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*Corresponding author: Haroon Hussain, Noon Business School, University of Sargodha, Pakistan
E-mail: ranaharoonhussain@gmail.com

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Stirling, United Kingdom

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Impact of firm characteristics and ownership structure on firm efficiency: evidence from non-financial firms of Pakistan

Shafaat Muhammad Habib¹, Haroon Hussain^{2*}, Mamdouh Abdulaziz Saleh Al-Faryan³ and Rana Yassir Hussain⁴

Abstract: This study aims to examine the impact of firm characteristics and ownership structure on the firm efficiency of listed non-financial firms in Pakistan from 2012 to 2017. Firm characteristics include market capitalization, cash holdings, book-to-market ratio and negative book-to-market ratio and ownership structure includes insider ownership, institutional ownership and concentration ownership while controlling for firm size, profitability, leverage and age. Data related to firm efficiency, cash holdings, book-to-market ratio and negative book-to-market ratio was collected from Financial Statement Analysis published by SBP whereas data related to market capitalization and ownership structure (insider ownership, institutional ownership and concentration ownership) was collected from business recorder and published annual reports respectively. At first stage the firm efficiency is reported by using DEA CRS approach and results show that the year 2014 was the best year because 24% firms were efficient and 2015 was the worst because only 18% firms were efficient. The results also show that textile, sugar, food, manufacturing, chemical & pharmaceuticals, cement, motor vehicle, information communication & transportation are the poor performing sectors of Pakistan. This inefficiency might be due to the inefficient use of resources as agency theory advocates. Then at second stage, the correlation and variance inflation factor did not show any multicollinearity. Tobit model is used to find the regression results. The regression results show that market capitalization, cash holdings and concentration ownership positively and significantly influence the firm efficiency. Negative book-to-market ratio, insider ownership and institutional ownership negatively and significantly influence the firm efficiency whereas the book-to-market ratio is insignificant with the firm efficiency. It might be due to the self-interest by the insider and institutional ownership. This study is also helpful for the investors. They can choose the efficient firm for investment and to avoid the inefficient firms to stay away from the losses.

Subjects: Finance; Business, Management and Accounting; Industry & Industrial Studies

Keywords: firm Efficiency; DEA; cash holdings; book-to-market ratio; negative book-to-market ratio

1. Introduction

Almost all organizations in the world are in a combat to win its supreme objective means increase its profit through growth in its sales. This corporate goal can be achieved by formulating the right plans pulled together with required resources and usage of these resources for implementation and achievement of objective. Considering truly that the resources are scarce, they are needed to be utilized efficiently. Ability of a firm to produce maximum output by investing least amount of input will maximize the efficiency of firm. So efficiency is extremely important issue both for public and private policy makers (Sufian & Majid, 2007).

In the recent era, it is extremely important for organizations to be efficient in their operations. Efficiency is the ability of converting inputs to outputs, directly affect the costs and consequently profits and capital investments (Neda & Sowlati, 2006). To measure the efficiency many researchers conducted different studies. Farrell (1957) was the pioneer researcher who measured the efficiency of the firm by a single input and single output. Later on his work was extended by Charnes et al. (1978) called as CCR in which multiple inputs were taken against the multiple outputs. In 1984 it was further extended by Banker, Charnes and Cooper and it was known as BCC model. In this model a set of decision-making units provide different inputs and outputs to examine efficiency.

According to the Pakistan Economic Survey 2018–19, the muted growth has been recorded at 3.29% against target of 6.2%. This target was based upon agriculture 3.8%, industry 7.6% and service 6.5% whereas the actual growth was agriculture 0.85% (witnessed negative growth in production of cotton, rice and sugarcane), industry 1.4% (decline in textile, food, beverage & tobacco, coke & petroleum, pharmaceutical, chemicals, mineral products, automobiles and iron & steel) and service 4.7%. Likewise, Pakistan was ranked at 107 and 110 among 140 and 141 countries respectively for the years 2018 and 2019 in terms of governance quality by the Global Competitiveness index (The Global Competitiveness Report, 2018 & 2019). It indicates that low output growth may be a result of poor governance quality in Pakistan. This low output shows that there is a problem of firm efficiency in non-financial sector of Pakistan.

Many past studies have reported the firm efficiency by using different mixes of input and output variables (Ahmadi & Ahmadi, 2012; Akgöbek & Yakut, 2014; Bayyurt & Gokhan, 2008; Boussofiane et al., 1991; Dyson et al., 2001; Mahajan et al., 2014; Memon & Tahir, 2011; Y. S. Chen & Chen, 2011; Wang & Lan, 2011). In addition, others have reported the significant determinants of firm efficiency such as leverage (Cheng & Tzeng, 2011; Margaritis & Psillaki, 2007), corporate governance (Bozec et al., 2010; Khan et al., 2018), ownership structure (Abbas et al., 2013) and stock prices (Berger & Humphrey, 1992; Fiordelisi, 2007; Liadaki & Gaganis, 2010; Gaganis et al., 2013; Chan & Karim, 2014), stock return (Alam & Sickles, 1998; Beccalli et al., 2006; Guzman & Reverte, 2008; Hirshleifer et al., 2013; Nguyen & Swanson, 2009). Among these determinants, some measures of firm characteristics have not been given attention. For instance, the impact of market capitalization, cash holdings, book-to-market ratio and negative book-to-market ratio on firm efficiency has not been paid heed to.

Different types of ownership structures such as insider ownership, institutional ownership and concentration ownership have been taken into account to measure the effect on efficiency in the past (Berle & Means, 1932; Denis et al., 1999; Jensen & Meckling, 1976; King & Santor, 2008; Lemmon & Lins, 2003; Saunders et al., 1990; Shleifer & Vishny, 1986; Stein, 1989). In past studies this relationship has been examined for well-developed economies whereas this study is going to examine this relation by taking all these three types of ownership structures for Pakistani non-financial firms.

