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Cash and Profit Efficient in Malaysia and South Korea Listed Company using non-parametric DEA method and Parametric Regression Method

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ABSTRACT

A corporate cash holding is significant element in the cash and liquidity management. Corporations with higher excessive cash reserves will benefit when high liquidity makes it easier for managers to transfer funds among several of the corporations' expenses and debts, and allows for more flexibility in managing daily operational activities. However, it raise some issue as firm with higher cash holdings tend to explore to higher agency cost due to the conflict of interest between ownership and management. This study employs data envelopment analysis (DEA) estimation and two-stage regressions model. The findings conclude that the firm size, firm growth, and gross domestic product (GDP) are statistically significant for firm efficiency in both markets. The cash holdings help improve firm efficiency as the adjusted R-square is significantly increased for all models. However, the cash holdings are not related to the efficiency of high-cash holding firms for these two stock exchanges. The contribution of cash holdings to firm efficiency is higher, and even double for a developed market compared with a developing market (Bursa Malaysia), which shows that the development stage of a country impacts on cash holdings' contribution to firm efficiency.

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INTRODUCTION

Cash holdings are liquid assets that provide sufficient liquidity levels for corporations to meet daily operational activities, such as interest due on short-term debt financing, as well as positioning for positive investment opportunities. The role of cash in minimizing the opportunity cost per dollar is a pertinent issue discussed in the trade-off model (Opler et al., 2001). In general, corporations hold excessive cash in the balance sheet for precautionary and liquidity motives (Keynes, 1936). The precautionary motive for holding excessive cash is to provide solutions for an emergency occurring that may impact daily operational activities. Corporate managers prefer to hold more cash reserves when credit risk is high as a precautionary motive (Acharya et al., 2011). However, liquidity motive is found to be more prevalent to explain the recent increase in risk than the precautionary motive, since the importance of the precautionary motive has decreased over time. As a result, firms merely maintain little precautionary savings during the last decade (Boileau and Moyen, 2009).

The decision of firms to hold significant cash reserves in recent times has received attention in finance literature (Opler et al., 1999; Dittmar et al., 2002; Ozkan and Ozkan, 2004). The static trade-off model suggested for this behavior implies that corporate cash holdings are there to achieve an optimal level of cash where the marginal benefit of holding additional cash is equal to the marginal cost. If the appearance of an optimal cash level is true, then excessive or lower corporate cash relative to the optimal balance should have a negative contribution toward firm's performance. Theoretically, the estimation of optimal cash holdings is very easy to achieve, but not many firms maintain them in practical operations. The impact of excessive cash holdings on the performance of corporations can be either positive (Mikkelson and Partch, 2003) or negative (Harford et al., 2008), subject to other factors such as governance and shareholders' protection.

The amount of cash held is determined by internal and external factors which vary across firms, industries, countries and the objectives of the corporation. Firms with cash holdings worth more than 25 per cent of its net assets are considered as high-cash firms (Mikkelson and Partch, 2003). Corporations with higher excessive cash reserves will benefit when high liquidity makes it easier for managers to transfer funds among several of the corporations' expenses and debts, and allows for more flexibility in managing daily operational activities. Besides, this also helps save external finance costs when a corporation lacks sufficient cash to meet obligations such as short-term debt, withdrawal of investments and payment settlements to creditors. However, higher cash-holding levels involve greater carrying costs and opportunity costs as cash held on hand is unproductive and is incapable of generating any profit or appreciating in value. In other words, a high corporate cash reserve actually increases the operational cost of corporations, since opportunity cost increases. Nevertheless, it also facilitates managing agency conflict costs between managers and shareholders, especially for countries with low shareholders' protections and rights.

On the other hand, managers may misuse a large portion of corporate cash holdings in unproductive investments. Besides, the tenure of an investment is also a concern in utilizing cash in corporations. Malaysia is one of the emerging countries seriously affected by the East Asian financial crisis of 1997/98, highly dependent on high volatility short-term capital inflow (Devason, 1998; Leong and Chan, 2001). A mismatch between the fund and investment tenure will cause managers to face mismatch difficulties. As a consequence, they may be forced to forgo some profitable investments as a result of cash being tied up in some long-term unprofitable investment. Most managers would rather keep excessive cash balance in banks rather than invest cash in highly volatile and risky financial instruments.

Alternatively, managers may perhaps prefer to channel their liquid cash holdings towards acquisition plans of other corporations in a similar industry instead of holding excessive cash in the balance sheet or bank (Harford et al., 2008). However, acquisitions that are a result of high excessive corporate cash holdings usually reduce the firm's value and performance. Corporations with more cash reserves tend to take over other corporations that suffer from liquidity problems. The take-over action that is frequently executed by cash-rich corporations may establish unhealthy competition in a fair market. High-cash corporations do not always have the knowledge and skills needed to solve the problems of the firms that have been bought over. A cash-rich corporation is not necessarily the most appropriate or effective party to handle problematic firms, and a take-over might lead to inefficiency in resource allocation and wastefulness of assets and capital. Furthermore, large amounts of take-overs and acquisitions by several cash-rich corporations in the same industry will

encourage monopoly; the absence of fair competition will lead to market inefficiency and restrict consumers' choices and economic welfare.

Corporations with too much cash holdings are essentially generating more disadvantages than benefits on the business landscape, market, industry and economy. However, too little corporate cash holdings might cause a corporation to be trapped in liquidity difficulties with the high possibility of facing insolvency. In general, corporations with less cash holdings might fail to meet financial obligations from banks and creditors (suppliers). Once these corporations temporarily run out of cash, the scheduled debt claims and payments from corporations' payable parties will be postponed and delayed. The delayed payments will damage the corporations' reputation and trust of those payable parties that offer credit to the said corporations. Banks and suppliers may then evaluate corporations that are trapped in liquidity problems at a lower credit ranking as the result of losing trust in the financial condition of the said corporations. Subsequently, lower credit rankings could generate negative impacts on credit line availability and external financing costs. Banks may even charge higher interest on the credit offered to corporations with liquidity problems as the chances of default increase. Banks have to bear higher risks for the funds offered. Some banks might reject the application for external financing needs required by low-cash-holding corporations due to bad records in historical payment documentations. The same also applies to other alternative financial markets such as the stock and securities debt markets; higher fees will be charged for any external financial needs.

Liquidity problems will lead to additional fees involved in external financing as compensation for the higher risk tolerated by investors and banks, and the low-credit-ranking corporations. As a result of higher risks borne by the parties offering credit, suppliers may shorten the credit tenure offered to mitigate the risk taken, and set certain terms and conditions for repayment, which directly reduces the convenience and flexibility of the corporations. Some of the creditors and suppliers might transform the incremental risks into the price charged for raw materials and services offered, which then raises the total production cost and cost per unit produced. Corporations have to pay more for the same amount of raw materials and services whereas the selling price for each unit remains the same; because the increase in production cost is due to an internal problem, corporations are unable to transfer the burden to consumers. The increase in external finance fees and production cost might worsen the corporations' financial condition. This will then lead to more difficulty in accumulating cash.

