a firm. In the present study, the same measure has been used as a proxy of asymmetric information. In the present study, the market value of equity has been calculated by taking closing prices with BSE at the end of the respective financial year. On the other handbook, the value of equity has been calculated by taking all total assets except fictitious assets of the respective financial year and subtracting all long term debt and current liabilities. Then, market to book value (MTB) has been calculated by dividing the market value of equity by book value of equity. From the above discussion and study, it is expected that asymmetric information may have a negative impact on the working capital of the firm. Accordingly, an alternative hypothesis has been formulated:

Hypothesis (H_{3a}): The level of asymmetric information has a negative impact on the future working capital requirement of the firm.

2.4. Nature of business

The nature of business is an important determinate of working capital. The future requirement of working capital in firms may differ as per the nature of the business. In the BSE Sensex, there is a combination of two types of companies that companies belonging to the manufacturing sector and service sector. In the present study, for quantifying the nature of business dummy variables have been used as 1 has been assigned to manufacturing companies and 0 to service sector companies. The working capital management differs from industry to industry. In this way, the nature of the business may be addressed as one of the determinants of working capital. A simple comparison of the service industry and manufacturing industry can clarify the point. In the service industry, there is no inventory and therefore, one big component of working capital is already avoided. So, the nature of the industry is a factor in determining the working capital requirement (Efinance Management, 2018) It is expected that the nature of business has a negative impact on the future requirements of BSE listed companies (Banerjee, 2017).

Hypothesis (H_{4a}): The nature of business has a negative influence on the future requirements of working capital in BSE listed companies.

2.5. Size or capital market access

In comparison to small organizations, large organizations have better access to capital. Large organizations have better growth opportunities and require more money for their daily operations. But they are better at cash management. Thus, a negative relationship has been observed between working capital and the size of the organization. Larger organizations can afford to invest less money in working capital (Manoori & Muhammad, 2012; Wasiuzzaman & Arumugam, 2013). Small organizations require higher working capital as they are more vulnerable to risk (Bereznicka, 2014). But, a study conducted in Nigeria established a positive relationship between working capital and the size of the organization. This is because large organizations can make working capital investments due to plenty of financing alternatives (Salawu & Alao, 2014).

Hypothesis (H_{5a}): Size or Capital Market Access has a positive impact on the future working capital requirement.

2.6. Asset tangibility

A negative relationship is expected between working capital and asset tangibility. Limited financial resources are available which have to be invested wisely. Organizations choose to invest in areas that offer high returns. Organizations prefer making long term investments thus reducing working capital investment (Wasiuzzaman & Arumugam, 2013). Assets tangibility has been measured by the ratio of net fixed assets to the total value of assets during the study period of selected BSE listed companies. Banos-Caballero, Teruel, and Martínez (2010) used this variable to predict working capital but they observed that the effect of tangibility on working capital investment is not clear.

Hypothesis (H_{6a}): Asset Tangibility has a negative impact on the future working capital requirement of the firm.

2.7. Revenue volatility

Revenue volatility is associated with sales volatility. It becomes difficult to forecast revenue generation due to sales volatility. This financial parameter is an indicator of operating risk. Organizations with greater revenue volatility tend to invest less money in working capital. Thus, a negative relationship is observed between revenue/sales volatility and working capital investment (Wasiuzzaman & Arumugam, 2013). Hill et al. (2010) find varied results for the relationship between working capital requirements and revenue volatility based on past literature. They argue that with higher revenue volatility, or high deviations in demand, coming up with the optimal level of inventory may be difficult and so to be on the safe side, firms could increase inventory levels.

Hypothesis (H_{7a}): Revenue Volatility has a negative impact on the future working capital requirement of the firm.

2.8. Profitability

Profitability has a significant impact on working capital. Organizations with high profitability are likely to invest more in working capital due to the availability of cash. Thus, there is a positive relationship between working capital investment and profitability of the organization (Manoori & Muhammad, 2012; Wasiuzzaman & Arumugam, 2013). Whereas, a study conducted in Athens established a negative relationship between profitability and working capital (Atseye et al., 2015). High profitability helps firms strongly to bargain with both vendors and customers, and firms can use these competitive advantages to improve their liquidity (Petersen & Rajan, 1997; Shin & Soenen, 1998). Profitability has a significant positive impact on working capital requirements. More investment in working capital means more sources engaged and make more opportunity cost for firms (Deloof, 2003).In the present study return on common equity (ROCE) has been used to measure the profitability of selected organizations.

Hypothesis (H_{8a}): Profitability has a positive influence on the future requirements of working capital in BSE listed companies.

2.9. Operating cash flow

Operating cash flow has a significant impact on working capital. Organizations with better operating cash flow tend to increase their working capital investment (Atseye et al., 2015; Wasiuzzaman & Arumugam, 2013). On the contrary, some researchers believe that operating cash flow has a negative relationship with working capital. Better cash flow results in reduced working capital investment (Manoori & Muhammad, 2012). Appuhami (2008) and Chiou, Cheng, and Wu (2006) explored the significant negative relationship between operating cash flows (OCFA) and working capital requirements. But other researchers did not find any statistically significant relationship between working capital and operating cash flows (Al Taleb, AL-Zoued, & AL-Shubiri, 2010; Nazir & Afza, 2008).

Hypothesis (H_{9a}): Operating cash flow has a significant (positive or negative) influence on the future requirements of working capital in BSE listed companies.

2.10. Board characteristics or board size

A study of 192 companies in Malaysia established that the board characteristics (board size and board independence) do not have a significant impact on working capital investment. This may be due to the fact that board members do not make decisions regarding working capital. Also, the decisions made by the board members on significant issues do not impact working capital investments (Wasiuzzaman & Arumugam, 2013).

Hypothesis (H_{10a}): Board Characteristics or Board Size has a significant influence on the future requirements of working capital in BSE listed companies.

2.11. Economic conditions

A study conducted in Singapore found that GDP has a negative impact on working capital investment (Manoori & Muhammad, 2012). On the contrary, a study conducted in Nigeria established a positive relationship between working capital and GDP (Salawu & Alao, 2014). During the recession, the organizations may choose to invest more in working capital for the smooth functioning of day-to-day operations. But some researchers have a different point of view. They argue that economic conditions have a negative impact on working capital investments. The organizations reduce working capital investments due to financial constraints during the recession. They believe that working capital investments increase during economic growth (Wasiuzzaman & Arumugam, 2013).

Hypothesis (H_{11a}): Economic conditions significantly affect the future requirements of working capital in BSE listed companies.

3. Objectives of the study

The following are the main objectives of the study:

O1: To identify the determinants of gross working capital requirements of selected BSE listed companies.

O2: To identify the determinants of net working capital requirements of selected BSE listed companies.

O3: To provide useful suggestions to the board of directors companies for forecasting working capital requirements and to arrive at an optimum level of working capital.

4. Research methods

The present study is an empirical analysis of determinants of working capital of the top 150 BSE listed companies including BSE Sensex 30 companies using the most recent available data. There are around 5000 companies listed with the Bombay Stock Exchange at the time of the study. A sample of 150 companies has been taken as these companies are top-performing companies and these companies represent the entire economy as well as different industries. These

companies engaged in diverse business viz., banking and finance, FMCG, power and infrastructure, telecommunication, refinery, pharmaceuticals, Information technology, etc. For arriving at good analysis and an adequate number of observations for the study more recent data have been taken off the last 9 years. Secondary data related to selected companies have been taken from the financial statements available at the prowess database of the Centre for Monitoring Indian Economy (CMIE). Data have been collected for the last nine years i.e., from 2009 to 2017. Selected companies have age either 15 years or more when data was retrieved from the above-mentioned sources. In the present paper eleven exogenous and two endogenous variables (NWC and GWC) are used. These exogenous and endogenous variables are stated in Table A1. In the present study, four different methods have been used to develop models to forecast the future requirement of working capital of selected companies. The first method is the ordinary least square method (OLS). The paper employs two cointegration techniques (FMOLS and DOLS) and generalized method of moment (GMM). We consider alternative methods of panel data estimation to check whether the findings from the methods are consistent and justify the relevance of the findings from the earlier studies. Before applying cointegration techniques (FMOLS and DOLS), it is mandatory to check that data series of every endogenous and exogenous variables should be stationary. There is also a second essential condition that there should be cointegration in the model which is supposed to be developed using FMOLS and DOLS. To check stationary of data series, three different unit root tests have been applied viz., ADF (Dickey & Fuller, 1979), PP (Philips & Perron, 1988) and KPSS (Kwiatkowski, Phillips, Schmidt, & Shin, 1992). These tests have been applied without constant (none) and trend (T), with constant and constant and trend (C and T). Johansen cointegration unrestricted rank test is performed by taking the criteria of trace value and maximum Eigenvalue. After meeting these two conditions, FMOLS and DOLS have been applied to develop models to forecast future requirements of net working capital and gross working capital. The determinants observed in this study can be utilized to know the future working capital requirement selected BSE listed companies. But the interpretation can be made for the whole set of Indian companies listed with BSE. The measures of working capital have been identified from the studies conducted across the globe. At the initial stage, the various determinants of working capital are pulled from the previous studies conducted around the world. Consequently, OLS, cointegration tests (FMOLS, DOLS) and GMM are employed to determine whether there exists a relationship between the multiple explanatory variables. Regression equations are formed to develop the models using firm-specific determinants and Eviews10 software has been used to obtain the results of four different methods.