2. Literature review

EfficiencyFollowing the Farrell, Charnes et al. (1978) developed Data Envelopment Analysis for comparative efficiency assessment and resolved the problem of the multiple inputs and multiple outputs and later on it was named as CCR model (Charnes-Cooper-Rhodes). The objective function was to maximization one ratio. Boussofiane et al. (1991) introduce the ways and techniques to

resolve basic issues that can create problems in the application of the DEA. Dyson et al. (2001) focused on many procedural problems and presented applicable protocols to remove the problems. Bayyurt and Gokhan (2008) compared the relative efficiencies of manufacturing firms of China and Turkey. They found that Chinese manufacturing firms are more efficient whereas the Turkish manufacturing firms are efficient on average.

Bozec et al. (2010) investigated the association between governance and performance of firm. Data from 2001–2005 was collected in Canada published by Global and Mail. The results showed that better corporate governance organizations are more efficient. In a study covering the period from 1990 to 2001 in Indonesia used DEA to measure the firm efficiency of 23 manufacturing organizations for a period of twelve year. Researcher used employees and core capital as input variables and dollar value added and value of production as output variables. He concluded that 20 out of 23 sectors are inefficient (Saputra, 2011). In a previous study 2011, Chen & Chen find out the operational performance by taking total assets (both current and fixed assets), operating cost (raw material cost plus labor cost) and selling/marketing & administrative cost (salaries of employees and their expenditures on sales promotion) as input variables and net sales (sales revenues less sales returns and allowances) as output variables to raise its share in the global market. They concluded that CRS and VRS should be improved rather than scale efficiency.

In the period from 2008 to 2010, a study was conducted to evaluate the efficiency of 49 Pakistani manufacturing companies. They used DEA model which was input-oriented having CRS and VRS, they used cost of goods sold, plant & machinery, staff expenses and raw material as input variables and earnings after tax and net sales as output variables. The results indicate that 16% companies were regularly operating at most productive scale size throughout the period and 20% companies have operated at least once at the MPSS in the said period. The results showed that inefficient companies, on average, should minimize their inputs than prime practicing companies (Memon & Tahir, 2011).

2.2. Market capitalization

Many researchers found positive and significant association between firm profit efficiency and stock prices (Berger & Humphrey, 1992; Chan & Karim, 2014; Fiordelisi, 2007; Gaganis et al., 2013; Liadaki & Gaganis, 2010; Sufian & Majid, 2007), stock return and technical efficiency (Alam & Sickles, 1998), stock return and operational efficiency (Beccalli et al., 2006), shareholders value and productive efficiency (Guzman & Reverte, 2008), stock return and relative efficiency (Nguyen & Swanson, 2009), stock return and innovative efficiency (Hirshleifer et al., 2013). In past a number of researchers showed negative association between firm cost efficiency and stock prices (Chan & Karim, 2014; Clark, 1996; Fiordelisi, 2007). Few researchers found no relationship between firm cost efficiency and stock prices (Gaganis et al., 2013; Liadaki & Gaganis, 2010). The stock prices have mixed results with the efficiency.

In past studies researchers examined the association of stock prices and stock return on profit efficiency, cost efficiency, technical efficiency, operational efficiency, productive efficiency, relative efficiency, innovative efficiency, firm performance and firm value. If stock price and/or stock return have some relationship with different kinds of efficiency, so there might be some relationship between market capitalization and firm efficiency. The current study tries to explore the relationship between market capitalization and firm efficiency.

The main contribution of the current study is to find the impact of market capitalization on firm efficiency. According to the best of my knowledge no past study has examined the impact of market capitalization on firm efficiency by taking the net sales as output variable and total assets, operating cost and selling & admin cost as input variables (Y. S. Chen & Chen, 2011). So this study will found the affect of market capitalization on the efficiency of Pakistani non-financial firms.

H₁. The market capitalization affects the efficiency of Pakistani non-financial firms.

2.3. Cash holdings

The cash holdings measure the firm's ability to meet its short-term obligations. Many researchers showed the positive impact of cash holdings on efficiency (Afza & Asghar, 2017; Nguyen & Swanson, 2009), firm performance (Daniel et al., 2004; Deb et al., 2017; Ebben & Johnson, 2011; Faulkender & Wang, 2006; George, 2005; Kim & Bettis, 2014; Wang, 2002), Profitability (Bromiley, 1991; governance (Dittmar & Mahrt-Smith, 2007; C. Lee & Park, 2016), firm value (Bourgeois, 1981; Levinthal, 1997), financial constraints (C. Lee & Park, 2016), distress (Thompson, 1967), growth and exploration via innovation, experimentation and new entry (George, 2005; Mishina et al., 2004). A large number of researchers found negative impact of cash holdings on firm performance such as (Deloof, 2003; Harford et al., 2008; Jensen, 1986; Shin & Soenen, 1998; Wang, 2002), Shareholders wealth (E. Lee & Powell, 2011), governance (Schauten et al., 2013), NPV & transfer pricing (Dittmar et al., 2003; Frésard & Salva, 2010; Opler et al., 1999; Pinkowitz et al., 2006), information asymmetry (Chung et al., 2015), profitability (Deephhouse & Wiseman, 2000), share-holders protection (Kalcheva & Lins, 2007). Few numbers of researchers could not found any association between cash holdings and firm performance (Tan & Peng, 2003), investment behavior (Sheu & Lee, 2012), profitability (Deephhouse & Wiseman, 2000).