Therefore, corporate cash holdings are important in determining the performance and profitability of firms, and also as an extension to shareholders' wealth. A brief analysis of how cash holdings influence corporations will become clearer after we discuss the advantages and disadvantages of holding too much or too little cash in the balance sheet. The issue of the amount of cash holdings in firms does not solely impact the firms' balance sheets and agency costs. It also has several effects on the different dimensions of credit ranking of firms, their reputations and investment opportunities, future development, and trust of their stakeholders.

The majority of studies of cash holdings were conducted in the institutionally more developed capital markets such as the United States, European countries and Japan. The main reason developed countries became the focus of these studies was due to the size of their markets, availability of information and the value of the research with more users interested in the findings (investors, stakeholders and number of firms). Therefore, studies of corporate cash holdings in developing capital markets are becoming increasingly importance, hence providing the motivation of the study, especially in new markets in the Asia-Pacific region. It is interesting to conduct research on Asia-Pacific countries due to the heterogeneity of the regions' economies and their characteristics, which are recently having rapid growth. Therefore, this thesis, using appropriate methodology aims to investigate the contribution of cash holdings to firm's efficiency. This study selects South Korea and Malaysia as representatives of a developed and a developing country in the Asia Pacific region. The main reason for selecting these two countries is no prior research on cash holding has been conducted on South Korea and Malaysia. The two selected countries hold relatively high cash than other countries in Asia Pacific. However, the significance of the cash holdings study on South Korea and Malaysia is long overdue.

In prior studies, cash holdings are always linked to leverage, external funding and investment opportunities. The amount of cash holdings is often determined by two common factors, which are accessibility to external funding and financial investments; these elements are connected to financial institutions and negatively related to the amount of cash holdings. Firms will hold lesser cash if they prefer to

invest in financial instruments or have easy access to external funding. However, these determinants are actually associated with each other and a change in one of them will impact the other in a financial cycle. Thus the decision to hold relatively more cash reserves becomes significant in order to maintain sufficient liquidity and avoid depending on these two elements while facing relatively higher default risk.

Prior studies have examined the role of agency cost in firms holding large amounts of cash, and have suggested several solutions to mitigate the cost charges on shareholders.[1] Surprisingly, few have studied the role of cash in generating firm's efficiency, thus increasing shareholders' wealth. If cash holdings positively contribute to higher shareholders' wealth, e.g. higher profits, higher dividends and better stock prices, studies of agency cost will be less important. By focusing on the efficiency of the role of cash in maximizing shareholders' wealth, this study provides new insight into the need to hold a certain amount of cash. If the role of cash holdings in generating firm's efficiency is important, this study will be able to enhance the information about cash holdings, and show that agency cost, while influencing shareholders' wealth to a certain extent, should not be the main concern of the shareholders.

LITERATURE REVIEW

Firm Performance and Earnings

Most studies on cash holdings link the effect of cash holdings on firm's performance to other internal and external characteristics such as the pattern of liquidity management. There is no prior literature show evidence on relationship between corporate cash holdings and firm efficiency. It is common connect firm's performance and firm's value together since efficiency determines the profitability and capability of a firm in generating good returns. Julea et al. (2018) conducted a conceptual paper attempts to assess the moderating effect of earning quality on the relation of cash holding towards the firm's efficiency by sector in Malaysia. Failure in utilizing the cash within the firms may lead to the existence of agency conflict which later will cause the firm value to drop. Shinada (2012) concluded that large investment opportunities will lead to a positive relationship between cash holdings and firm returns on assets and values. He summarized that conservative cash holdings could enhance the market values of a firm but the enhancement could only be sustained for a short term, showed by the diminishing effect in the later years.

Mikkelson and Partch (2003) found that persistent extreme cash holdings do not lead to poor performance and do not represent conflicts of interest between managers and shareholders. They found that high-cash firms can perform better than others within the same size and industry. High-cash holdings support greater investment, particularly in R&D expenditures, and spur a greater growth in assets. Anagnostopoulou (2012) examined that high-cash reserves are not an important factor in determining the future performance of public firms; their results are almost similar to the findings of Mikkelson and Partch (2003) for large cash holders, that results portray a positive influence on the future profitability of private firms, as having a high levels of current cash could be a signal reflecting that the firm's development is at the expansion stage.

Additional evidence of the negative relationship between cash holdings and firm's performance was provided by Couderc (2005) which shows that excessive cash holdings will lead to poor firm's performance. If the performance of a firm with excessive cash holdings is above average, then the performance is inconsistent with the free-cash-flow hypothesis. On the other hand, his study supports the managerial opportunism thesis, according to Jensen (1986). As a result of his study, subsequent cash levels in a firm's balance sheet are perhaps a sign of the existence of entrenched managers. In this study, the earnings is proxy by the annual total sales of the firm.

Firm Growth

Firm growth is not an element that is directly associated with cash holdings and efficiency; however, it is seen to have some influence on cash decisions from the aspect of firm efficiency. Some reports suggest that fast-growing firms will experience complications caused by speedy growth, and these problems will lead to a decrease in efficiency in generating profitability. Therefore the need for cash holdings increases as it can

[1] Refer to corporate debt policy (Kim and Eric, 1986), Organization (Vijay and Seungjin, 1991), dividend payout ratio (Rozeff, 1982), and capital structure (Friend and Lang, 1988).

reduce the probability of costly external funding such as debt or equity issuance, especially when the funding is needed to solve emergency difficulties. Thus the relationship between firm growth and cash holdings level should be considered but the relationship between these two elements is still debatable according to MacMillan and Day (1987), who opined that speedy growth might enhance efficient and generate higher profitability since new firms are able to harness practical skills on a larger scale and in a shorter time. The proxy used for firm growth is current year sales minus previous year sales over previous year sales (refer to Zariyawati and Annuar, 2009; Caballero et al., 2010).

A higher cash holdings level will usually contribute to higher firm growth, however, some existing studies indicate that the growth of a firm may lead to managerial issues as well as other issues related to the expansion of the firm's business. MacMillan and Day (1987) report that quick growth may give rise to higher profitability as new firms become more profitable when they join the markets rapidly and on a large scale.

Firm Size

Firms larger in size are recognized as being more successful than smaller firms, and hence should have more cash, after adjusting for investment (Opler et al., 1999). Their findings are consistent with those of Ferreira and Vilela (2004). They employed the natural logarithm of total assets as a proxy for the real size of firms, and it applied in this study as well. Larger firms tend to have larger shareholder spreading, which raises superior managerial discretion. Moreover, larger companies are not likely to be the target of a takeover due to the amount of financial resources needed by the bidder. Thus it is expected that managers of larger firms have more discretionary power over the firms' investments and financial policies, leading to a greater amount of cash holdings (Ferreira and Vilela, 2004).

However, some studies show an inverse relationship with firm size on cash holdings. Mulligan (1992) indicates that large firms hold less cash as a percentage of sales, compared with smaller firms. Smaller firms tend to hold larger cash balances relative to their total assets than those firms larger in size (Chang and Noorbakhsh, 2006). Smaller firms are likely to hold more cash can be explained by their lower accessibility to capital, and therefore their internal cash reserves need to be significant to overcome any unexpected uncertainty on cash flow (Whited, 1992; Fazzari and Petersen, 1993; Kim et al., 1998).