4.1. Ordinary least square vs cointegration tests

Dynamic OLS and fully modified OLS are better than ordinary least square methods due to a number of reasons. First OLS estimates are super-consistent, but the t-statistic obtained without stationary are only approximately normal. Even though, OLS is super-consistent, in the presence of a large finite sample bias' the convergence of OLS can be low in finite samples.

Second OLS estimates may suffer from heteroskedasticity autocorrelation since the omitted dynamics are captured by the residual so that inference using the normal tables will not be valid - even asymptotically. Therefore, "t" statistics for the estimates OLS estimates are useless.

Dynamic and fully modified OLS take care endogeneity by adding the leads and lags (DOLS). In addition, white heteroskedastic standard errors are used. FMOLS does the same using a nonparametric approach (Arize, John, & Ghosh, 2015) and (Arize, Thomas, & Slottje, 2000).

Both the cointegration tests DOLS and FMOLS are proffered over OLS estimator as they take into consideration small sample bias and endogeneity bias by using leads and lags of the first-differenced regressors. However, the parametric DOLS is prioritized over nonparametric FMOLS. As the later imposes additional conditions that all the variables should be integrated of the same order [i.e., I (1)] and that the regressors themselves should not be cointegrated (Masih & Masih, 1996).

4.1.1. Equations for OLS, FMOLS and DOLS

(a) NWC = α+ β1 (Nature of Business) + β2(Growth) + β3(Profitability) + β4(Size)+ β5(Assets Tangibility) + β6(Leverage) + β7(Revenue Volatility)+ β8(Operating Cash Flows)+ β9(Board Size)+ β10(Asymmetric Information)+ β11(Economic Condition)+e

(b) GWC = α+ β1 (Nature of Business) + β2(Growth) + β3(Profitability) + β4(Size)+ β5(Assets Tangibility) + β6(Leverage) + β7(Revenue Volatility)+ β8(Operating Cash Flows)+ β9(Board Size)+ β10(Asymmetric Information)+ β11(Economic Condition)+e

In the above equations α is the intercept, β1 to β16 are the slope of different exogenous variable and e is the error term in the models

4.2. Generalised method of moments

Hansen (1982) first introduced the generalized method of moments (GMM). GMM is one of the main statistical tools for the analysis of economic and financial data. GMM can be applied cross-sectional data, time-series data, and panel data analysis Generalized Method of Moments (GMM) is an estimation procedure that allows economic models to be specified while avoiding often unwanted or unnecessary assumptions, such as specifying a particular distribution for the errors.

This method requires that a certain number of moment conditions are to be specified for developing a model using GMM. These moment conditions are functions of the model parameters and the data, such that their expectation is zero at the parameters' true values. The GMM method then minimizes a certain norm of the sample averages of the moment conditions. The GMM estimators are known to be consistent, asymptotically normal, and efficient in the class of all estimators that do not use any extra information aside from that contained in the moment conditions. The specification we use for this purpose for the two models takes the following general form:

NWCit = α_0 **+ f (NWC**$_{it-1,\ it}$, Age $_{it}$, BOD Size $_{it}$, Price Earning Patio $_{it}$, Size $_{it}$, Profitability(ROCE) $_{it}$, Leverage $_{it}$, Growth $_{it}$, Revenue Volatility $_{it}$, operating cash Flow $_{it}$, Tangibility, $_{it}$**)+ n**$_i$ **+n**$_t$ **+**ε_{it}

GWCit = α_0 **+ f (GWC**$_{it-1,\ it}$, Age $_{it}$, BOD Size $_{it}$, Price Earning Patio $_{it}$, Size $_{it}$, Profitability(ROCE) $_{it}$, Leverage $_{it}$, Growth $_{it}$, Revenue Volatility $_{it}$, operating cash Flow $_{it}$, Tangibility, $_{it}$**)+ n**$_i$ **+n**$_t$ **+**ε_{it}

Where **NWC**it and **GWC**it are the net working capital and gross working capital ratios of the firm I in year t, n_i is the unobserved firm-specific effects, n_t is the time-specific effects and εit is the error term. The remaining variables in the above equations are already used as explanatory variables in the previous two methods of estimation except for the nature of the business. Due to adding the lagged value of the dividend payout ratio as an exogenous variable in the model, there was problem of multicollinearity due to the nature of the business which was taken as a dummy predictor variable in the previous two models. Now, this variable has been removed as the results of the GMM model were not coming due to the high level of multicollinearity. Unobserved factors of the firm which may have a significant impact on a firm's dividend payout ratio are expressed as n_i. n_t expresses the effects of macroeconomic factors such as interest rate, inflation, etc.

OLS estimation technique remained biased in the presence of firm-specific effects, by presuming that n_i is unobservable and there is covariance between predictors variables and unobserved characteristics (n_i) (Hsiao, 1985).In this situation, an instrumental variable estimation method provides consistent results if the error term (ε_{it}) are serially uncorrelated. Taking the assumption that error term serially uncorrelated, the generalized method of the moment is proposed by Arellano and Bond (1991). GMM is the most efficient method in the class of instrumental variable estimators (Honore & Hu, 2003). In the present study, the two-step GMM estimation has been

used. It is observed by many previous studies that two-step GMM is more efficient than the one-step estimation when the disturbances are expected to show heteroscedasticity in large sample data with a relatively long time period (Arellano & Bond, 1991; Blundell & Bond, 1998).

However, the effectiveness of GMM estimation depends upon certain assumptions that lagged value of the dependent variable and other predictors' variables should be valid instruments and error terms of model do not exhibit autocorrelation. For this purpose, Arellano and Bond (1991) proposed three tests. The first is to test that there is not first-order serial correlation or autocorrelation of the error term of the proposed model. Under the null hypothesis of no serial correlation, the test statistic is distributed as a standard normal. Second is to check that there should not be second-order autocorrelation of the error term of the GMM model, which is distributed as a standard normal under the null hypothesis of no serial correlation. The third is the Sargan (1958) test or J statistics of over-identifying restrictions. This tests the validity of the instruments and is asymptotically distributed as Chi-square under the null of instrument validity.

5. Analysis and interpretation

The descriptive statistics of all eleven explanatory and two endogenous variables (GWC and NWC) are presented in Table A2. The mean value of the proportion of gross and networking capital (GWC NWC) to total assets has remained 0.57 and 0.07 respectively during the study period. The standard deviation of these two measures of working capital is quite high which reflects high volatility in the gross and networking capital of selected companies. Specifically the case of NWC, volatility is quite high.

The average board of directors (BOD size) of selected BSE listed companies has remained 11 with a standard deviation of 2.90. The average GDP of the country has remained 0.07 or 7% with a standard deviation of 0.01 or 1%. It shows much consistency in terms of the economic growth of the Indian economy. Growth could be an important indicator to predict future working capital requirements of selected organizations. Growth, as measured through the natural logarithm of revenue of selected BSE companies, has remained quite high i.e., 0.12 or 12% with very high standard deviation. Leverage, as measured through total debt/total assets, is 0.33 but it also shows high dispersion as revealed from standard deviation. For studying the nature of the business, dummy variables have been used (Where 1 for manufacturing and 0 for service Sector Company) average score of nature of the business is 1 and the standard of deviation is 0.48. Operating Cash Flow (OCFA) has mean value 0.20 and the standard deviation is quite high (1.01). Market to book value (MTB) has an average score of 5.64 with a high standard deviation. Revenue volatility (REVVOL) as measured through the coefficient of variation of net sales of the rolling period of 4 years has an average value of 0.21 with a standard deviation of 0.11. The average return on common equity (ROCE) is quite high (22.29 %) of selected BSE listed companies with a high standard deviation. The size of the firm as measured through the natural log of total assets is 10.56 with a low standard deviation. Assets tangibility (TANG) as measured by net fixed assets to total assets (NFATA) has a mean value of 0.28 of selected BSE listed companies with high volatility as revealed from high standard deviation.

According to (Malhotra & Dash, 2009) to test the assumption of a normal distribution, Skewness should be within the range ±1 and Kurtosis value should be within range ±3. Some people use ±2 range of Kurtosis.

Further, the most widely used method, at least in econometrics, that has been suggested and used for testing whether the distribution underlying a sample is normal is the (Bowman & Shenton, 1975) statistic, which subsequently was derived by Bera and Jarque as the Lagrangian Multiplier (LM) test against the Pearson family distributions. For that reason, the JB test is also referred to as the Jarque-Bera test (Bera & Jarque, 1982; Bowman & Shenton, 1975; Jarque & Bera, 1987; Shenton & Bowman, 1977). The JB statistic has an asymptotic chi-square distribution with two degrees of freedom. The JB test is simple to compute and its power has proved comparable to

other powerful tests. It turns out that this test statistic can be compared with a χ^2 (chi-square) distribution with 2 degrees of freedom. The null hypothesis of normality is rejected if the calculated test statistic exceeds a critical value from the χ^2 (2 degrees) distribution. JB test statistic is much greater than 5.99 of all dependent and independent variables (chi-square table value at 2 degrees of freedom), that the null hypothesis of normality is rejected and data series is not normal as per JB statistics. The Jarque-Bera test statistic of all variables exceeds the critical values for any reasonable significance level to lead to the conclusion that data series of different variables do not follow a normal distribution.