In all of the above discussion, the associations of many variables have been examined with the cash holdings. Most variables have positive association with the cash holdings which is consistent with the transactional theory perspective. Some variables have negative association with cash holdings which is consistent with the perspective of agency theory and few have no association. The impact of cash holdings on the firm efficiency is very scarce in literature. Just two studies I could found in literature where association of cash holdings is examined with firm efficiency. Nguyen and Swanson (2009) considered the portfolio efficiency as firm efficiency and Afza and Asghar (2017) measured the efficiency by taking labor, business services, and physical capital as input variables and advances, deposits and investment as output variables in Pakistani banking sector. The current study is different from previous studies because this study uses the total assets, operating cost and selling & admin cost as input variables and net sales as output variable (Y. S. Chen & Chen, 2011). The second difference is that current study addresses all non-financial listed Pakistani firms. For doing so, current study has developed a hypothesis:

H₂. The cash holdings affect the efficiency of Pakistani non-financial firms.

2.4. Books-to-market ratio

The association of growth stock with value stock (Capaul et al., 1993), earning management (Chi & Gupta, 2009), stock return (Badertscher, 2011; Kothari et al., 2006; Trecartin, 2001), stock volatility (Aggarwal et al., 1999; Arouri et al., 2010; Gursoy et al., 2008), earning restatement (Marciukaityte & Varma, 2008), earning disappointment (Skinner & Sloan, 2002), risk (Petkova and Zhang 2003), skewness of stock return (Zhang, 2013), investors expectations (Marciukaityte & Varma, 2008), investor protection (Chen et al., 2014; Klein, 2002; La Porta et al., 2000), assets growth (Cooper et al., 2008), short-term changes in aggregate stock prices (Campbell et al., 2010), leverage (L. Chen & Zhao, 2006), economic growth (Cole et al., 2008; Liew & Vassalou, 2000), performance of market value (Cummins, 2002), cost efficiency (Jordan et al., 2011; Simoens & Vander Vennet, 2021).

In the above studies, book-to-market ratio has been discussed with many variables but its relationship with the efficiency is very scarce in literature. Only the cost efficiency has been discussed in few studies which show positive relationship between book-to-market and cost efficiency (Jordan et al., 2011; Simoens & Vander Vennet, 2021). The current study intends to examine the impact of book-to-market ratio with the firm efficiency. The second contribution of

this study is that this relationship has not been examined in non-financial listed firms in Pakistan. So the current study has developed a hypothesis.

H₃. The book-to-market ratio affects the efficiency of Pakistani non-financial firms.

2.5. Negative book-to-market ratio

Fama & French (1992) argued that negative book-to-market ratio is the consistent poor earning and distress. In the current study negative book-to-market ratio is considered as distress because these firms cannot generate enough proceeds to meet operational and financial expenses. Shortly, distress is the negative connotation that shows the firms inefficiency to fulfill their obligations on time (Gordon, 1971; Platt & Platt, 2002) and researchers agreed that distress causes the firm performance negatively (Farooq & Nazir, 2012; Opler & Titman, 1994; Pindado & Rodrigues, 2005; Stulz, 1990).

Few researchers found positive association between distress and firm efficiency (Kahl, 2002; Makridakis, 1991; Ofek, 1993), distress firms and control efficiency of management by Gilson (1989) and financial distress improves the organizational efficiency by pushing managers to take decision regarding value maximizing choices (Jensen, 1989; Wruck, 1990) and consequently the firm efficiency. Many studies in past explored the impact of distress in the context of well-developed nations while least amount of intention was given to the developing countries like Pakistan. Current study tried to examine the impact of distress on the firm efficiency to fill the gap. In the light of above, it is hypothesized that negative book-to-market affects the efficiency of Pakistani non-financial firms.

H₄. The negative book-to-market ratio affects the efficiency of Pakistani non-financial firms.

2.6. Insider ownership

In the past studies suggested that there is negative association between insider ownership and firm efficiency (Berle & Means, 1932; Denis et al., 1999; Jensen & Meckling, 1976; Lemmon & Lins, 2003; Saunders et al., 1990). A number of researchers found positive association between insider ownership and firm performance (James, 1999; King & Santor, 2008; Shleifer & Vishny, 1986; Stein, 1989). Denis et al. (1999) documented that if insider have owned large amount of equity ownership, the efficiency can be improved. The above studies examined the impact of insider ownership on firm performance and these studies were related to well-developed market while least amount of intention was given to the developing markets like Pakistan. The current study tried to examine this relationship between insider ownership and firm efficiency in non-financial listed firm in Pakistan. In the light of above, it is hypothesized that insider ownership affects the efficiency of Pakistani non-financial firms.

H₅. The insider ownership affects the efficiency of Pakistani non-financial firms.

2.7. Institutional ownership

The results of a number of researchers showed positive relationship between institutional ownership and firm performance (Alfaraih et al., 2012; Duggal & Millar, 1999; Han & Suk, 1998; McConnell & Servaes, 1990; Shleifer & Vishny, 1986; Tsai & Gu, 2007). Few researchers found the negative impact of institutional ownership and firm performance (Bhattacharya & Graham, 2007; Charfeddine & Elmarzougui, 2010). Empirical studies show inconsistent results about affect of institutional ownership on firm performance (Agrawal & Knoeber, 1996; AL-Najjar, 2015; Chaganti & Damanpour, 1991; Demsetz & Lehn, 1985; Demsetz & Villalonga, 2001; Loderer & Martin, 1997; McConnell & Servaes, 1990; Seifert et al., 2005). The above research studies examined the impact of institutional ownership

on firm performance and these studies were related to well-developed markets while least amount of intention was given to the developing markets like Pakistan. The current study tried to examine this relationship between institutional ownership and firm efficiency in non-financial listed firm in Pakistan. Due to the mixed results by the different researchers, current study is addressing the impact of institutional ownership on the efficiency of Pakistani non-financial firms.

H₆. The institutional ownership affects the efficiency of Pakistani non-financial firms.