DATA AND RESEARCH METHODOLOGY

Data Sources and Variables

This study analyses the secondary and quantitative data of listed firms in the Korea Exchange and Bursa Malaysia. Firms in Korea Exchange and Bursa Malaysia were selected. Korea Exchange is considered one of the stock exchanges of developed countries in the Asian region and Malaysia is still at a developing stage. Thus, combining these two selected Asian countries might give a clear picture of the role and value of cash holdings in different levels of corporate development. Rafinda (2018) conducted a preliminary test on the cash holding determinants on developing and developed countries, however, his results are not consistent and need more further study. The time period of this study started from year 2002 to 2016; therefore listed firms in Bursa Malaysia operating during the study period and fulfilling certain criteria are taken as part of the sample. The financial and utility industries are excluded from the sample as the role and value of cash in these industries differ from other industries. Financial firms are excluded from the sample because of the unique role that cash plays for financial institutions and banks. Utilities are also excluded because they are regulated and should have a small differential between the costs of internal and external funds. The financial data and market data of each listed firm are collected from the Data stream database and the S&P capital IQ dataset. Data of firms that are outliers and those that are missing are excluded from the study. The outlier is estimated as the 5 per cent of the bottom and top of the sample. Any listed firms that fail to offer continuous data that are less than 5 years are deleted from the sample. This tight screening process reduces the sample sizes of Korea Exchange (from three thousands plus to around eight hundreds firms) and Bursa Malaysia (from one thousand plus to around 5 hundreds firms).

Mikkelson and Partch (2003) considered cash holdings large when the ratio of a firm's cash-to-net assets is more than 25 per cent. A testing session conducted to test the practicality of 25 per cent in category samples

of cash-rich firms saw Pan (2006) applying the percentages mentioned in Mikkelson and Partch (2003), and collecting a sample of 169 high-cash firms and 128 low-cash firms. No latest estimation can explain the reasonable cash-holding restriction; this study therefore applies the common and most frequently used method, which defines firms with the ratio of cash-to-total assets greater than 25 per cent as high-cash firms.

Test Model

Firstly, the main point of this study is to estimate the role of corporate cash holdings in firm's efficiency. As the intention of this research is to investigate the significance of cash holdings' contribution to firm's efficiency, selection of the method used to measure the firm's efficiency becomes an important decision. Many existing studies measure firm's performance using return on assets and equity (ROA and ROE), and the Tobin-q or market-to-book value; an increase in these values measured indicates improvement in firm's performance for a specific period. However, these measurements only manage to cover some of the meaningful variables that reflect how well the firm is. Furthermore, these measurements do not provide comparative information regarding a firm's performance when comparing with other firms operating in the same market. To enhance the accuracy of evaluation of a firm's ability to generate earnings and offer comparative figures to compete with other firms, the Data Envelopment Analysis (DEA) estimation is more appropriate for use in estimating firm's efficiency. Besides, since the DEA model is a non-parametric technique, the efficiency generated will again regress with other relevant firm-specific and macroeconomic variables in order to obtain statistical evidence to support the linear relationship among firm's efficiency and other tested variables, also called the second stage regression. Findings supported by combining non-parametric and parametric tests are capable of providing more comprehensive evidence at a relatively higher degree of reliability (Kriebel, 1999), as the combination can overcome the disadvantages of non-parametric and parametric methods.

The DEA Method in Evaluating Firm's efficiency

DEA is a tool developed by Charnes et al. (1978) to assess the efficiency of decision-making units (DMUs) that have multiple inputs and outputs. DEA is a technique generally used to empirically measure productive efficiency of individual DMUs. While DEA is strongly connected to the production theory in economics, somehow it is also applied to benchmark operations management where a set of input-output vectors is chosen to benchmark the performance of manufacturing and service operations, especially in the banking sectors. In the situation of benchmarking, the efficient DMUs, as selected by DEA, may not essentially shape a "production frontier", but to a certain extent, it forms a "best-practice frontier" (Cook et al., 2014).

The efficiency score is generated based on a frontier, by developing all the observed input-output vectors. The efficiency of each firm is measured by the distance of its input-output vectors to the frontier, which indicates that the virtual performance of all utilities in the sample can be judged against each other, and DEA can then benchmark firms against the best producers. This method presumes that if a firm can generate a certain level of output using particular input levels, another firm of equal scale is supposed to be able to produce a similar output. The most efficient producers can structure a 'composite producer' that will allocate the estimation of an efficient solution for every point of input or output. Where there is no actual corresponding firm, 'virtual producers' are identified to make comparisons" (Berg, 2010). It is a non-parametric technique that makes no assumptions about the form of production technology or its functions. Moreover, it is a non-stochastic approach, as all observations are treated as predictable, and change in a stable pattern or order.

Compared with other statistical methods, DEA has unique features that make it an excellent tool for evaluating firm's efficiency. DEA does not require any assumptions on the relationships between inputs and outputs. It is capable of managing multiple inputs and outputs, especially in performance measures. It can be worked into a single mathematical model without the need for specifications of trade-offs among multiple measures related to firm's performance. Additionally, DEA evaluates each DMU individually by creating individual performance efficiency scores that are comparative to the entire sample under examination. Mis-specification that commonly occurs in a regression analysis is not likely to happen in DEA as DEA generates a best-practice frontier based on peer comparisons within the sample.

This study is uses TE (Technical Efficiency) as a measure of efficiency at firm level instead of TFP (Total Factor Productivity). Much of the performance in efficiency gains comes from adoption of relevant production technology, which determines the TE at firm level. Hence in this thesis TE is applied as the measure of efficiency to relate to cash holdings.

However, DEA has its disadvantages as well. The DEA approach does not provide information regarding measurement error and statistical noise that may impact the shape and position of the frontier. Furthermore, it does not go through testing for hypotheses – the usual tests of an econometric approach to identify the significance of the relationship between dependent and independent variables. In a DEA analysis, it is commonly presumed that there are *n* DMUs using amounts of *m* different inputs to produce *s* outputs.

The notation is as follows:

$$
\begin{aligned}
& = \text{input } g \ (g \\
x_{gj} \quad & = 1, \ldots, m), \text{DMU } j (j \\
& = 1, \ldots, n) \\
y_{hj} \quad & = \text{output } h \ (h \\
a_j \quad & = \text{non} - \text{negative weights attached to DMU } j' \text{s inputs and outputs}
\end{aligned}
$$

An output orientation is employed in this study. The agency conflict and cost issues have caused the role of corporate cash holdings to be questioned by stakeholders. Under these circumstances, it is necessary for stakeholders to know how much output can be produced if a firm improves its technical efficiency, given a fixed amount of inputs. Thus an output orientation is the appropriate choice (Coelli et al., 1998). This method employs $F_o(x_j, y_j) = \text{maximum } \emptyset$ to represent the output-oriented Farrell efficiency score that indicates the maximum possible expansion of output for DMU *j*.

The output-oriented DEA model is assumed to be associated with a maximization of $\emptyset$ subject to:

$$\sum_{j=1}^{n} a_j y_{gj} \geq \emptyset y_{gj}, \text{g} = 1, \ldots, \text{s} \tag{1}$$

$$\sum_{j=1}^{n} a_j x_{hj} \leq x_{hj}, \text{h} = 1, \ldots, m \tag{2}$$

$$a_j \geq 0, j = 1, \ldots, n \tag{3}$$

This model presumes a constant return to scale (CRS), as mentioned in the earlier research work of Charnes et al. (1978). The assumption is only preferable when all DMUs function at an optimum scale. The linear programming that is required in the DEA model is fulfilled for every DMU in the selected sample in order to attain its relative performance. The efficiency measure is collected as the inverse of the maximum proportional output that it is capable of producing with the level of input remaining consistent. The firm's efficiency evaluated in this method defines a technical efficiency score that is in the range of zero to one.