Table A3 reports the correlation coefficients of variables and VIF coefficients. There are two alternative measures of working capital which have not been correlated. The correlation coefficient between these variables is 0.24. The variance inflation factor (VIF) coefficient is the indicator of the existence of multicollinearity between explanatory variables. Among the explanatory variables, SIZE is highly correlated with leverage (correlation coefficient is 0.72), similarly, MTB is also showing a high correlation with ROCE i.e., 0.68. On the other hand nature of business (NOB) is showing a high negative correlation with leverage (−0.57) and size demonstrate a high inverse correlation with MTB.Size also depicts a high inverse correlation with tangibility (correlation coefficient is −0.51). One measure of working capital (GWC) is highly correlated with ROCE (correlation coefficient is 0.43. Whereas, another measure of working capital (NWC) is showing a high negative correlation with TANG. Other explanatory measures Viz., BOD Size, GDP, OCFA, and REEVOL are minimum correlated with other explanatory variables as well as with two measures of working capital. VIF tests reveal that the value corresponding to each explanatory variable is less than 10, which indicates that multicollinearity is not a serious problem here. Multicollinearity is a serious problem if the value of the variance inflation factor (VIF) is greater than 10 (Nachane, 2006).

5.1. Unit root test (ADF and PP)

The unit root test is carried out by using (Dickey and Fuller, 1979) or ADF, (Philips and Perron, 1988) or PP and (Kwiatkowski et al., 1992) or KPSS techniques

The following hypotheses are set up for ADF and PP.

H_0: There is a unit root for series.

H_1: There is no unit root for the series. The series is stationary

5.1.1. Unit root test (KPSS)

The unit root test is done by KPSS by setting hypothesis as:

H_0: The Series is stationary.

H_1: The Series is not stationary.

The unit root tests (ADF and PP) for data series for dependent and independent variables have been conducted in three different ways i.e., without intercept and linear trend (without C and T), with intercept or constant (with C) and with both trend and intercept/constant (with C and T).

Table A4 reports the results of the unit root test of ADF, PP, and KPSS. According to ADF and PP tests, the data series of all explanatory variables and two dependent variables are found to be stationary at level. T statics of two endogenous variables and eleven exogenous variables are shown in Table A4 accompanied by p-value in parenthesis. Since p-value < 0.05, so the null hypothesis is rejected. It reports that data series are stationary for two dependent variables (NWC and GWC). Without constant and trend using ADF test, BOD, GDP, Growth, NOB and size are not stationary at a level as their associated p-value >0.05. Similarly, p values of t statistics of PP

test of variables viz., BOD, GDP, and Size are greater than 0.05 at without constant and trend. But with constant as well as constant and a trend p-value of all the exogenous variables are less than 0.05. It means that data series of all these variables are stationary at level.

According to the KPSS test, data series are assumed to be stationary if the null hypothesis is accepted or LM statistics of KPSS test are less than the critical value. In this test, critical values at a 5 % significance level are shown in the parenthesis. Data series of dependent variables (NWC and GWC) are found to be stationary, as the associted critical values (0.46300 and 0.1460) are quite higher than the actual calculated value of LM statistics as depicted in Table A5. Similarly, critically values at a 5% significance level are also higher than the calculated value of LM statistics of all exogenous variables. It means that data series for all eleven exogenous variables are stationary at level (Table A4).

5.2. Cointegration test

Johansen's unrestricted cointegration rank test is performed for model 1 (NWC). According to trace value criteria as shown in Table A5 there are eight cointegration equations out of eleven equations. In all cointegration equations, the calculated value of trace statistics is higher than the critical value at a 5 % significance level and p-value < 0.05. The trace values of first seven equations are 742.4614, 486.5950, 349.0122, 262.3885, 202.1680, 155.1471, 111.0497, 72.12307, 17.82775 and 8.542550 respectively. All these trace values are higher than the critical value at a 5% significance level. It denotes the rejection of the null hypothesis and acceptance of the alternative hypothesis. It means there is a cointegration in model 1 (NWC).

Johansen's unrestricted cointegration rank test is also performed using the criteria of maximum Eigenvalue for model-1 (NWC). According to Eigenvalue criteria as depicted in Table A5 there are four cointegration equations. As maximum Eigenvalue statistics is greater the critical value at 0.05 level and p-value < 0.05. The maximum Eigen statistics of the first three equations are 137.5828, 86.62373, and 60.22047 respectively which is greater than the critical value at a 5 % significance level. The equation 11 is also showing significant value as its p-value < 0.05. These equations denote the rejection of the null hypothesis and acceptance of the alternative hypothesis. It means there is cointegration in model 1 (NWC) as per maximum Eigenvalue criteria (Table A5).

Johansen cointegration rank test is also performed for model 2 (GWC) using criteria of trace value and maximum Eigenvalue. According to trace value criteria as depicted in Table A6, all eleven cointegration equations have calculated value greater than the critical value and p-value < 0.05. These cointegration equations have trace value 680.5220, 423.7147, 305.1810, 225.5563, 167.0569, 121.3377, 83.10222, 52.98266, 32.23084 and 8.132066 respectively. These equations reflect the rejection of the null hypothesis at the 0.05 level and acceptance of the alternate hypothesis. It means there is a cointegration in model 2 (Table A6).

According to maximum Eigenvalue criteria (Table A6) for the model −2 (GWC), the four cointegration equations are found significant at a 5% level. As maximum Eigenvalue statistics is greater the critical value and p-value < 0.05. The maximum Eigen statistics of the first four equations are 256.8072, 118.5338, 79.62470 and 58.49943 respectively. These equations reflect the rejection of the null hypothesis and the acceptance of the alternative hypothesis. It means there is also cointegration in model 2 (Table A6).

5.3. Results of OLS, FMOLS, and DOLS

Table A7 reports the significant determinants of networking capital (NWC) obtained through three different methods i.e., ordinary least square, fully modified OLS (FMOLS) and dynamic OLS (DOLS). According to OLS, there are five determinants of networking capital Viz., board size (BOD), leverage (LEV), nature of business (NOB), market to book value and assets tangibility (TANG). All these variables have t statistics greater than 1.96 and p-value < 0.05. All these variables are predictors of future requirements of networking capital (NWC) and showing a negative association with net

working capital. It means due to an increase or decrease in these variables there will opposite change in net working capital. T statistics of leverage (8.078) are highest followed by tangibility (−6.677) and nature of business (−3.717). The constant or intercept is also found significant in OLS as t statistics are 7.945 and p-value < 0.05.

According to FMOLS, there are only three significant predictors of the requirement of networking capital which are also found significant in OLS viz., leverage (LEV), nature of business (NOB) and tangibility (TANG). The t statistics of these variables are −4.1292, −2.1108 and −3.8899 respectively. Just like the previous method, these variables show a negative relationship with net working capital. This method validates the results of OLS.

The dynamic ordinary least square (DOLS) method reflects only two significant variables in Table A6, which are also observed significantly in the previous two methods (OLS and FMOLS). These variables are leverage (LEV) and tangibility (TANG). The t statistics of these variables are −3.3739 and −3.2429 respectively. Since p values < 0.05, so both these variables are significant as per DOLS.

R square reflects the percentage of variance as properly explained by all significant variables of net working capital. In the case of OLS, all five significant variables explain 30.8 % percent of the variance of net working capital. In fully modified OLS (FMOLS) and dynamic OLS (DOLS), R square values are 0.2930 and 0.3816 respectively. It means that FMOLS and DOLS explain 29.30% and 38.16 % of the variance of the dependent variable (net working capital). The minimum difference between R square and adjusted R square validates the results of all the methods used to develop models to forecast future requirements of net working capital. Durbin Watson ratio reflects that there is no problem of autocorrelation in the case of the OLS method as this value is greater than 1.50. Anova value (24.916) is also found significant in OLS technique as p-value < 0.05 (Table A6).

Table A8 reports the significant exogenous variables of gross working capital (GWC) obtained from three different methods Viz., OLS, and FMOLS and DOLS. OLS method has found five major determinants of gross working capital of BSE listed Indian companies viz., board size (BOD), return on common equity (ROCE), nature of business (NOB), size and tangibility (TANG). All these variables have t statistics > 1.96 and p-value < 0.05. All these variables are significant as per the OLS method. Return on common equity (ROCE) and board size (BOD) have a positive coefficient value which reflects the positive association with gross working capital. The remaining three significant determinants (NOB, SIZE, and TANG) demonstrate a negative relationship with gross working capital. Constant is also found significant in the ordinary least square (OLS) method with t statistics 4.916 and p value< 0.05.

FMOLS method demonstrates six determinants to forecast future requirements of the gross working capital of BSE listed companies. These determinants are board size (BOD), nature of business (NOB), operating cash flows (OCFA), market to book value (MTB), return on common equity (ROCE) and tangibility (TANG). All these variables have t statistics > 1.96 and a p-value of less than 0.05. ROCE, MTB, and BOD are showing a positive relationship with gross working capital and the other three variables (OCFA, TANG and NOB) are showing a negative association with GWC.