2.8. Concentration ownership

Many researchers found positive association between ownership structure and firm efficiency (see, Bolton & Von Thadden, 1998; Jiraporn & Gleason, 2007; Pedersen & Thomsen, 2003; Short, 1994). Concentrated ownership can also have negative influence on firm performance (Barclay & Holderness, 1989; Stulz, 1988) described that controlling shareholders may involve in such activities that their personal benefit will be maximize. Previous studies also showed that concentrated ownership have no significant effect on firm performance (Demsetz & Lehn, 1985; Kole & Lehn, 1997). The above research studies examined the impact of concentration ownership on firm performance and these studies were related to well-developed markets while least amount of intention was given to the developing markets like Pakistan. The current study tried to examine this relationship between concentration ownership and firm efficiency in non-financial listed firm in Pakistan. In the light of above mixed results, it is hypothesized that concentration ownership impacts the efficiency of Pakistani non-financial firms.

H₇. The concentration ownership affects the efficiency of Pakistani non-financial firms.

3. Data & methodology

3.1. Population, sample and data collection

All non-financial firms in Pakistan which are listed on Pakistan Stock Exchange are considered as population. All listed non-financial firms in Pakistan whose data is available according to the variables of the study and continued their operation from 2012 to 2017 are taken as sample. Using panel data from 2012 to 2017, 188 firms are taken as sample because of availability of data with 1128 observations.

Only secondary data is collected for the purpose of this study. Data is collected from published audited annual reports of the firms and Financial Statement Analysis of Companies (Non-Financial) Listed at Pakistan Stock Exchange (2012–2017) published by the State Bank of Pakistan. Share prices data is collected from the website of the business recorder.

3.2. Econometric models

This study used two-way analysis. At first stage DEA is used to report the firm efficiency and at second stage tobit model is used to find the regression results.

3.2.1. DEA

For efficiency DEA is used in this study which is a technique of linear programming originated by the Farrell (1957). Later on his work was extended by Charnes et al. (1978) in which multiple inputs were taken against the multiple outputs. Charnes et al. (1978) formulated and presented this model that is why it is called as CCR. In 1984 it was further extended as known as BCC model. In this model a set of decision-making units provides different inputs and outputs to examine efficiency (Abbas et al., 2013; Y. S. Chen & Chen, 2011). The efficiency is measured with the help of following equation.

$$\text{Max } E_j = \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \quad (1)$$

$$\text{Subject to (a.) } \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1 \quad (2)$$

$$(b.) u_r, v_i \geq 0 \quad (3)$$

Where

$r = r$ th output, $r = 1, \dots, s$;

$i = i$ th input, $i = 1, \dots, m$;

$j = j$ th firm, $j = 1, \dots, n$;

E_j = objective measure of efficiency for j th firm;

j = a specific firm to be evaluated;

y_{rj} = the amount of output r from firm j ;

x_{ij} = the amount of input i to firm j ;

u_r = weight chosen for output r ;

v_i = weight chosen for input i ;

n = the number of firms;

s = the number of outputs;

m = the number of inputs.

3.2.2. Tobit model

The results of efficiency scores are in the range from 0 to 1. So there is limit on the dependent variable. To tackle this problem Tobit regression model is used. Tobit model is the extension of probit model originally formulated and developed by the Nobel laureate economist James Tobin. Tobin (1958) examined the relationship between household expenditure on the durable goods and household income. He noted that a linear function cannot be modeled due to many observations in the expenditure were zero. A sample is known as censored sample in which information related to regressand is available only for some observations. He developed a model to handle this censoring issue. Therefore, Tobit model is known as censored regression model. It is also known as limited dependent variable regression model because it puts on restriction on regressand values. Tobit regression is used for the purpose of analysis because the nature of data is sensory.

$$E_{it} = \alpha + \beta_1 MC_{it} + \beta_2 CH_{it} + \beta_3 BM_{it} + \beta_4 NBM_{it} + \beta_5 IO_{it} + \beta_6 Inst O_{it} + \beta_7 CO_{it} + \beta_8 FS_{it} \\ + \beta_9 FP_{it} + \beta_{10} FL_{it} + \beta_{11} FA_{it} + e_i \quad (4)$$

E_{it} is the efficiency score of the individual firm i in the relevant year t .

MC_{it} is the market capitalization of the relevant firm of the relevant year.

CH_{it} is the cash holdings of the relevant firm of the relevant year.

BM_{it} is the book to market ratio of the relevant firm of the relevant year.

NBM_{it} is the negative book to market ratio of the relevant firm of the relevant year.

IO_{it} is the insider ownership of the relevant firm of the relevant year.

$InstO_{it}$ is the institutional ownership of the relevant firm of the relevant year.

CO_{it} is the concentration ownership of the relevant firm of the relevant year.

FS_{it} is the firm size of the relevant firm of the relevant year.

FP_{it} is the firm profit of the relevant firm of the relevant year.

FL_{it} is the firm leverage of the relevant firm of the relevant year.

FA_{it} is the firm age of the relevant firm of the relevant year.

3.3. Operational definition of variables

The following section provides Table 1 for input and output variables for efficiency and Table 2 for operational definition of variables. Firm efficiency was calculated by measuring technical efficiency using DEA (Data Envelopment Analysis). The input and output variables were used following the previous studies (Hussain, 2022; Hussain et al., 2022; Y. S. Chen & Chen, 2011). The input/output-oriented approach is preferable over using only sales as proxy for firm efficiency because it also considers the expenditures made in order to obtain the sales figures. By using such a measure of firm efficiency is Input and output variables are used following the previous studies (Hussain, 2022; Hussain et al., 2022; Margaritis & Psillaki, 2007; Y. S. Chen & Chen, 2011), where net sales which is used as output of the inputs such as total assets, operating cost and selling and administrative costs.

4. Results and discussion

4.1. Efficiency tables and interpretation

Table 3 provides the details of efficient as well as inefficient firms both sector wise and year wise.