Output Variable for the Firm's efficiency Model

As output is the significant element used in evaluating the efficiency level of firms; therefore it has to be appropriate in denoting a firm's results based on its daily business activities and operations. The net earnings, which are defined as the net sales of a particular firm in its income statement, are used as the output variable in this study. Net sales usually refer to the revenue of a firm, minus the cost of sales returns, allowances and discounts. They also refer to the net profit or sales net of all expenses. Net sales measure a business' financial performance and provide a reflection of how well the business is doing (refer to Kao et al., 2003; Wu et al., 2006).

Input Variable for the Firm's efficiency Model

A firm uses numerous resources (inputs) and produces tangible goods or intangible services (outputs) to fulfill the requirements essentials of a consumer. In the production process, all inputs (referring to production factors, including capital, labour, materials and time) will be transformed into outputs. Following existing literature, the indicators selected as input vectors for most of the firms' studies include total capital (Shao and

(Lin, 2002), total assets (Kao et al., 2003), number of workers (Cooper et al., 2001; Kao et al., 2003), salaries/wages (Shao and Lin, 2002), operating expenses (Kauffmann et al., 2000; Cooper et al., 2001), etc. This study is concerned with metrics that can precisely reflect the relationship of a firm's efficiency in utilizing total capital and human resources. Therefore, this study adopts the total shareholders' equity, total debt (long term and short-term debt), and expenses on salaries and benefits as input variables.

Two-stage Regression on Firm's efficiency

To determine whether and to what extent the technical efficiency of a firm can be explained by corporate cash holdings, this study is regresses the technical efficiency on cash ratio and lagged cash ratio. A ratio of cash-to-assets is selected instead of the amount of cash and cash equivalents as the cash ratio can be adjusted with firm size and is more appropriate to use in regression with firm's efficiency. The cash ratio is defined as ratio of cash-to-net assets, where cash refers to cash and cash equivalents, and net assets is total assets minus cash and cash equivalents. It is recognized as a suitable measurement for liquid assets and is widely used in existing literature (Opler et al., 1999 and 2001; Dittmar et al., 2002 and 2003; Chen and Mahajan, 2010; Beuselinck et al., 2012). The lagged cash ratio is included in order to answer whether the previous period's variables are statically significant with firm's efficiency as the cash ratio is presumed to have a dynamic impact on and be influence by the previous period. To precisely measure the influence of corporate cash holdings on efficiency, this study also includes some of the firm-specific and macroeconomic variables that may affect efficiency (Lamberson, 1995; Zariyawati and Annuar, 2009; Caballero et al., 2010).

Since the technical efficiency varies from zero to one, the distribution of efficiency is trimmed from unity. Therefore the parameter estimates would be biased if the OLS regression selected has been used to identify the linear relationship between efficiency and the independent variables. The common method in mitigating this problem is to employ a limited dependent variable model such as the Tobit regression. However, this study has decided to use panel regression with random and fixed effects in estimating firm's efficiency and the cash ratio. The reason for selecting this choice is because the characteristics of these data consist of time effects and individual effects in the panel data set (Peterson, 2009). It is mainly due to the serial correlations which cause the interception of the panel data to differ across units. Besides, to ensure that there are fewer mistakes made while choosing the right method, empirical tests on Tobit's regression have been conducted (which is not discussed in this research); it shows that the findings in Tobit's regression and the random/fixed effect regression are highly similar. Secondly, since this study uses a two-stage regression approach, the adjusted R-square plays an important role in identifying the wellness of variables in enhancing the fitness of the model. Yet, the Tobit's regression does not provide information on the fitness of the model. Thus, to avoid overlooking these hidden effects that might lead to inconsistent and biased standard errors, fixed or random effect panel regression is the preferable option, compared with OLS regressions. Fixed and random-effect regression have provides the adjusted R-square to make a comparison of the significance of certain variables to firm's efficiency, which shows fitness of the model that is absent in Tobit's regression.

The panel regression is separated into three models, which will indicate the effects of firm-level and macroeconomic variables, and cash ratio on firm's efficiency over the fiscal year. The equation in 3.4 regresses the efficiency score with firm-level variables. The macroeconomic variables are added in (3.5), and the cash ratio and lag cash ratio variables are included in (6).

The function of firm's efficiency and control variables can be written in their simple general forms as below:

$$\text{Firm's efficiency} = \alpha_0 + \alpha_1 CE + \alpha_2 CE_{t-1} + \alpha_3 FG + \alpha_4 FS + \varepsilon_{i,t} \quad (4)$$

$$\text{Firm's efficiency} = \beta_0 + \beta_1 CE + \beta_2 CE_{t-1} + \beta_3 FG + \beta_4 FS + \beta_5 \text{INT} + \beta_6 \text{GDP} + \beta_7 \text{INF} + \beta_8 \text{TB} + \varepsilon_{i,t} \quad (5)$$

$$\text{Firm's efficiency} = \gamma_0 + \gamma_1 CE + \gamma_2 CE_{t-1} + \gamma_3 FG + \gamma_4 FS + \gamma_5 \text{INT} + \gamma_6 \text{GDP} + \gamma_7 \text{INF} + \beta\gamma_8 \text{TB} + \gamma_9 \text{CR} + \gamma_{10} \text{CR}_{t-1} + \varepsilon_{i,t} \quad (6)$$

RESULTS AND DISCUSSIONS

Descriptive Statistics for Efficiency Score and Variables

There are two descriptive statistics tables respectively for South Korea and Malaysia: tables 1 and 2. Results in each table are presented under 3 categories as the entire sample, high-cash holding firms and low-cash holding firms.

Table 1 Descriptive statistics for Korea Exchange starting from 2002 to 2016

	All		High-cash		Low-cash	
Variable	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Capital expenditure	0.079	0.1583	0.0772	0.127	0.0792	0.162
Cash ratio	0.129	0.115	0.3315	0.1663	0.103	0.0832
Efficiency score	0.4821	0.2015	0.5727	0.254	0.3721	0.1914
Firm growth	0.1312	0.3867	0.1771	0.3965	0.1251	0.3851
Firm size	12.536	1.5066	11.956	1.0527	12.6143	1.5412
Interest rate	3.4545	0.8583				
GDP	959.4664	196.1967				
Inflation	3.0909	0.7428				
Trade balance	21460.21	14758.19				
No. of firms	864 (100%)		94 (10.87%)		770 (89.12%)	
Observation	8027		937		7090	

Source: Datastream

Table 2 Descriptive statistics for Bursa Malaysia starting from 2002 to 2016

	All		High-cash		Low-cash	
Variable	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Capital expenditure	0.0681	0.1237	0.0637	0.1200	0.0687	0.1242
Cash ratio	0.1235	0.1203	0.3206	0.1360	0.0995	0.0896
Efficiency score	0.1432	0.1866	0.1592	0.2195	0.1418	0.1803
Firm growth	0.1697	0.6566	0.2150	0.7982	0.1633	0.6337
Firm size	11.2485	1.4016	10.860	1.5984	11.3032	1.3629
Interest rate	2.3182	1.3101				
GDP	191.8764	67.2077				
Inflation	6.3027	0.3473				
Trade balance	29721.26	8223.836				
No. of firms	561 (100%)	70 (12.48%)	491 (87.52%)			
Observation	4941	592	4349			

Source: Datastream

Korea Exchange is larger than the stock market of Malaysia. 10.87 per cent of the Korea Exchange sample is high-cash holding firms and the balance of 89.12 per cent is low-cash holding firms, holding an average of cash less than 25 per cent of their total assets. The low-cash holding firms dominate the Korean market and the same is also true for Malaysia.