Four significant variables are obtained in the dynamic OLS (DOLS) method. All these variables are also significant in the previous two methods. These variables are the nature of business (NOB), operating cash flows (OCFA), return on common equity (ROCE) and tangibility (TANG). Only ROCE is showing a positive impact on gross working capital and the remaining three significant variables are negatively related to GWC.

R square represents the total variance explained of the dependent variable (GWC) by all significant explanatory variables together. In OLS and FMOLS, the total variance explained of gross working capital by all exogenous variables is 33.9% and 33.81% respectively. In the dynamic OLS (DOLS) method, the total variance explained (42.8%) is quite high as compare to the previous

two methods. In all the models, the difference between R square and adjusted R square is less than 0.05 which further authenticates the validity of these models to predict the future requirement of gross working capital (GWC). Durbin Watson's ratio reflects that there is no problem with autocorrelation in the case of the OLS method as this value is 1.3465. Anova value (23.968) is also significant in the case of the OLS technique as a p-value < 0.05 (Table A8).

5.4. Results of generalized method of moments (GMM) estimation

Table A9 reports the results of the GMM estimation for two alternative models specified of Eq. 1 and 2 using the alternative measures of working capital. The lagged working capital ratio found significant at one percent level for both models along with other explanatory variables. So both models meet the first condition as proposed by (Arellano & Bond, 1991).

In model one (NWC), other explanatory variables which are also found significant at 1 percent level are GDP, the price-earnings ratio (P/E) and tangibility (Tang). Age and leverage are also found significant at the 10 percent level. In model two (GWC) along with lagged gross working capital ratio, age, and board size, operating cash flow (OCFA), market to book value ratio (P/B), return on common equity (ROCE), leverage and size are also found significant at 1 percent level. The price-earnings ratio is significant at 5% level. In model one, lagged net working capital ratio, price-earnings ratio and leverage are showing a positive association with net working capital. Other significant variables have a negative association with the dependent variable (NWC). In model two related to gross working capital, five variables are showing positive relationship endogenous variable (GWC ratio). The remaining variables are showing a negative relationship with the dependent variable. In both the models on age are showing a similar relationship, the rest of the significant variable has an opposite association in both the models. It is because of that in both models dependent variables are not the same. The first model is related to networking capital ratio and second deals with the gross working capital ratio.

In both the models, values of the Surgan test or J statistics are 20.20069 and 19.81940 respectively. Null hypothesis means that instruments are valid and they are uncorrelated with residual

So, we accept the absence of correlation between instruments and residuals and instruments are valid. The validity of instruments is proven by the Sargan test with respective p-values 0.2640 and 0.2042, which are higher than the significance level of 5%. Results of this indicate that instruments are valid and instruments and error terms are uncorrelated. Serial correlation as calculated for the first order is found significant at 10 % ($P < 0.10$) level for NWC, but not for model two (GWC). For both the models, the serial correlation calculated by Arellano and Bond (1991) method is showing a negative value. But second-order correlation accepting the null hypothesis and showing positive values in both the models.

The tests of serial correlation of Arellano and Bond (1991) should show that the first order statistic is statistically significant, whereas the second-order statistic is not, which is what we would expect if the model error terms are serial uncorrelated in levels. In our study, the first-order serial correlation is statically significant for the first model at a 5% level and second-order serial correlation is not statistically significant. But in model two, first and second-order serial correlation is not statistically significant.

Table A10 reports the acceptance and rejection of a hypothesis using four alternative methods of estimation. Leverage (H_1) is a strong predictor of networking capital as revealed from the four alternative methods of estimation. Hypothesis (H_4) is also accepted all the alternative methods that the Nature of business has a negative influence on the future requirements of working capital in BSE listed companies. According to the hypothesis (H_8), profitability can also be strongly recommended as a predictor of the future requirement of gross working capital, as it is found to be significant in all the methods. Hypothesis (H_{10}) is accepted that Board characteristics or Board Size have a significant influence on the future requirements of working capital in BSE listed companies. Hypothesis (H_6) strongly recommended as an explanatory variable to predict the future

requirement of the working capital of Indian companies, as it is found significant in four alternative techniques. Hypothesis (H_3) is partially accepted that the level of asymmetric information has a negative impact on the future working capital requirement of the firm. It is found to be significant, according to OLS and FMOLS. Similarly, hypothesis (H_5) is also partially accepted that size or Capital Market Access has a positive impact on the future working capital requirement. According to GMM technique, hypothesis (H12) is accepted the lagged value of the dependent variable (NWC and GWC) positively affect the future requirement of Working Capital.

6. Discussion of results of OLS, FMOLS, DOLS and GMM

The study conducted by (Akinlo, 2012a; Chiou et al., 2006; Nyeadi, Sare & Aawaar, 2019Singh & Kumar, 2017; Wasiuzzaman & Arumugam, 2013) observed that leverage is inversely related to working capital requirements.The results of present study similar to these studies. Study observed that assets tangibility has inverse relation with working capital. The similar findings are observed by (Fazzari & Petersen, 1993; Kieschnich, LaPlante, & Moussawi, 2006; Singh & Kumar, 2017) The Board size has also been founds significant variable showing negative association with working capital. The similar results are also observed by (Moussawi, LaPlante, Kieschnick, & Baranchuk, 2006). On other side Zariyawati, Taufiq, Annuar, and Sazali (2010) found insignificant relationships between leverage and assets tangibility variables for the Malaysian case. Our study shows the positive association between working capital and profitability (ROCE). There are numerious studies who have also found the similar findings (Atseye et al., 2015; Azami & Tabar, 2016; Azeem & Marsap 2015; Banos Caballero, Garcı´a-Teruel, & Martı´nez-Solano, 2010; Shin & Soenen, 1998; Chiou et al., 2006; Fatimatuzzahra & Kusumastuti, 2016; Nyeadi, Sare, & Aawaar, 2019; Petersen & Rajan, 1997; Singh & Kumar, 2017; Wasiuzzaman & Arumugam, 2013). The our observed size of firm is inversely associated with working capital. However, (Chiou et al., 2006; Fatimatuzzahra & Kusumastuti, 2016; Kieschnich et al., 2006) stated that the requirement of working capital increased with size. So there is a positive relationship between size and working capital. The study conducted by (Wasiuzzaman & Arumugam, 2013; Sare, Yakubu and Aawaar, 2019) found that requirement of working capital declines as the size of business increases. The current study shows that operating cash flows (OCFA) negative association with working. The study conducted (Wasiuzzaman & Arumugam, 2013) also arrived with similar findings. Contrary (Fazzari & Petersen, 1993; Hill et al., 2010; Myers & Majluf, 1984; Wasiuzzaman & Arumugam, 2013) disclosed that working capital requirement (WCR) positively related to the operating cash flow.

7. Conclusion

The study is carried out to explore the determinants of the gross and networking of BSE listed companies. Four alternative methods (OLS, FMOLS DOLS, and GMM) are chosen to develop models and to identify the significant variables affecting the working capital of selected companies. It is intended to use four different methods so that results obtained from one method can be verified from other methods. The first method OLS identified five significant variables to forecast the future requirement of net working capital. These variables are board size (BOD), leverage (LEV), market price to book value (MTB), nature of business (NOB) and asset tangibility. All these variables are showing a negative relationship with net working capital.

It means that due to change (increase/decrease) in these variables, the net working capital (NWC) will move in the opposite direction. The second method FMOLS method has obtained three significant variables (nature of business, leverage and assets tangibility). These three predictor variables are common with the previous method and also showing a negative relationship with net working capital. So FMOLS, validate the results obtained from OLS. The third method DOLS has explored only two significant variables (leverage and assets tangibility) to forecast future requirements of net working capital (NWC). These variables are also found significant in the earlier two methods and showing a negative association with net working capital (NWC). All these methods have also been used to develop a model to forecast the gross working capital requirements of selected companies. The first method of ordinary least square (OLS) has identified five predictors variables of gross working capital Viz., return on common equity (ROCE), board size (BOD), size of the firm (SIZE, assets tangibility (TANG) and nature of business (NOB). The two variables (ROCE and BOD) are showing a positive association

with working capital and the remaining three variables (NOB, Size, and TANG) have shown a negative relationship with gross working capital.

FMOLS has explored six significant determinants of gross working capital. Three variables (board size, return on common equity and market to book value) out of them are showing a positive impact on working capital. Three other variables (nature of the business, assets tangibility and operating cash flows are depicting a negative relationship with gross working capital.

Out of these six variables, the four variables (nature of the business, return on common equity, the board size, and assets tangibility) are also found significant in the previous method (OLS). Dynamic OLS has explored four significant predictors' variables of gross working capital viz., nature of the business, operating cash flows, return on common equity and asset tangibility. These variables are also significant as per fully modified OLS.