4.1.1. Efficiency scores (Sector Wise)

The sector wise firm efficiency scores have been given in Table 3. The twelve sectors are included in the study and having 188 non-financial firms in total with 1128 observations. In this study the number of inputs is three and number of output is one. So the number of firms in a sector should

Table 1. Input and output variables for efficiency

Input Variables	Notation	Output Variable	Notation
Total Assets	TA	Net Sales	NS
Operating Cost	OC		
Selling & Adm. Cost	SA		

Note: Input and output variables are used following the Y. S. Chen and Chen (2011) where NA represents Net Sales which is measured as Sales revenues less sales returns and allowances, TA represents total assets measured as total current and non-current assets at the end of year, OC represents operating cost which is measured as total cost on raw material and labor, SA represents Selling & Adm. Cost which is measured as cost of employee salaries and sale promotion expenditures.

Table 2. Operational definitions of the variables

Variables	Notation	Measurement	Author
Efficiency (DV)	E	Provided in Table 1	Y. S. Chen and Chen (2011)
Market Capitalization (IV)	MC	Log of the market value of equity. Market value defined as the number of shares outstanding times the price of each share.	Krüger et al. (2015)Lins et al. (2017)
Cash Holdings (IV)	CH	Measured as cash and short-term investment divided by assets.	Lins et al. (2017) Afza and Asghar (2017)
Book to Market Ratio (IV)	BM	Book value of equity divided by market value of equity	Lins et al. (2017) Fernando et al. (2012)
Negative B/M Ratio (IV)	NBM	Dummy variable set to one when the book to market ratio is negative and zero otherwise	Lins et al. (2017)
Insider Ownership (IV)	IO	Percentage of ordinary shares owned by the directors, managers, spouse, children and chief executives.	Hussain (2022)
Institutional Ownership (IV)	Inst O	Percentage of shares held by financial institutions	Tsai and Gu (2007) Charfeddine and Elmarzougui (2010)
Concentration Ownership (IV)	CO	Percentage shares owned by ten largest shareholders.	Abbas et al. (2013) Gonzalez et al. (2017)
Firm Size (CV)	FS	Measured by the (logarithm of) total assets of the company	Shan and Xu (2011)
Firm Profitability (CV)	FP	Firm profitability is measured as return on common equity.	Abbas et al. (2013)
Firm Leverage (CV)	FL	Total debts to total assets	Shan and Xu (2011)
Firm Age (CV)	FA	Measures the number of years since initial listing	Shan and Xu (2011)

exceed from the product of inputs and outputs (Boussofiene et al., 1991). So all those non-financial sectors have not been included in the current study which has less than four firms and those whose complete data according to the variables of the study could not be collected such as fuel & energy, woolen, real estate, glass & ceramics, synthetic and other services, etc. In the current study only those firms were considered efficient whose efficiency score was exact 1 and those firms were considered inefficient whose efficiency score was less than 1.

In textile sector only 9% firms were efficient in 2017 and this ratio is too low in the previous years. In sugar sector only 36% firms were efficient in 2014 and in 2017 this ratio was only 14%. In food sector 43% firms were efficient in first three years of the study and in 2016. In chemical and pharmaceutical sector top performing year was 2014 with only 27% efficient firms. In manufacturing firms top score was 28% in 2013. In the mineral sector the condition was better showing 75% efficient firms in 2012 and 2014. In cement sector top score was 44% in the 2012. In motor vehicle sector highest score was in 2015 with the 31% efficient firms. In information, communication and transportation highest score was 33% in the years 2012, 2014 and 2017. In coke and refinery sector efficient firms were 100% in 2014 whereas the lowest score was 50% in 2013. In

Table 3. Sector wise firm efficiency scores

	2012	2013	2014	2015	2016	2017
Textile (All)						
Efficient	6%	4%	4%	4%	8%	9%
Inefficient	94%	96%	96%	96%	92%	91%
Sugar						
Efficient	29%	29%	36%	14%	29%	14%
Inefficient	71%	71%	64%	86%	71%	86%
Food						
Efficient	43%	43%	43%	29%	43%	14%
Inefficient	57%	57%	57%	71%	57%	86%
Chemical & Pharmaceuticals						
Efficient	6%	21%	27%	6%	15%	15%
Inefficient	94%	79%	73%	94%	85%	85%
Manufacturing						
Efficient	22%	28%	11%	11%	6%	6%
Inefficient	78%	72%	89%	89%	94%	94%
Minerals						
Efficient	75%	50%	75%	50%	25%	25%
Inefficient	25%	50%	25%	50%	75%	75%
Cement						
Efficient	44%	25%	19%	25%	38%	31%
Inefficient	56%	75%	81%	75%	62%	69%
Motor Vehicle, Trailers & Autoparts						
Efficient	25%	25%	19%	31%	25%	25%
Inefficient	75%	75%	81%	69%	75%	75%
Inform. Comm. & Transportation						
Efficient	33%	17%	33%	17%	17%	33%
Inefficient	67%	83%	67%	83%	83%	67%
Coke & Refined Petroleum						
Efficient	75%	50%	100%	75%	75%	75%
Inefficient	25%	50%	0%	25%	25%	25%
Paper & Paper Board						
Efficient	60%	40%	80%	80%	80%	60%
Inefficient	40%	60%	20%	20%	20%	40%
Electrical Machinery						
Efficient	60%	80%	60%	60%	80%	80%
Inefficient	40%	20%	40%	40%	20%	20%

paper and paper board sector, the efficient firms were 80% in consecutive three years from 2014 to 2016. In machinery sector highest score about efficient firm was 80% in 2013, 2016 and 2017.