South Korea has a higher figure for the majority of variables compared with Malaysia, except for firm growth, inflation and trade balance Korea has a larger GDP compared with Malaysia. The mean GDP for South Korea is USD959.46b whereas for Malaysia, it is only USD191.87b. The GDP gap between South Korea and Malaysia might be due to the different levels of development. South Korea is considered a developed country in Asia, after its speedy growth in the past 30 years, while Malaysia is still in the process of developing. The different levels of development can also be explained by the inflation rate and growth, where Malaysia has the higher figure compared with South Korea. Although listed firms in Malaysia have slightly higher growth than those in South Korea, the standard deviation is very high, which shows that the growth among listed firms in Malaysia varies a lot.

Apart from the big differences mentioned earlier, the trend for other variables is similar for listed firms in both Korea Exchange and Malaysia. Higher-cash firms have higher mean and standard deviation for capital expenditure, cash ratios, and efficiency scores, lag capital expenditures, lag cash ratio and firm growth. Low-cash holding firms have higher value for firm size than high-cash holding firms in both countries. This shows that bigger firms are less likely to hold high-cash compared with smaller firms. It corroborates with findings

in existing literature which state that there exists a negative relationship between cash holdings and firm size (refer to Mulligan, 1997; Ferreira and Vilela, 2004; Nguyen, 2005; and Saddour, 2006).

Table: 3 Independent samples test for equality of variance for the efficiency scores in low-cash holding firms and high-cash holding firms

Group: low-cash holding firms and high-cash holding firms		Korea Exchange		Bursa Malaysia	
		F-statistics	p-value	F-statistics	p-value
Efficiency score	Equal variances assumed	27.949	0.000***	54.578	0.000***

Note: *** Significance at 0.01 confidence level, ** significance at 0.05 confidence level, * significance at 0.1 confidence level. However, non-parametric method provides partial estimation of the efficiency scores based on the input and output variables. Therefore a parametric method has to be used to test the significance and relationship of the efficiency score with the variables of interest in this research. Several panel regressions are carried out to further analyze the linear relationship between firm's efficiency and corporate cash holdings as well as to define how well cash holdings aids in increasing firm's efficiency.

A simple individual t-test on the equality of variance is conducted to compare the means of the efficiency scores between low-cash holding firms and high-cash holding firms for listed firms in Korea Exchange and Bursa Malaysia. The results are shown in Table 4.2.4 which reports that the equality of variance for the efficiency scores in the two subsamples is significant at 0.01confidence level for listed firms in both stock exchanges. Thus the efficiency scores for listed firms in Korea Exchange and Malaysia significantly differ. Therefore it is expected that the effect of cash towards firm's efficiency of both low-cash holding firms and high-cash holding firms will differ in the panel regression tests.

Efficiency Scores and Cash-Holding Study for Listed Firms in Korea Exchange

Three models are tested using entire sample, high-cash holding firms and low-cash holding firms. The first model is on efficiency scores with firm-level variables; macroeconomic variables are added in Model 2, and the corporate cash ratio and lag cash ratio are included in Model 3.

The results for Korea Exchange are shown in Table 4. The firm-level variables are capital expenditure, lag capital expenditure, firm growth and firm size. Lagged capital expenditure is included as one of the firm-level variables as the current capital expenditure is correlated to last year's capital expenditure; therefore lagged capital expenditure is expected to lend meaning to the explanation of firm's efficiency. The list of macroeconomic variables in Model 2 is interest rate, GDP, inflation and trade balance. To avoid inaccurate results due to varying firm sizes, the cash ratio is chosen to replace corporate cash holdings, as the cash ratio by dividing cash holdings by total assets. Cash ratio and lagged cash ratio are added to Model 3. Lagged cash ratio is included as it is believed that the current cash ratio will correlate with the cash ratio of the past year.

In Table 4, the firm growth is significant for all models with coefficient of 0.0787 in model 3. A positive sign of firm growth is that higher firm growth will lead to higher firm's efficiency. Firms with growing sales volume are generating more profit which contributed to increases in share's and firm's value which shows outperform than their competitors. Firm growth is increasing firm's efficiency through lower production cost and advantages of economic scales. MacMillan and Day (1987) observed that speedy growth might lead to higher effectiveness as expended firms become more profitable when they enter markets rapidly and on a big scale.

The table shows the three results of regressing efficiency score on firm level and macroeconomic variables over the fiscal year. The equation in model 1 regresses the efficiency score with firm level variables. The macroeconomic variables are added in model 2, and the cash ratio and lag cash ratio variables are included in model 3.

Table 4 Impact of firm-Level and macroeconomic variables on firm's efficiency for listed firms in Korea Exchange starting from 2002 to 2016

Independent Variable	Dependent variable: efficiency score		
	Model 1	Model 2	Model 3
Constant	1.8964 [5.4200***] (0.0000)	1.0855 [2.7300***] (0.0060)	1.0873 [3.0200**] (0.0030)
Capital expenditure	0.0773 [1.4700] (0.1430)	-0.0598 [-1.0400] (0.2990)	-0.0378 [-0.6800] (0.4960)
Lag capital expenditure	-0.0404 [-0.6500] (0.5150)	-0.0207 [-0.3500] (0.7250)	-0.0006 [-0.0100] (0.9920)
Firm growth	0.1191 [3.5900***] (0.0000)	0.0782 [2.5800**] (0.0100)	0.0787 [2.7600**] (0.0060)
Firm size	-0.1358 [-4.8900***] (0.0000)	-0.0602 [-1.8100*] (0.0710)	-0.0661 [-2.1400**] (0.0330)
Interest rate		-0.0218 [-1.1100] (0.2670)	-0.0205 [-1.1000] (0.2710)
GDP		0.0005 [5.9000***] (0.0000)	0.0005 [6.0800***] (0.0000)
Inflation		-0.0153 [-2.3400**] (0.0190)	-0.0139 [-2.1900**] (0.0290)
Trade balance		0.0000 [-1.7000*] (0.0890)	0.0000 [-1.7100*] (0.0890)
Cash ratio			0.4115 [2.7500**] (0.0060)
Lagged cash ratio			0.0212 [0.1700] (0.8630)
Adjusted R-square	0.3169	0.3720	0.3864
F-stat / Chi-square	15.2500	20.3000	18.0700
p-value	(0.0000***)	(0.0000***)	(0.0000***)

Note: The coefficients for the trade balance are negative and less than 0.0000. Significant at 0.01(*), 0.05(**), 0.001(***) level. t-values are in square brackets, p-values are in parentheses.