The results generalized methods of moments (GMM) are also similar to the previous three methods. Determinants, as identified for networking capital by earlier three methods (OLS, FMOLS, and DOLS), are supported by GMM except for few exceptions. Similarly, determinants, as identified for gross capital requirement, are also observed the same in GMM. But there is an addition of new determinants of GWC by using GMM. Now we can say that the findings of four alternative methods of panel data estimation are consistent and justify the relevance of the findings from the earlier studies with some new developments.

The study will have numerous benefits to policymakers specifically board of directors/mangers of BSE listed companies. Board directors always want to maintain an optimum level of working capital and want to avoid the inadequate and excessive working capital situation. As an inadequate flow of working capital put an obstacle in the day to day business operation and excessive working capital creates idle funds. The different significant variables as discovered in this study shall be useful to concerned authorities of the company for arriving at optimal working capital of the company and providing maximum benefits to existing shareholders of the company. Consequently, concerned authority will be able to utilize significant variables of the company in such a way, so that they may be able to forecast future requirements of working capital of their companies. The study has made recognized that any increase in profitability board size in Indian companies will lead directly to increment in working capital in a firm while increase in leverage, Size assets tangibility and operating cash flows will lead to a decrease in working capital if a firm. The managers or policymakers will be benefitted by into account all the variables showing positive or negative association while arriving optimum the optimum level of working capital so as to avoid waste in firm operations. The study contributes significantly to existing body of knowledge. This study has been carried by taking into account the historical economic reforms so it provides complete new insight for forecasting the requirement of working to existing Indian firms. Although this study is carried out by taking into account only 150 BSE listed firms but interpretation from this can be made for whole set of Indian firms as well as outside the India. This study will provide new base to academician to explore further the determinants by taking into consideration the similar situation of particular economy.

Funding
The authors received no direct funding for this research.

Author details
Rakesh Kumar Sharma[1]
E-mail: rakesh.kumar@thapar.edu
Apurva Bakshi[1]
E-mail: abakshi@thapar.edu
Sheena Chhabra[1]
E-mail: sheena.chhabra@thapar.edu
[1] School of Humanities and Social Sciences, Thapar Institute of Engineering and Technology (Deemed University), Patiala, India.

Citation information
Cite this article as: Determinants of behaviour of working capital requirements of BSE listed companies: An empirical study using co-integration techniques and generalised method of moments, Rakesh Kumar Sharma, Apurva Bakshi & Sheena Chhabra, *Cogent Economics & Finance* (2020), 8: 1720893.

References

Abbadi, S. M., & Abbadi, R. T. (2012). The determinants of working capital requirements in Palestinian industrial corporations. *International Journal of Economics and Finance*, *5*, 1. doi:10.5539/ijef.v5n1p65

Agyei, S. K., Oduro, I. M., & Ansong, A. (2013). Determinants of working capital requirements and policies of Banks in Ghana. *Ghanaian Journal of Economics*, *1*, 35–51.
Akinlo, O. O. (2012a). Determinants of working capital requirements in selected quoted companies in Nigeria. *Journal of African Business*, *13*(1), 40–50. doi:10.1080/15228916.2012.657951
Akinlo, O. O. (2012b). Effect of working capital on profitability of selected quoted firms in Nigeria. *Global Business Review*, *13*(3), 367–381.
Al Taleb, G., AL-Zoued, A. L.-N., & AL-Shubiri, F. N. (2010). The determinants of effective working capital management policy: A case study on Jordan. *Interdisciplinary Journal of Contemporary Research in Business*, *2*(4), 248–264.
Appuhami, B. A. R. (2008). The impact of firms' capital expenditure on working capital management: An empirical study across industries in Thailand. *International Management Review*, *4*(1), 11–24.
Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economics Study*, *58*, 277–297. doi:10.2307/2297968
Arize, A. C., John, M., & Ghosh, D. (2015). Purchasing power parity-symmetry and proportionality: Evidence from 116 countries. *International Review of Economics and Finance*, *37*(3), 69–85. doi:10.1016/j.iref.2014.11.014
Arize, A. C., Thomas, O., & Slottje, D. J. (2000). Exchange-rate volatility and foreign trade: Evidence from thirteen LDC's. *Journal of Business and Economic Statistics*, *18*(1), 10–17.
Atseye, F. A., Ugwu, J. I., & Takon, S. M. (2015). Determinants of working capital management. *International Journal of Economics, Commerce and Management*, *3*(2), 1–11.
Azami, Z., & Tabar, F. J. (2016). Investigating the factors affecting working capital of companies using the generalized method of moments. *Bulletin De La Société Royale Des Sciences De Liège*, *85*, 1402–1415.
Azeem, M. M., & Marsap, A. (2015). Determinant factors and working capital requirement. *International Journal of Economics and Finance*, *7*(2), 280.
Banerjee, B. (2017). *Financial policy and management accounting- forecasting working capital* (Ninth ed.). New Delhi: PHI Learning Pvt. Ltd.
Banos-Caballero, S., Garcı´a-Teruel, P. J., & Martı´nez-Solano, P. (2010). Working capital management in SMEs. *Accounting and Finance*, *50*, 511–527. doi:10.1111/j.1467-629X.2009.00331.x
Bera, A., & Jarque, C. (1982). Model specification tests: A simultaneous approach. *Journal of Econometrics*, *20*, 59–82. doi:10.1016/0304-4076(82)90103-8
Bereznicka, J. K. (2014). The capital structure as a determinant of working capital management: Empirical evidence across size groups of firms in the EU countries. *Journal of International Scientific Publications*, *8*, 36–54.
Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal Econometrics*, *68*(1), 29–52.
Bowman, K., & Shenton, L. R. (1975). Omnibus contours for departures from normality based on 1b and 2 b. *Biometrika*, *62*, 243–250.
Chiou, J., Cheng, L., & Wu, H. (2006). The determinants of working capital management. *The Journal of American Academy of Business*, *10*(1), 149–155.
D'Mello, R., Krishnaswami, S., & Larkin, P. J. (2008). Determinants of corporate cash holdings: Evidence from spin-offs. *Journal of Banking and Finance*, *32*, 1209–1220. doi:10.1016/j.jbankfin.2007.10.005
Deloof, M. (2003). does working capital management affect the profitability of belgian firms? *Journal of Business Finance and Accounting*, *30*(3–4), 573–588. doi:10.1111/1468-5957.00008
Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of The American Statistical Association*, *74*(366), 427–431.
Efinance Management. (2018). Factors determining working capital requirement. Retrieved from https://efinancemanagement.com/working-capital-financing/factors-determining-working-capital-requirement.
Elbadry, A. (2018). The determinants of working capital management in the Egyptian SMEs. *Accounting and Finance Research*, *7*(2), 155–165. doi:10.5430/afr.v7n2p155
Eljelly, A. (2004). Liquidity - profitability tradeoff: an empirical investigation in an emerging market. *International Journal of Commerce and Management*,*14*(2), 48–61.
Emmanuel, O. (2016). Determinants of working capital requirements: Evidence from selected non-financial firms listed on the johannesburg securities exchange. *The Journal of Accounting and Management*, *6*(1), 35–45.
Fatimatuzzahra, M., & Kusumastuti, R. (2016). The determinants of working capital management of manufacturing companies. *Member*, *32*(2), 276–281.
Fazzari, S. M., & Petersen, B. (1993). Working capital and fixed investment: New evidence on financing constraints. *Rand Journal of Economics*, *24*, 328–342. doi:10.2307/2555961
Filbeck, G., & Krueger Thomas, M. (2005). An analysis of working capital management results across industries. *American Journal of Business*, *20*(*2*), 11–20.
Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica*, *50*(4), 1029 1054. doi:10.2307/1912775. JSTOR1912775
Hill, M. D., Kelly, G. W., & Highfield, M. J. (2010). Net operating working capital behavior: A first look. *Financial Management*, *39*(2), 783–805. doi:10.1111/j.1755-053X.2010.01092.x
Honore, B., & Hu, L. (2003). Estimation of cross-sectional and panel data censored regression models with endogeneity. *Working Paper No. 4*, Princeton University.
Hsiao, C. (1985). Benefits and limitations of panel data. *Economic Review*, *46*(4), 1251–1271.
Jarque, C., & Bera, A. (1987). A test for normality of observations and regression residuals. *International Statistical Review*, *55*, 163–172. doi:10.2307/1403192
Kieschnich, R., LaPlante, M., & Moussawi, R. (2006). Corporate working capital management: Determinants and consequences, Working paper. University of Texas, Dallas.
Kwenda, F., & Holden, M. (2014). Determinants of working capital investment in South Africa: Evidence from selected JSE-listed firms. *Journal of Economics and Behavioral Studies*, *6*(7), 569–580.
Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root. *Journal of Econometrics*, *54*(1–3), 159–178. doi:10.1016/0304-4076(92)
Lamberson, M. (1995). Changes in working capital of small firms in relation to changes in economic