4.1.2. Efficiency scores (Year Wise)

In the comparison of all sectors in 2012 minerals and coke & refinery were considered as most efficient sectors having 75% efficient firms whereas the textile and chemical & pharmaceuticals were considered as least efficient sectors having only 6% efficient firms. In 2013 the electrical machinery was at the top with the score of 80% efficient firms whereas textile sector was again standing at least efficient firms just 4%. In 2014 most noted sectors were coke & refinery, paper & paper board and minerals having efficient firms 100%, 80% and 75% whereas textile sector showed most poor results as before just 4%. In 2015 paper & paper board was most efficient having 80% efficient firms whereas textile, chemical & pharmaceuticals and manufacturing were most inefficient sectors with the ratio of 4%, 6% and 11%. In the year 2016 manufacturing sector was most inefficient sector with the score of 6% whereas the paper & paper board and electrical machinery were considered as most efficient with the score of 80%. In the year 2017 manufacturing and textile were most inefficient with the scores of 6% and 9% whereas the electrical machinery and coke & refinery having the highest scores of 80% and 75% efficient firms.

4.1.3. Overall firm efficiency scores

In Table 4 overall efficiency scores have been reported. The year 2014 was the best year because 24% firms were efficient and 2015 was the worst because only 18% firms were efficient. In 2012 and 2013 the efficient firms were 23% and in the year 2016 and 2017 the efficient firms were 21% and 20% respectively.

From the above discussion it is clear that textile, sugar, food, manufacturing, chemical & pharmaceuticals, cement, motor vehicle, information communication & transportation are the poorest performing sectors of Pakistan. All of these sectors having less than 50% efficient firms in all years from 2012 to 2017. Especially the textile which is the largest as well as the greater contributor in the economy needs to be improved.

4.2. Descriptive statistics

Descriptive statistics are reported in Table 5. This section provides the descriptive statistics of 188 listed non-financial firms from the period from 2012 to 2017 covering 12 sectors in Pakistan. The efficiency is the dependent variable and its mean value 0.463863 and having standard deviation of 0.363895. The first independent variable is MC with the mean value of 9.360293 and SD is 0.905663. The CH is the symbol of liquidity. Its mean value is 0.069974 and SD of 0.118864. The BM has taken symbol of growth stock with the average value of 1.46572 and with the SD of 2.359077. NBM has been taken as a symbol of distress whose average value is 0.039007 with SD of 0.193698. The IO has the average value of 0.302388 with the SD of 0.28882. The Inst. O has the mean value 0.494691 with the SD of 0.330594. The CO has average value of 0.793097 with the SD of 0.3807433. In the current study FS is the first control variable whose average value is 6.697252 and SD is 0.633911. The FP is the second control with the average value is 0.099582 and SD is 0.622985. The FL is the third control variable whose mean value is 0.558081 and SD is 0.27402. The FA has mean value of 29.73404 and SD is 13.95023.

Table 4. Overall firm efficiency scores

	2012	2013	2014	2015	2016	2017
Efficient	23%	23%	24%	18%	21%	20%
Inefficient	77%	77%	76%	82%	79%	80%
Firms	188	188	188	188	188	188

Table 5. Descriptive statistics

Variables	Mean	Median	Maximum	Minimum	SD	Obs.
E	0.463863	0.368500	1.000000	0.000000	0.363895	1128
MC	9.360293	9.247170	11.73940	7.125691	0.905663	1128
CH	0.069974	0.017075	0.887730	0.000205	0.118864	1128
BM	1.465720	0.925000	26.75358	-14.40940	2.359077	1128
NBM	0.039007	0.000000	1.000000	0.000000	0.193698	1128
IO	0.302388	0.259500	0.987700	0.000000	0.288820	1128
Inst. O	0.494691	0.532050	1.000000	0.000000	0.330594	1128
CO	0.793097	0.814594	7.472940	0.076568	0.380733	1128
FS	6.697252	6.658688	8.480886	5.072669	0.633911	1128
FP	0.099582	0.109750	3.984300	-14.11240	0.622985	1128
FL	0.558081	0.548464	2.387498	0.007217	0.274020	1128
FA	29.73404	26.00000	68.00000	1.000000	13.95023	1128

E represents the firm efficiency. MC represents the market capitalization measured as log of market value of all shares outstanding. CH represents the cash holdings measured as cash and marketable securities divided by total assets. BM represents book-to-market ratio measured as book value of equity divided by market value of equity. NBM represents negative book-to-market ratio which is a dummy variable which is set as 1 if book-to-market is negative and 0 otherwise. IO represents the insider ownership measured as shares owned by director, their spouse, children and chief executive divided by total number of shares outstanding. Inst. O represents the institutional ownership measured as shares owned by all institutions divided by total number of shares outstanding. CO represents concentration ownership measured as shares owned by 10 largest shareholders divided by total number of shares outstanding. FS represents the firm size which is measured as log of total assets. FP represents the firm profitability measured as return on equity. FL is the firm leverage measured as total debts divided by total assets. FA represents firm age measured as number of years since its initial listing.

4.3. Correlation

The results of Pearson correlation coefficient are provided in Table 6.

The correlation is a measure of statistics which is used to measure the strength of association and relative movements between two variables. In the current study the correlation is used to check the multicollinearity between the variables. All values of table shows that there is association between the variables but these values are not too high so that there might be the problem of multicollinearity.

4.4. Variance inflation factor

In order to check the multicollinearity, the current study provides the variance inflation factor in Table 7.

The current study has applied variance inflation factor to check multicollinearity among independent variables. The results show that there is no multicollinearity between independent variables because correlation values are low. High collinearity between variables the values of variance inflation factor increases whereas the low collinearity between the variables the values of variance inflation factor decreases. Gujarati et al. (2012) argued that VIF greater than 10 shows that independent variables are highly associated. The Table 3 shows the VIF values for all independent variables used in this study. The highest value of VIF is 6.2543 which show that there is no multicollinearity.

4.5. Tobit regression

The current study applied the Tobit regression model and its results are in the following Table 8.