The firm size is significant for all models with coefficient of 0.0661 in model 3. A negative sign on firm size means that bigger firms could have lower efficiency. Immediate decision is harder to make in firms with bigger size which involve multi-level management and several departments, thus decrease firm's efficiency in operating management. Some evidence from existing literature shows that on average, small and medium sized firms tend to be more efficient than larger firms (Diaz and Sanchez, 2008; and Konzelmann et al., 2007).

The adjusted R-square increases by 5.51 per cent from 0.3169 to 0.3720 after adding in the macroeconomic variables. It shows that firm's efficiency can be explained by the changes in GDP, inflation and trade balance. Firms' daily operations and production are affected by the macroeconomic factors where the firm operating. Firms could operate with higher efficiency in stable and growing economic which indicated stable production cost and increases in demand on product. The GDP is significant at 0.1 per cent confidence level with coefficient of 0.0005 in model 2 and 3. Trade balance is significant at 0.1 per cent confidence level in model 2 and 3 with coefficient less than 0.000. A positive sign on GDP and trade balance show that higher GDP and trade balance will aid in increasing firm's efficiency. The growths in GDP and trade balance are lead to higher demand from domestic and international which increasing the firm's sales volume and earning. Inflation is significant at 0.5 per cent with coefficient of 0.0139 in model 3. A higher inflation rate which leads to higher production cost and depreciation on liquid assets is causing firm's efficiency to decline. Firms have no direction and future growth perspectives while the inflation rate is too high. Generally firm's efficiency is determined by the market and internal control. It is less likely that the interest rate movements provide any support for the explanation of firm's efficiency.

From the results obtained from Model 3, the cash ratio shows a significance level at 0.05, and the coefficient is 0.4115 with a positive sign. I t reveals that the percentage of cash holdings over total assets

provides evidence of the positive relationship with firm's efficiency. A higher cash-ratio practice in firms will lead to greater firm's efficiency. The lagged cash ratio is insignificant. The adjusted R-square increases by 1.44 per cent from Model 2 to Model 3 after including cash ratio into the model. As the additional macroeconomic variables (which contain four variables) are only able to provide an increase of 5.51 per cent for the goodness-of-fit statistics, the increase in the R-square of 1.44 per cent reveals that the cash ratio carries better weight in explaining firm's efficiency. Compared with the explanatory power among the other firm-specific variables (Model 3 and Model 1), the difference in the adjusted R-square is 6.95 per cent after adding in the cash ratio. Therefore cash ratio serves as an important indicator in providing a better fit to the model in order to explain firm's efficiency. The F-statistics for the entire model are significant at 0.01.

The table shows the three results of regressing efficiency score on firm level and macroeconomic variables over the fiscal year. The equation in model 1 regresses the efficiency score with firm level variables. The macroeconomic variables are added in model 2, and the cash ratio and lag cash ratio variables are included in model 3.

Table 5 Impact of firm-level and macroeconomic variables on Firm's efficiency for high-cash holding firms in Korea Exchange Starting from 2002 to 2016

Independent Variables	Dependent Variable: Efficiency Score		
	Model 1	Model 2	Model 3
Constant	1.4693 [6.5700***] (0.0000)	1.5994 [4.7900***] (0.0000)	1.6720 [5.1000***] (0.0000)
Capital Expenditure	-0.1555 [-1.1500] (0.2500)	-0.2703 [-2.3000**] (0.0220)	-0.1843 [-1.3000] (0.1920)
Lag Capital Expenditure	-0.1585 [-1.1900] (0.2350)	-0.1754 [-1.4500] (0.1480)	-0.1474 [-1.1900] (0.2330)
Firm growth	0.2329 [4.4700***] (0.0000)	0.1742 [3.1100**] (0.0020)	0.1833 [3.4000***] (0.0010)
Firm size	-0.0996 [-4.4600***] (0.0000)	-0.0712 [-3.9900***] (0.0000)	-0.0732 [-4.2000***] (0.0000)
Interest rate		-0.0523 [-1.2500] (0.2100)	-0.0667 [-1.5600] (0.1190)
GDP		0.0007 [3.6100***] (0.0000)	0.0007 [3.3500***] (0.0010)
Inflation		-0.0577 [-3.7900***] (0.0000)	-0.0601 [-3.9200***] (0.0000)
Trade Balance		0.0000 [1.7100*] (0.0870)	0.0000 [1.4800] (0.1380)
Cash Ratio			0.2209 [1.1500] (0.2510)
Lagged Cash Ratio			-0.0925 [-0.4500] (0.6530)
Ad R-Square	0.3062	0.4547	0.4837
F-stat/ Chi-square	63.4900	84.7000	102.6900
P Value	(0.0000***)	(0.0000***)	(0.0000***)

Note: The coefficient for the trade balance is positive and less than 0.0000. Significant at 0.01(*), 0.05(**), 0.001(***) level. t-values are in square brackets, p-values are in parentheses.

The comparisons between the results of low-cash holding firms and high-cash holding firms are presented in Table 5. High-cash holding firms have similar results in Korea Exchange. Firm growth and firm size are significant in Model 1 with negative and positive signs respectively. The effect of firm growth on the efficiency of high-cash holding firms is stronger compared with the entire sample in Korea Exchange; the coefficient is 0.2329 and significant at 0.001. But the impact of firm size on the efficiency of high-cash holding firms is lower than for the entire sample. The coefficient for firm size in high-cash holding firms is 0.0996, which is less than 0.1358 in the entire sample. Capital expenditure and lagged capital expenditure are not significant for high-cash holding firms in Korea Exchange.

The result form Model 2 shows that GDP, inflation and trade balance are significant with the same signs as in the previous table therefore the explanations are similar. The coefficients of all the significant macroeconomic variables are higher than the results in the previous table. This indicates that the high-cash holding firms are more adaptive to the changes in macroeconomic variables. It can be further supported by the increase of 14.85 per cent in the adjusted R-square from Model 1 to Model 2 after the addition of macroeconomic variables. In Model 3, the cash ratio and lagged cash ratio for high-cash holding firms in Korea Exchange are insignificant to the efficiency score.

The results on low-cash holding firms in Korea Exchange are in Table 6. Firm growth and size are significant with the expected signs. It is the same with the entire sample and high-cash holding firms in Korea Exchange. However, the coefficients of firm growth and firm size of low-cash holding firms are smaller than the coefficients of the same variables for high-cash holding firms.[2] Besides, in Model 1, the capital expenditure and lagged capital expenditure are significant at 0.05, with positive and negative signs respectively. However, these two variables become insignificant in models 2 and 3 after positive signs in models 2 and 3. The coefficient of the GDP for low-cash holding firms is slightly smaller than that for high-cash holding firms in Korea Exchange, which are 0.0003 and 0.0007, respectively. The impact of macroeconomic variable is less likely to happen on firm with low-cash holding in Korea Exchange. The possible reason to support the findings is that most of the high-cash holding firms are traditional domestic firms and less involved in international trading. Therefore interest, inflation and trade balance do not impact on firm's efficiency for low-cash holding firms in Korea Exchange. In Model 3, firm growth becomes insignificant, but firm size and GDP remain significant at 0.001. The cash ratio for low-cash holding firms reveals a significant positive relationship with firm's efficiency at 0.05, with the coefficient of 0.3647.