activity. *Mid-American Journal of Business*, *10*(2), 45–50. doi:10.1108/19355181199500015
Lyngstadaas, H., & Berg, T. (2016). Working capital management: Evidence from Norway. *International Journal of Managerial Finance*, *12*(3), 295–313. doi:10.1108/IJMF-01-2016-0012
Malhotra, N., & Dash, S. (2009). Marketing Research: An Applied Orientation (5th ed.). Pearson Prentice Hall.
Manoori, E., & Muhammad, D. J. (2012). Determinants of working capital management : Case of Singapore firms. *Research Journal of Finance and Accounting*, *3* (11), 15–24.
Masih, A. M. M., & Masih, R. (1996). Stock-Watson dynamic OLS (DOLS) and error-correction modeling approaches to estimating long- and short-run elasticities in a demand function: New evidence and methodological implications from an application to the demand for coal in mainland China. *Energy Economics*, *18*(4), 315–334. doi:10.1016/S0140-9883(96)00016-3
McGuigan, J. R., Moyer, R. C., Rao, R., & Kretlow, W. J. (2012). *Contemporary corporate finance* (12th ed.). South-Western: Cengage Learning.
Mongrut, S., O'shee, D. F., Zavaleta, C. C., & Zavaleta, J. C. (2014). Determinants of working capital management in Latin America. *Revista Innovar*, *24*(51), 5–18. doi:10.15446/innovar.v24n51.41235
Moussawi, R., LaPlante, M., Kieschnick, R., & Baranchuk, N. (2006). Corporate working capital management: Determinants and consequences. *Working Paper*, Baylor University. Retrieved from http://www.fma.org/SLC/papers/cwcmf-fma.pdf.
Mukhopadhyay, D. (2004). Working capital management in heavy engineering firms-A case study. *Management accountant-Calcutta*. 39–44.
Myers, S., & Majluf, N. (1984). corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, *13*, 187–221. doi:10.1016/0304-405X(84)90023-0
Nachane, D. M. (2006). *Econometrics: Theoretical foundations and empirical perspectives*. USA: Oxford University Press.
Nazir, M. S. (2009). Impact of working capital aggressiveness on the firm's profitability. *IABR and TLC Conference Proceedings*, San Antonio, TX.
Nazir, M. S., & Afza, T. (2008). Working capital management policies of firms: Empirical evidence from Pakistan. *Pakistan Journal of Commerce and Social Sciences*, *1*(1), 25–36.
Nunn, K. P., Jr. (1981). The strategic determinants of working capital: A product-line perspective. *Journal of Financial Research*, *4*(3), 207–219. doi:10.1111/jfir.1981.4.issue-3
Nyeadi, J. D., Sare, Y. A., & Aawaar, G. (2019). Determinants of working capital requirement in listed firms: Empirical evidence using a dynamic system GMM. *Cogent Economics and Finance*, *6*, 1. doi:10.1080/23322039.2018.1558713
Onalapo, A. A., & Sunday, K. O. (2015). What are the determinants of working capital requirements of nigerian firms? *Research Journal of Finance and Accounting*, *6*(6), 118–127.
Pandey, I. M. (2007). *Financial management-principles of working capital management*. New Delhi: Visas Publishing House Pvt. Ltd.
Petersen, M., & Rajan, R. (1997). Trade credit: Theories and evidence. *Review of Financial Studies*, *10*(3), 661–691. doi:10.1093/rfs/10.3.661
Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335–346.
Salawu, R. O., & Alao, J. A. (2014). Determinants of working capital management: Case of Nigerian manufacturing firms. *Journal of Economics and Sustainable Development*, *5*(14), 49–56. Retrieved from http://www.iiste.org/Journals/index.php/JEDS/article/view/14564
Sargan, J. D. (1958). The estimation of economic relationships using instrumental variables. *Econometrica*, *26*(3), 393–415. doi:10.2307/1907619
Shaista, W., & Veeri, C. A. (2013). Determinants of working capital investment: A study of Malaysian public listed firms. *Australasian Accounting Business and Finance Journal*, *7*(2), 63–83. doi:10.14453/aabfj.v7i2.5
Shenton, L. R., & Bowman, K. O. (1977). A bivariate modal for the distribution of √b1 and b2. *Journal of the American Statistical Association*, *72*(357), 206–211.
Shin, H., & Soenen, L. (1998). The efficiency of working capital and corporate profitability. *Financial Practice and Education*, *8*(2), 37–45.
Singh, H. P., & Kumar, S. (2017). Working capital requirements of manufacturing SMEs: Evidence from an emerging economy. *Review of International Business and Strategy*, *27*(3), 369–385. doi:10.1108/RIBS-03-2017-0027
Vijayakumar, A., & Venkatachalam, A. (1996). Responsiveness of working capital management-A case study of Tamilnadu sugar corporation. *Finance India*, *10*(3), 647–655.
Wasiuzzaman, S., & Arumugam, V. C. (2013). Determinants of working capital investment: A study of Malaysian public listed firms. *Australasian Accounting, Business and Finance Journal*, *7*(2), 63–83. doi:10.14453/aabfj.v7i2.5
Zariyawati, M. A., Taufiq, H., Annuar, M. N., & Sazali, A. (2010, June 18–20). Determinants of working capital management: Evidence from Malaysia'. In *Financial theory and engineering: Proceedings of the 2010 international conference* (190–194). Dubai, UAE: IEEE Computer Society Press. doi:10.1016/j.antiviral.2009.09.001

Appendix

Table A1. Measures & determinants of working capital

S.No	Variable	Measure	Citation
1.	Net working capital	Current Assets—Current Liabilities/Total Assets * 100	Akinlo (2012a), Wasiuzzaman and Arumugam (2013), Singh and Kumar (2017), Nyeadi et al. (2019)
2.	Gross working Capital	Current Assets/Total Assets * 100	
3.	Nature of Business (NOB)	Dummy Variable- I for manufacturing companies and 0 for others	Akinlo (2012a), Onalapo and Sunday (2015), Banerjee (2017), Efinance Management (2018)
4.	Growth (GRW)	Natural Logarithm of Revenue in t period/ Revenue in the t-1 period	Nunn (1981), Akinlo (2012a), Kwenda and Holden (2014), D'Mello et al. (2008), Hill et al. (2010), Wasiuzzaman and Arumugam (2013), Manoori and Muhammad (2012), Salawu and Alao (2014), Azeem and Marsap (2015), Banos Caballero et al. (2010), Akinlo (2012b), Atseye et al. (2015), Singh and Kumar (2017), Nyeadi et al. (2019)
5.	Profitability (ROCE)	Return on Common Equity = Profit available to equity shareholders/ Shareholders funds or net worth	Myers and Majluf (1984), Nazir, 2009; Abbadi and Abbadi (2012) Lyngstadaas and Berg (2016), Onalapo and Sunday (2015), Shin and Soenen (1998), Petersen and Rajan (1997), Deloof (2003), Wasiuzzaman and Arumugam (2013), Manoori and Muhammad (2012), Azeem and Marsap (2015), Atseye et al. (2015), Banos Caballero et al. (2010), Fatimatuzzahra and Kusumastuti (2016), Azami and Tabar (2016), Singh and Kumar (2017), Nyeadi et al. (2019)
6.	Size	Natural Log of Total Assets	Atseye et al. (2015), Olayinka (2012), Wasiuzzaman and Arumugam (2013), Manoori and Muhammad (2012), Bereznicka (2014), Salawu and Alao (2014), Akinlo (2012a), Agyei, Oduro, and Ansong (2013), Fatimatuzzahra and Kusumastuti (2016), Lyngstadaas and Berg (2016), Onalapo and Sunday (2015), Mongrut, O'shee, Zavaleta, and Zavaleta (2014), Nazir (2009)
7.	Assets Tangibility (TANG	Net Fixed Assets to Total Assets	Banos-Caballero et al. (2010), Wasiuzzaman and Arumugam (2013), Shaista and Veeri (2013), Singh and Kumar (2017).
8.	Leverage (LEV)	Total Debt/Total Assets	Salawu and Alao (2014); Wasiuzzaman and Arumugam (2013), Azeem and Marsap (2015), Onalapo and Sunday (2015), Banos Caballero et al. (2010), Olayinka (2012), Abbadi and Abbadi (2012), Agyei et al. (2013), Akinlo (2012a), Elbadry (2018), Nazir (2009), Onalapo and Sunday (2015), Azami and Tabar (2016), Singh and Kumar (2017), Nyeadi et al. (2019)

(*Continued*)

S.No	Variable	Measure	Citation
9.	Revenue Volatility (REVVOL)	The coefficient of variation of net sales of the rolling period of 4 years	Wasiuzzaman and Arumugam (2013), Hill et al. (2010), Shaista and Veeri (2013)
10.	Operating Cash Flow (OCFA)	Operating cash flow (OCF) is measured as the earnings before interest and taxes (EBIT) plus depreciation and amortization minus interest expenses, tax, and common dividends. It is then scaled by revenue at time t-1.	Manoori and Muhammad (2012), Appuhami (2008), Chiou et al. (2006), Al Taleb et al. (2010), Nazir and Afza (2008), Shaista and Veeri (2013), Wasiuzzaman and Arumugam (2013), Atseye et al. (2015), Azeem and Marsap (2015), Atseye et al. (2015), Singh and Kumar (2017).
11.	Board Size (BOD)	Number of directors	Wasiuzzaman and Arumugam (2013), Shaista and Veeri (2013), Moussawi et al. (2006)
12.	Asymmetric Information (P/B)	The market Price to Book Value Ratio	Hill et al. (2010), Wasiuzzaman and Arumugam (2013), Shaista and Veeri (2013), Azami and Tabar (2016), Myers and Majluf (1984)
13.	Economic Condition (GDP)	Gross domestic product (GDP) growth rate of India	Azami and Tabar (2016), Emmanuel (2016), Manoori and Muhammad (2012), Atseye et al. (2015), Lamberson (1995), Akinlo (2012a), Lyngstadaas and Berg (2016), Olayinka, (2012), Nyeadi et al. (2019)