Table 8 shows the results of tobit regression model. The results show that MC is positively and significantly associated with the efficiency. It also implies that with the increase of MC through the rise in the market price of equity uplifts the efficiency (see, Berger & Humphrey, 1992;

Table 6. Correlation

Variable	E	MC	CH	BM	NBM	IO	Inst O	CO	FS	FP	FL	FA
E	1											
MC	0.2462	1										
CH	0.2296	0.3368	1									
BM	-0.1440	-0.4352	-0.1497	1								
NBM	-0.0854	-0.0821	-0.0928	-0.3289	1							
IO	-0.2539	-0.3998	-0.2846	0.1649	-0.0796	1						
Inst O	0.2192	0.4677	0.3181	-0.2179	0.0738	-0.8757	1					
CO	0.0428	-0.0508	0.0071	-0.0135	0.0019	0.0481	0.0820	1				
FS	0.0741	0.7887	0.1367	-0.1443	-0.0262	-0.2898	0.3395	-0.0665	1			
FP	0.1225	0.2159	0.1128	-0.1336	0.0359	-0.0849	0.1207	0.0369	0.0862	1		
FL	-0.1515	-0.2225	-0.3447	-0.1971	0.6251	0.0420	-0.0551	0.0162	0.0038	-0.0929	1	
FA	0.0426	0.0890	0.0457	0.0387	0.0389	-0.0986	0.1116	0.1013	0.0828	-0.0079	-0.0365	1

E represents the firm efficiency. MC represents the market capitalization measured as log of market value of all shares outstanding. CH represents the cash holdings measured as cash and marketable securities divided by total assets. BM represents book-to-market ratio measured as book value of equity divided by market value of equity. NBM represents negative book-to-market ratio is a dummy variable which is set as 1 if book-to-market is negative and 0 otherwise. IO represents the insider ownership measured as shares owned by director, their spouse, children and chief executive divided by total number of shares outstanding. Inst. O represents the institutional ownership measured as shares owned by all institutions divided by total number of shares outstanding. CO represents concentration ownership measured as shares owned by 10 largest shareholders divided by total number of shares outstanding. FS represents the firm size which is measured as log of total assets. FP represents the firm profitability measured as return on equity. FL is the firm leverage measured as total debts divided by total assets. FA represents firm age measured as number of years since its initial listing.

Fiordelisi, 2007; Sufyan & Majid, 2008; Liadaki & Gaganis, 2010; Gaganis et al., 2013; Chan and Karim (2014). The second hypothesis is also accepted at 1% level of significance. It also implies that liquidity is the important factor for the efficiency because the liquidity maintain the operating cycle by generating the revenue and payment of obligations (see; Afza & Asghar, 2017; Nguyen & Swanson, 2009). The results show that the BM is insignificant. The BM having p-value of 0.6166 which does not fall in 1%, 5% or 10% significance level. The book-to-market ratio can be viewed as a risk approximation based on the book value of equity due to the expected relationships between (1) financial risk and capital structure indicators based on the market value of equity and (2) equity risk indicators. When summarized as a ratio, the book-to-market ratio can be viewed as a combined measure of asset risk and financial risk (Peterkort & Nielsen, 2005). This high ratio indicates high risk of leverage, where threats created by management's failure to meet debt financing needs become effective motivators to make businesses more efficient. Applying more liabilities to the capital structure helps monitor the spending behavior of managers and mitigates overinvestment problems. However, the results of this study showed that the book-to-market ratio had a negligible impact on business risk. These insignificant results could be due to management problems in the companies. Companies with greater managerial abilities are less likely to make inefficient investments when they have excess liquidity (Cho et al., 2018). Management skills are important determinants of business efficiency, but oversight mechanisms complement the impact of talented managers on investment efficiency (García-Sánchez & García-Meca, 2018). A high level of outside financing reduces the inefficiency of small investments and unnecessary expenditure managers through asset embezzlement (Berger & Patti, 2006; Canarella et al., 2014; Kochhar, 2015). Future research studies could incorporate management efficiency into this type of relationship.

The NBM which is the symbol of distress is accepted at 5% level of significance. It implies that distress influences the efficiency negatively (see, Gordon, 1971; Platt & Platt, 2002). The fifth is accepted at 1% level of significance but negatively influences the efficiency. This argument can be supported by the agency theory which states the managerial control over the utilization of asset badly effect the firm operations (see, Berle & Means, 1932; Denis et al., 1999; Jensen & Meckling,

Table 7. Variance inflation factors

S.No.	Variables	VIF
1	MC	6.2543
2	CH	1.3402
3	BM	2.0203
4	NBM	1.8642
5	IO	4.6206
6	Inst O	5.0559
7	CO	1.1037
8	FS	4.0594
9	FP	1.0842
10	FL	2.3096
11	FA	1.0449

E represents the firm efficiency. MC represents the market capitalization measured as log of market value of all shares outstanding. CH represents the cash holdings measured as cash and marketable securities divided by total assets. BM represents book-to-market ratio measured as book value of equity divided by market value of equity. NBM represents negative book-to-market ratio is a dummy variable which is set as 1 if book-to-market is negative and 0 otherwise. IO represents the insider ownership measured as shares owned by director, their spouse, children and chief executive divided by total number of shares outstanding. Inst. O represents the institutional ownership measured as shares owned by all institutions divided by total number of shares outstanding. CO represents concentration ownership measured as shares owned by 10 largest shareholders divided by total number of shares outstanding. FS represents the firm size which is measured as log of total assets. FP represents the firm profitability measured as return on equity. FL is the firm leverage measured as total debts divided by total assets. FA represents firm age measured as number of years since its initial listing.

1976; Lemmon & Lins, 2003; Saunders et al., 1990). The results show that IO negatively associated the firm efficiency (see, Bhattacharya & Graham, 2007; Charfeddine & Elmarzougui, 2010). The last hypothesis is accepted at 5% level of significance and it influences the efficiency positively. It implies that with the increase of largest 10 shareholders the efficiency of firm increases. (see, Bolton & Von Thadden, 1998; Jensen & Meckling, 1976; Jiraporn & Gleason, 2007; Pedersen & Thomsen, 2003; Shleifer & Vishny, 1986; Short, 1994).