The table shows the three results of regressing efficiency score on firm level and macroeconomic variables over the fiscal year. The equation in model 1 regresses the efficiency score with firm level variables. The macroeconomic variables are added in model 2, and the cash ratio and lag cash ratio variables are included in model 3.

Table 6 Impact of firm-level and macroeconomic variables on firm's efficiency for low-cash holding firms listed firms in Korea Exchange starting from 2002 to 2016

Independent Variable	Dependent variable: efficiency score		
	Model 1	Model 2	Model 3
Constant	1.0850 [6.9200***] (0.0000)	0.9448 [6.3600***] (0.0000)	0.8901 [6.0300***] (0.0000)
Capital expenditure	0.0785 [2.4400**] (0.0150)	0.0219 [0.6700] (0.5000)	0.0429 [1.3500] (0.1760)
Lag capital expenditure	-0.1185 [-3.0100**] (0.0030)	-0.0226 [-0.5500] (0.5830)	-0.0081 [-0.1900] (0.8470)
Firm growth	0.0687 [3.2700***] (0.0010)	0.0385 [1.9900**] (0.0470)	0.0261 [1.3900] (0.1660)
Firm size	-0.0713 [-4.3600***] (0.0000)	-0.0671 [-4.3600***] (0.0000)	-0.0661 [-4.3700***] (0.0000)
Interest rate		0.0310 [1.3600] (0.1740)	0.0317 [1.4100] (0.1580)
GDP		0.0003 [3.8700***] (0.0000)	0.0004 [4.0600***] (0.0000)
Inflation		-0.0065 [-1.2700] (0.2060)	-0.0061 [-1.2300] (0.2200)
Trade balance		0.0000 [-1.3800] (0.1690)	0.0000 [-1.2300] (0.2170)
Cash ratio			0.3647 [3.0100**] (0.0030)

[2] The coefficients of firm growth for high-cash holding firms and low-cash holding firms are 0.2329 and 0.0687; coefficients of firm size = for high-cash holding firms and low-cash holding firms are 0.0996 and 0.0713, respectively.

Table 6 Cont.

Lagged cash ratio			-0.1331 [-1.2100] (0.2270)
Ad R-square	0.3294	0.3876	0.4002
F-stat/ chi-square	104.7000	54.9300	44.7700
p-value	(0.0000***)	(0.0000***)	(0.0000***)

Note: The coefficient for the trade balance is positive and less than 0.0000. Significant at 0.01(*), 0.05(**), 0.001(***) level. t-values are in square brackets, p-values are in parentheses.

Liquidity is an important element in influencing firm's performance in low-cash holding firms; therefore the cash ratio carries a significant role in explaining firm's performance. Low-cash holding firms have to estimate the cash needed for daily operations and buffering accurately, otherwise a shortage of cash holdings and liquidity can lead to great damage and losses, both on reputation and operations. The adjusted R-square improves at 1.26 per cent from 0.3876 in Model 2 to 0.4002 in Model 3. The F-statistics for the three models in Table 6 are significant at 0.001.

Efficiency Scores and Cash-Holding of Listed Firms in Bursa Malaysia

As the Malaysian and South Korean markets are at different developmental stages, the results of the contribution of cash holdings toward firm's efficiency are expected to vary, especially with different levels of maturity in the investment climate, financial instruments and economic fundamentals. Cash holdings are believed to work better and contribute more to firm's performance efficiency in developed countries compared with developing countries. As mentioned in Chapter 1, a good investment climate is able to enhance the return of investment. Developing countries have to overcome or mitigate all kinds of barriers to achieve efficiency in order to increase the return of investment. Otherwise, with very minimal profits or even negative returns, firms would rather hold cash instead of investing it in other ways. Thus corporate cash holdings are unable to contribute to firm's efficiency.

In Table 7, the results in Model 1 for Malaysia show that firm growth and lagged capital expenditure are significant at 0.05 and firm size significant at 0.001, with the same expected sign for listed firms in Korea Exchange. The coefficient of firm growth is relatively smaller (0.0142 < 0.1191) and firm size is relatively higher (0.2061 > 0.1358) for listed firms in Malaysia compared with results for Korea Exchange. In Model 2, the macroeconomic variables that are significantly related with firm's efficiency are interest rate, GDP and trade balance. The interest rate factor is significant with a negative sign at 0.001, which can be explained by the effect of higher interest rates (higher cost of borrowing) that leads to higher outstanding debt burdens, especially for low-cash holding firms, which are more likely to rely on borrowings to finance working capital (refer to Forbes, 2002). Thus the burden of borrowing costs will generate a negative impact on firm's performance. The signs of the GDP and trade balance are the same. However, unlike the results for Korea Exchange, inflation does not seem to impact firm's efficiency in Malaysia. The adjusted R-square value in Model 1 is low at 0.1227 compared with the 0.3169 for Korea Exchange. However, the adjusted R-square rises to 21.82 per cent to 0.3410 in Model 2 after including the macroeconomic variables. This reflects that efficiency Malaysia is better explained by macroeconomic variables than firm-specific variables, which are completely different to those for Korea Exchange.

The table shows the three results of regressing efficiency score on firm level and macroeconomic variables over the fiscal year. The equation in model 1 regresses the efficiency score with firm level variables. The macroeconomic variables are added in model 2, and the cash ratio and lag cash ratio variables are included in model 3.

Table 7 Impact of firm level and macroeconomic variables on firm's efficiency for listed firms in Bursa Malaysia starting from 2002 to 2016

Independent variable	Dependent variable: efficiency score		
	Model 1	Model 2	Model 3
Constant	2.5275 [3.1600***] (0.0000)	1.5164 [3.5700***] (0.0000)	1.5036 [3.5300***] (0.0000)
Capital expenditure	0.0380 [1.5700] (0.1170)	0.0037 [0.1700] (0.8680)	0.0091 [0.4000] (0.6910)
Lag capital expenditure	0.0677 [3.0200**] (0.0030)	-0.0018 [-0.0900] (0.9300)	0.0084 [0.4200] (0.6730)
Firm growth	0.0142 [2.0900**] (0.0370)	0.0177 [2.6900**] (0.0070)	0.0181 [2.7200**] (0.0070)
Firm size	-0.2061 [-4.3200***] (0.0000)	-0.0731 [-4.6900***] (0.0000)	-0.0741 [-4.7900***] (0.0000)
Interest rate		-0.0477 [-5.4400***] (0.0000)	-0.0471 [-5.4500***] (0.0000)
GDP		0.0016 [5.7200***] (0.0000)	0.0017 [6.9300***] (0.0000)
Inflation		-0.0017 [-0.6000] (0.5480)	-0.0023 [-0.8000] (0.4220)
Trade balance		0.0000 [6.7600***] (0.0000)	0.0000 [7.1400***] (0.0000)
Cash ratio			0.1360 [2.9900**] (0.0030)
Lagged cash ratio			0.0491 [1.1400] (0.2550)
Ad R-square	0.1227	0.3410	0.3636
F-stat/ Chi-square	114.3100	412.6500	345.3200
p-value	(0.0000***)	(0.0000***)	(0.0000***)

Note: The coefficient for the trade balance is positive and less than 0.0000. Significant at 0.01(*), 0.05(**), 0.001(***) level. t-values are in square brackets, p-values are in parentheses.