Source: Author's Compilations

Table A2. Summary statistics for working capital and its determinants

	NWC	GWC	BOD SIZE	GDP	GROWTH	LEV	NOB	OCFA	MTB	REVVOL	ROCE	SIZE	TANG
Mean	0.07	0.57	11.93	0.07	0.12	0.33	0.63	0.20	5.64	0.21	22.29	10.56	0.28
Median	0.03	0.59	11.00	0.07	0.12	0.24	1.00	0.13	4.28	0.19	16.86	10.42	0.23
Maximum	0.88	2.43	22.00	0.10	1.04	0.89	1.00	7.47	50.71	0.70	142.01	14.80	1.00
Minimum	−1.26	0.01	8.00	0.05	−0.85	-	-	−10.51	0.46	0.01	−38.18	6.91	0.00
Std. Dev.	0.31	0.33	2.90	0.01	0.15	0.32	0.48	1.01	5.55	0.11	21.69	1.64	0.23
Skewness	0.05	2.27	1.56	−0.61	−0.49	0.56	−0.55	−2.00	3.84	1.17	2.62	0.34	0.65
Kurtosis	4.05	14.10	5.71	3.01	13.02	1.82	1.31	62.07	24.41	5.49	12.84	2.59	2.80
Jarque-Bera	14.05	1,796.24	213.91	18.43	1,265.88	33.06	51.17	43,816.39	6,469.67	145.98	1,551.72	8.03	21.55
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Sum	21.30	170.43	3,579.00	21.8	36.84	100.38	190.00	61.18	1,692.6	61.99	6,688.44	3,169.4	83.23
Sum Sq. Dev.	28.58	31.97	2,509.53	0.05	7.08	29.97	69.67	305.27	9,195.16	3.83	1,40,716.50	804.27	15.77
Observations	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350

Source: Author's Calculations

Table A3. Correlation coefficients between variables and VIF coefficients

	NWC	GWC	BOD SIZE	GDP	GROWTH	LEV	NOB	OCFA	MTB	REVVOL	ROCE	SIZE	TANG	VIF
NWC	1.00	0.24	−0.00	−0.04	−0.00	−0.15	−0.19	−0.05	−0.18	−0.06	−0.07	0.06	−0.36	
GWC	0.24	1.00	0.09	0.00	0.03	−0.03	−0.19	−0.12	0.30	0.04	0.43	−0.07	−0.15	
BODSIZE	−0.00	0.09	1.00	0.02	−0.10	−0.13	0.24	0.06	−0.10	−0.12	−0.02	0.11	−0.23	1.360
GDP	−0.04	0.00	0.02	1.00	0.01	0.03	0.01	0.01	0.04	0.09	−0.01	−0.02	−0.04	1.018
GROWTH	−0.00	0.03	−0.10	0.01	1.00	0.14	−0.14	0.22	−0.05	0.34	−0.01	−0.00	−0.01	1.231
LEV	−0.15	−0.03	−0.13	0.03	0.14	1.00	−0.57	−0.02	−0.35	0.32	−0.34	0.72	−0.34	2.753
NOB	−0.19	−0.19	0.24	0.01	−0.14	−0.57	1.00	0.03	0.23	−0.24	0.15	−0.56	0.41	2.037
OCFA	−0.05	−0.12	0.06	0.01	0.22	−0.02	0.03	1.00	−0.03	−0.02	−0.07	−0.01	−0.04	1.083
MTB	−0.18	0.30	−0.10	0.04	−0.05	−0.35	0.23	−0.03	1.00	−0.06	0.68	−0.49	0.32	2.140
REVVOL	−0.06	0.04	−0.12	0.09	0.34	0.32	−0.24	−0.02	−0.06	1.00	−0.11	0.06	−0.12	1.375
ROCE	−0.07	0.43	−0.02	−0.01	−0.01	−0.34	0.15	−0.07	0.68	−0.11	1.00	−0.40	0.25	1.989
SIZE	0.06	−0.07	0.11	−0.02	−0.00	0.72	−0.56	−0.01	−0.49	0.06	−0.40	1.00	−0.51	2.989
TANG	−0.36	−0.15	−0.23	−0.04	−0.01	−0.34	0.41	−0.04	0.32	−0.12	0.25	−0.51	1.00	1.570

Source: Author's Calculations

Table A4. Panel unit root tests for the level of the variables

	NWC	GWC	BOD SIZE	GDP	GROWTH	LEV	NOB	OCFA	MTB	REVVOL	ROCE	SIZE	TANG
ADF													
Without C & T	−5.7601 (0.000)	−2.6495 (0.008)	−0.8713 (0.3379)	0.0007 (0.6821)	−1.7288 (0.0795)	−3.3190 (0.001)	−1.7993 (0.068)	−10.7643 (0.000)	−3.3087 (0.001)	−2.3140 (0.020)	−3.8196 (0.000)	−0.7581 0.3873	−2.8087 (0.005)
With C	−5.9478 (0.000)	−5.8769 (0.000)	−4.1596 (0.000)	−6.2911 (0.000)	−16.9742 (0.000)	−4.8144 (0.000)	−3.1515 (0.024)	−11.4767 (0.000)	−5.5427 (0.000)	−9.9599 (0.000)	−5.6541 (0.000)	−4.7484 (0.000)	−5.3560 (0.000)
With C & T	−6.0113 (0.000)	−5.9369 (0.000)	−4.2388 (0.004)	−6.3456 (0.000)	−16.9598 (0.000)	−4.8119 (0.000)	−3.1740 (0.091)	−11.4951 (0.000)	−5.8074 (0.000)	−9.5848 (0.000)	−5.7984 (0.000)	−4.9386 (0.000)	−5.3454 (0.000)
PP													
Without C & T	−5.6055 (0.000)	−2.1428 (0.0311)	−0.8727 (0.3373)	−1.4982 (0.1255)	−14.1810 (0.000)	−3.3983 (0.000)	−2.6948 (0.007)	−16.5331 (0.000)	−3.8694 (0.000)	−3.1375 (0.000)	−3.8196 (0.000)	−0.5257 (0.4884)	−3.0558 (0.002)
With C	−5.8127 (0.000)	−5.4949 (0.000)	−4.5543 (0.000)	−28.1973 (0.000)	−16.9882 (0.000)	−4.9012 (0.000)	−4.4809 (0.000)	−17.1392 (0.000)	−5.9233 (0.000)	−8.3514 (0.000)	−5.8482 (0.000)	−4.8674 (0.000)	−5.5155 (0.000)
With C & T	−5.8839 (0.000)	−5.4207 (0.000)	−4.5772 (0.001)	−29.1460 (0.000)	−16.9766 (0.000)	−4.8989 (0.000)	−4.5194 (0.001)	−17.2367 (0.000)	−6.1270 (0.000)	−8.3370 (0.000)	−5.7153 (0.000)	−5.1006 (0.000)	−5.5054 (0.000)

Source: Author's Calculations

Table A5. Model 1 (NWC) unrestricted cointegration rank test (trace value & maximum eigen value)

Hypothesized		Trace	0.05		Max		0.05	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.579934	742.4614	334.9837	0.0000	0.579934	255.8664	76.57843	0.0001
At most 1 *	0.372733	486.5950	285.1425	0.0000	0.372733	137.5828	70.53513	0.0000
At most 2 *	0.254455	349.0122	239.2354	0.0000	0.254455	86.62373	64.50472	0.0001
At most 3 *	0.184649	262.3885	197.3709	0.0000	0.184649	60.22047	58.43354	0.0330
At most 4 *	0.147339	202.1680	159.5297	0.0000	0.147339	47.02088	52.36261	0.1591
At most 5 *	0.138847	155.1471	125.6154	0.0002	0.138847	44.09747	46.23142	0.0833
At most 6 *	0.123619	111.0497	95.75366	0.0029	0.123619	38.92660	40.07757	0.0670
At most 7 *	0.089981	72.12307	69.81889	0.0324	0.089981	27.81543	33.87687	0.2221
At most 8	0.049599	44.30764	47.85613	0.1037	0.049599	15.00688	27.58434	0.7477
At most 9	0.038145	29.30076	29.79707	0.0570	0.038145	11.47300	21.13162	0.6001
At most 10 *	0.030985	17.82775	15.49471	0.0219	0.030985	9.285204	14.26460	0.2632
At most 11 *	0.028543	8.542550	3.841466	0.0035	0.028543	8.542550	3.841466	0.0035

Source: Author's Calculation

Table A6. Model 2 (GWC) unrestricted cointegration rank test (trace value & maximum eigen value)