4.6. Summary of hypothesis acceptance/rejection

The Table 9 provides the acceptance or rejection of hypotheses. All hypotheses except H_3 are supportive.

5. Conclusion

This study examined the impact of firm characteristics and ownership structure on firm efficiency. At first this study found efficiency scores using DEA CRS approach and then this study applied Tobit regression to examine the impact of firm characteristics and ownership structure on firm efficiency.

At the first stage of analysis, it was found that many sectors who are the main contributors in Pakistan's economy facing severe efficiency scores like textile, sugar, food, manufacturing, chemical & pharmaceuticals, cement, motor vehicle, information communication & transportation because all these sectors have less than 50% efficient firms in all years of the study. At the second stage, it is found that MC, CH and CO are positively and significantly influencing the efficiency whereas the NBM, IO and Inst.O are negatively and significantly influencing the efficiency. The BM is found to be insignificant with the efficiency.

According to my best knowledge, the impact of MC, BM and NBM on firm efficiency is very limited in literature especially in Pakistani scenario which this study has tried to explore. As shown in the

Table 8. Regression results

Variable	Coefficient	P-value
C	0.317700	0.1106
MC	0.158711	0.0000***
CH	0.404507	0.0014***
BM	-0.003820	0.6166
NBM	-0.190190	0.0321**
IO	-0.498010	0.0000***
Inst. O	-0.250520	0.0039***
CO	0.087393	0.0242**
FS	-0.170340	0.0000***
FP	0.035418	0.0901*
FL	0.028635	0.6843
FA	0.000653	0.4810

E represents the firm efficiency. MC represents the market capitalization measured as log of market value of all shares outstanding. CH represents the cash holdings measured as cash and marketable securities divided by total assets. BM represents book-to-market ratio measured as book value of equity divided by market value of equity. NBM represents negative book-to-market ratio which is a dummy variable which is set as 1 if book-to-market is negative and 0 otherwise. IO represents the insider ownership measured as shares owned by director, their spouse, children and chief executive divided by total number of shares outstanding. Inst. O represents the institutional ownership measured as shares owned by all institutions divided by total number of shares outstanding. CO represents concentration ownership measured as shares owned by 10 largest shareholders divided by total number of shares outstanding. FS represents the firm size which is measured as log of total assets. FP represents the firm profitability measured as return on equity. FL is the firm leverage measured as total debts divided by total assets. FA represents firm age measured as number of years since its initial listing. The coefficient marked ***, ** and * are significant at the 1%, 5% and 10% level of significance respectively.

results that MC is significantly and positively impacting on the firm efficiency whereas the NBM is significantly and negatively associated with the firm efficiency and BM is insignificant. These implications will be good additions in the body of knowledge and can be helpful for the future research. This study is helpful for policy makers to find the reasons behind the inefficiency of many sectors and to take corrective actions. This inefficiency might be due to the inefficient use of resources as agency theory advocates. This study is also helpful for the investors. They can choose the efficient firm for investment and to avoid the inefficient firms to stay away from the losses.

First and most important limitation was the non-availability of data according to the variables of the study. Due to which only 188 non-financial firms could be included in the study sample. The second limitation was the lack of past research studies on relationship between market capitalization and firm efficiency, book-to-market ratio and firm efficiency and negative book-to-market ratio and firm efficiency.

This study contributes to the body of knowledge. First this study addresses the limited addressed area of the financial research. It found the relationship between market capitalization and firm efficiency, book-to-market ratio and firm efficiency and negative book-to-market ratio and firm efficiency. This study highlighted weak performing non-financial sectors of Pakistan economy on the basis of efficiency scores which needs to be improved.

There are a number of future research directions. In the current study CRS method of DEA technique is used whereas other method such as VRS, grey model, Malmquist productivity index can also be used. In the current study Tobit regression is used other method can also be used such as logit and probit models. The current study deals with the firm efficiency of only Pakistani non-financial firms whereas it can be extended by making a comparison with other countries. This study deals with only non-financial sector of Pakistan whereas financial sector is ignored. This

Table 9. Summary of hypothesis acceptance/rejection

S.No.	Hypothesis	Results
H ₁	The market capitalization affects the efficiency of Pakistani non-financial firms.	Supported
H ₂	The cash holdings affect the efficiency of Pakistani non-financial firms.	Supported
H ₃	The book-to-market ratio affects the efficiency of Pakistani non-financial firms	Not Supported
H ₄	The negative book-to-market ratio affects the efficiency of Pakistani non-financial firms.	Supported
H ₅	The insider ownership affects the efficiency of Pakistani non-financial firms	Supported
H ₆	The institutional ownership affects the efficiency of Pakistani non-financial firms.	Supported
H ₇	The concentration ownership affects the efficiency of Pakistani non-financial firms.	Supported

study covers the data from 2012 to 2017 whereas it can be extended with large scale data covering the years before 2012 and after 2017.

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Author details

Shafaat Muhammad Habib¹

Haroon Hussain²

E-mail: ranaharoonhussain@gmail.com

Mamdouh Abdulaziz Saleh Al-Faryan³

ORCID ID: <http://orcid.org/0000-0003-1665-807X>

Rana Yassir Hussain⁴

¹ Superior College Sargodha, Sargodha, Pakistan.

² Noon Business School, University of Sargodha, Sargodha, Pakistan.

³ Department of Accounting and Financial Management, Faculty of Business and Law, University of Portsmouth, UK & Consultant in Economics and Finance. Riyadh, Lahore, Saudi Arabia.

⁴ Department of Economics and Business Administration, University of Education Lahore, Portsmouth and Riyadh Pakistan.

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