Hypothesized	Eigenvalue	Statistic	Critical Value	Prob.**		Max-Eigen	0.05	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.581272	680.5220	285.1425	0.0000	0.581272	256.8072	70.53513	0.0001
At most 1 *	0.330892	423.7147	239.2354	0.0000	0.330892	118.5338	64.50472	0.0000
At most 2 *	0.236555	305.1810	197.3709	0.0000	0.236555	79.62470	58.43354	0.0001
At most 3 *	0.179879	225.5563	159.5297	0.0000	0.179879	58.49943	52.36261	0.0105
At most 4 *	0.143568	167.0569	125.6154	0.0000	0.143568	45.71917	46.23142	0.0567
At most 5 *	0.121564	121.3377	95.75366	0.0003	0.121564	38.23547	40.07757	0.0795
At most 6 *	0.097061	83.10222	69.81889	0.0030	0.097061	30.11956	33.87687	0.1317
At most 7 *	0.067928	52.98266	47.85613	0.0153	0.067928	20.75182	27.58434	0.2915
At most 8 *	0.048863	32.23084	29.79707	0.0257	0.048863	14.77873	21.13162	0.3047
At most 10 *	0.027190	8.132066	3.841466	0.0044	0.031100	9.320045	14.26460	0.2605

Source: Author's Calculations

Table A7. Determinants of net working capital as per OLS, FMOLS and DOLS

	OLS		FMOLS		DOLS	
Explanatory variables	**Model-1**	**T Statistics**	**Model-1**	**T Statistics**	**Model-1**	**T Statistics**
	NWC		**NWC**		**NWC**	
CONSTANT	0.686	7.945* (0.00)	0.6759	1.7712*** (0.0776)	0.5677	0.92000 (0.3584)
BOD SIZE	−0.012	−2.102** (0.036)	—	—		
GDP	—	—	—	—		
GROWTH	—	—	—	—		
LEV	−0.490	−8.078* (0.000)	− 0.5772	−4.1292* (0.000)	−0.5834	−3.3739* (0.000)
NOB	−0.156	−3.717* (0.000)	−0.1668	2.1108** (0.0356)		
OCFA	—	—	—	—		
MTB	−0.010	−3.407* (0.000)	—	—		
REVVOL	—	—	—	—		
ROCE	—	—	—	—		
SIZE	—	—	—	—		
TANG	−0.534	−6.677* (0.000)	−0.5656	−3.8899* (0.000)	−0.5712	−3.2429* (0.000)
R	0.546					
R Square	0.308		0.2930		0.3816	
Adj. R Square	0.286		0.2659		0.3081	
Anova	24.916 (0.000)					
Durbin Watson	1.596					

Source: Authors calculation with Eviews

Source: Authors Calculations

Note: P value is presented in parentheses.

* The coefficient is significant at 1 per cent level.

** The coefficient is significant at 5 per cent level.

*** The coefficient is significant at 10 per cent level.

Table A8. Determinants of gross working capital as per OLS, FMOLS and DOLS

	OLS		FMOLS		DOLS	
Explanatory variables	**Model-2**	**T Statistics**	**Model-2**	**T Statistics**	**Model-2**	**T Statistics**
	GWC		**GWC**		**GWC**	
CONSTANT	0.844	4.916* (0.000)	0.5874	1.7880*** (0.0748)	0.6326	1.1674 (0.2441)
BOD SIZE	0.016	2.642* (0.009)	0.0199	2.1470** (0.0326)	—-	———-
GDP	—	—	—	—		
GROWTH	—	—	—	—		
LEV	—	—	—	—		
NOB	−0.221	−4.945* (0.000)	−0.1993	−2.9298* (0.0037)	−0.2013	−2.2724** (0.0239)
OCFA	—	—	−0.0461	−1.9975** (0.0492)	−0.1130	−2.1080** (0.0360)
MTB	—	—	0.01222	2.0233** (0.0440)		
REVVOL	—	—	—	—		
ROCE	0.007	8.308* (0.000)	0.00582	3.9117* (0.000)	0.0061	2.6160* (0.009)
SIZE	−0.040	−2.951* (0.003)	—	—		
TANG	−0.274	−3.229* (0.001	−0.3325	−2.6561* (0.008)	−0.3139	−1.9823** (0.0476)
R	0.574					
R Square	0.339		0.3381		0.428	
Adj. R Square	0.315		0.2919		0.378	
ANOVA	23.968 (0.000)					
Durbin Watson	1.3465					

Source: Authors Calculations

Note: P value is presented in parentheses.

* The coefficient is significant at 1 per cent level.

** The coefficient is significant at 5 per cent level.

*** The coefficient is significant at 10 per cent level.

Table A9. Two-step GMM estimation of the models

Explanatory Variables	NWC (MODEL1)	GWC (MODEL2)
(Constant)	0.385935** (0.0111)	0.27595*** (0.0762)
Δ NWC-1 & Δ GWC-1	0.5672* (0.000)	0.80033* (0.000)
BOD Size	−0.022455 (0.7344)	0.02471* (0.000)
GDP	−1.62221* (0.000)	0.02812 (0.9452)
Growth	0.03813 (0.1524)	−0.02791 (0.6546)
OCFA	−0.00065 (0.8915)	0.00984* (0.000)
Profitability (ROCE)	0.00213* (0.001)	−0.00342** (0.0225)
Asymmetric Information (P/B)	−0.00042 (0.5678)	0.012471* (0.000)
Leverage	0.20669*** (0.0728)	−0.89822* (0.000)
Revenue Volatility	−0.07653 (0.3993)	0.12346 (0.2955)
Tangibility	−0.38101* (0.000)	0.15899 (0.1560)
Size	−0.03361 (0.3286)	0.16011* (0.000)
Correlation1	−0.5558** (0.0444)	−3.4675 (1.000)
Correlation 2	0.2896 (0.1940)	0.4187 (1.000)
Sargan test or J Statistics (df)	20.20069 (1) (0.2640)	19.81940 (1) (0.3430)
No. of Companies	150	150
Observations	1350	1350

Source: Author's Calculation with Eviews

Note: P value is presented in parentheses.

* The coefficient is significant at 1 per cent level.

** The coefficient is significant at 5 per cent level.

*** The coefficient is significant at 10 per cent level.

Table A10. Acceptance and rejection of hypothesis

S.No	Hypothesis	Acceptance or Rejection							
		OLS		FMOLS		DOLS		GMM	
		NWC	GWC	NWC	GWC	NWC	GWC	NWC	GWC
Ha1	Leverage has a significant negative influence on the level of working capital.	Accepted	Rejected	Accepted	Rejected	Accepted	Rejected	Accepted	Accepted
Ha2	Growth opportunity has a significant impact on the level of Working capital.	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected
Ha3	Level of asymmetric information has negative impact on the future working capital requirement of the firm.	Accepted	Rejected	Rejected	Accepted	Rejected	Rejected	Rejected	Rejected
Ha4	Nature of business has negative influence on the future requirements of working capital in BSE listed companies.	Accepted	Accepted	Accepted	Accepted	Rejected	Accepted	Rejected	Accepted
Ha5	Size or Capital Market Access has positive impact on the future working capital requirement.	Rejected	Accepted	Rejected	Rejected	Rejected	Rejected	Rejected	Accepted
H6a	Asset Tangibility has negative impact on the future working capital requirement of the firm.	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Rejected
H7a	Revenue Volatility has negative impact on the future working capital requirement of the firm.	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected
H8a	Profitability has positive influence on the future requirements of working capital in BSE listed companies.	Rejected	Accepted	Rejected	Accepted	Rejected	Accepted	Accepted	Accepted
H9a	Operating cash flow has significant influence (positive or negative) on the future requirements of working capital in BSE listed companies.	Rejected	Rejected	Rejected	Accepted	Rejected	Accepted	Rejected	Accepted

(*Continued*)

Table A10. (*Continued*)

S.No	Hypothesis	Acceptance or Rejection							
		OLS		FMOLS		DOLS		GMM	
		NWC	GWC	NWC	GWC	NWC	GWC	NWC	GWC
H10a	Board Characteristics or Board Size has significant influence on the future requirements of working capital in BSE listed companies.	Accepted	Accepted	Rejected	Accepted	Rejected	Rejected	Rejected	Accepted
H11a	Economic conditions significantly affect the future requirements of working capital in BSE listed companies.	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Accepted	Rejected
H12a	Lagged value of dependent variable (NWC and GWC) positively significantly affect future requirement of working Capital (Only for GMM)	NA	NA	NA	NA	NA	NA	Accepted	Accepted

Source: Author's compilation

© 2020 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

You are free to:
Share — copy and redistribute the material in any medium or format.
Adapt — remix, transform, and build upon the material for any purpose, even commercially.
The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:
Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made.
You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
No additional restrictions

You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

***Cogent Economics & Finance* (ISSN: 2332-2039) is published by Cogent OA, part of Taylor & Francis Group.**

Publishing with Cogent OA ensures:

- Immediate, universal access to your article on publication
- High visibility and discoverability via the Cogent OA website as well as Taylor & Francis Online
- Download and citation statistics for your article
- Rapid online publication
- Input from, and dialog with, expert editors and editorial boards
- Retention of full copyright of your article
- Guaranteed legacy preservation of your article
- Discounts and waivers for authors in developing regions

Submit your manuscript to a Cogent OA journal at www.CogentOA.com