The table shows the three results of regressing efficiency score on firm level and macroeconomic variables over the fiscal year. The equation in model 1 regresses the efficiency score with firm level variables. The macroeconomic variables are added in model 2, and the cash ratio and lag cash ratio variables are included in model 3.

Table 8 Impact of firm-level and macroeconomic variables on firm's efficiency for high-cash holding firms in Bursa Malaysia starting from 2002 to 2016

Independent Variable	Dependent variable: efficiency score		
	Model 1	Model 2	Model 3
Constant	3.0463 [3.3600***] (0.0000)	1.0936 [3.0900**] (0.0030)	1.2071 [3.4800***] (0.0010)
Capital expenditure	0.0425 [0.4200] (0.6790)	-0.0663 [-0.7700] (0.4470)	-0.0288 [-0.3100] (0.7550)
Lag capital expenditure	-0.0755 [-1.1100] (0.2700)	-0.1338 [-2.1500**] (0.0350)	-0.1198 [-1.9000*] (0.0620)
Firm growth	0.0133 [1.0400] (0.3020)	0.0122 [1.0100] (0.3140)	0.0164 [1.3100] (0.1960)
Firm size	-0.2523 [-3.5500***] (0.0000)	-0.0725 [-2.6000**] (0.0110)	-0.0877 [-3.1300**] (0.0030)
Interest rate		0.0196 (0.6700] (0.5080)	0.0195 [0.7100] (0.4800)

Table 8 Cont.

GDP		0.0022 [5.3900***] (0.0000)	0.0022 [6.2300***] (0.0000)
Inflation		-0.0023 [-0.2200] (0.8290)	-0.0024 [-0.2400] (0.8090)
Trade balance		0.0000 [5.0300***] (0.0000)	0.0000 [5.8400***] (0.0000)
Cash ratio			0.1046 [1.1800] (0.2430)
Lagged cash ratio			0.0160 [0.1800] (0.8560)
Ad R-square	0.1294	0.3154	0.3288
F-stat/ chi-square	19.0300	48.2100	51.0200
p-value	(0.0000***)	(0.0000***)	(0.0000***)

Note: The coefficient for the trade balance is positive and less than 0.0000. Significant at 0.01(*), 0.05(**), 0.001(***) level. t-values are in square brackets, p-values are in parentheses.

The table shows the three results of regressing efficiency score on firm level and macroeconomic variables over the fiscal year. The equation in model 1 regresses the efficiency score with firm level variables. The macroeconomic variables are added in model 2, and the cash ratio and lag cash ratio variables are included in model 3.

Table 9 Impact of firm-level and macroeconomic variables on firm's efficiency for low-cash holding firms in Bursa Malaysia starting from 2002 to 2016

Independent Variable	Dependent variable: efficiency score		
	Model 1	Model 2	Model 3
Constant	2.4681 [3.6900***] (0.0000)	1.5782 [3.6700***] (0.0000)	1.5500 [3.4500***] (0.0000)
Capital expenditure	0.0378 [1.5500] (0.1230)	0.0117 [0.5200] (0.6050)	0.0134 [0.5800] (0.5620)
Lag capital expenditure	0.0863 [3.6400***] (0.0000)	0.0167 [0.8000] (0.4260)	0.0242 [1.1500] (0.2500)
Firm growth	0.0152 [1.9600*] (0.0510)	0.0205 [2.8000**] (0.0050)	0.0201 [2.7100**] (0.0070)
Firm size	-0.2010 [-4.0200***] (0.0000)	-0.0724 [-4.3300***] (0.0000)	-0.0721 [-4.2900***] (0.0000)
Interest rate		-0.0592 [-6.5700***] (0.0000)	-0.0573 [-6.3800***] (0.0000)
GDP		0.0016 [5.4500***] (0.0000)	0.0016 [6.0200***] (0.0000)
Inflation		-0.0018 [-0.6100] (0.5450)	-0.0019 [-0.6700] (0.5060)
Trade balance		0.0000 [5.3500***] (0.0000)	0.0000 [5.5800***] (0.0000)
Cash ratio			0.1307 [2.5500**] (0.0110)
Lagged cash ratio			0.0481 [0.9600] (0.3370)
Ad R-square	0.1169	0.3524	0.3653
F-stat/ chi-square	101.2000	376.1800	305.3000
p-value	(0.0000***)	(0.0000***)	(0.0000***)

Note: The coefficient for the trade balance is positive and less than 0.0000. Significant at 0.01(*), 0.05(**), 0.001(***) level. t-values are in square brackets, p-values are in parentheses.

The firm size, firm growth, interest rate, GDP and trade balance remain significant with expected correct signs in results obtained for Model 3, and the newly-added cash ratio is significant with a positive sign at 0.05. The coefficient of the cash ratio is relatively small at 0.1360 compared with 0.4115 in Korea Exchange's result. It shows that the cash ratio has better explanatory power for efficiency in Korea Exchange, than in Malaysia. Therefore the contribution of cash holdings to firm's efficiency is higher in Korea Exchange than in Malaysia. Lagged cash ratio is insignificant, same as in Korea Exchange. The adjusted R-square improved from 0.3410 to 0.3636 in Model 3. The F-statistics for the three models are significant at 0.001.

Listed firms in Malaysia are regrouped to high-cash holding firms and low-cash holding firms: Table 8 and Table 9 which report the efficiency model results for high-cash holding firms and low-cash holding firms in Malaysia respectively. Firm growth becomes an insignificant variable in Model 1 to Model 3. In Model 1, only firm size is significant at 0.001 with a negative sign. The adjusted R-square is 0.1294. In Model 2, lagged capital expenditure and firm size are significant with a negative sign. Among all macroeconomic variables in Model 2, GDP and trade balance are significant with positive signs. As listed firm in Malaysia are involved in international trading activities, such as exports and imports, the trade balance impacts on firm's sales volume to some extent and lead the firm's efficiency changes. However, the coefficient of the trade balance is very small which means that the effect of trade balance on firm's efficiency is limited.

Efficiency of high-cash holding firms in Malaysia is not affected by the changes in interest rates. The interest rate usually impacts decisions on the cash flow and liquidity as firms have to meet the interest expenses obligations therefore it is expected to have no impact on firm's sales and efficiency. The adjusted R-square increased by 18.6 per cent after including macroeconomic variables as independent variables. The same variables are significant in Model 3 and the cash ratio and lagged cash ratio are insignificant, which is similar to high-cash holding firms in Korea Exchange. This further corroborates evidence that cash ratio does not generate any impact on high-cash holding firms as cash is no longer their main concern in improving organizational efficiency. The F-statistics are significant for the three models in Table 8.

From the results for low-cash holding firms in Bursa Malaysia as presented in Table 9, Model 1 shows that the lagged capital expenditure and firm size are significant with negative signs. Firm growth is significant with a positive sign in Model 1 at 0.1. In Model 2 lagged capital expenditure becomes insignificant after considering the impact of macroeconomic variables. Firm growth, firm size, interest rates, GDP and trade balance remain significant with expected signs in Models 2 and 3. The adjusted R-square increased by 23.55 per cent from Model 1 to Model 2. This reveals that firm's efficiency of low-cash holding firms is more about exploring the changes in macroeconomic variables, compared with high-cash holding firms in Bursa Malaysia. Therefore the explanatory power of macroeconomic variables aids in improving the fit of the model for low-cash holding firms with a higher rise in the adjusted R-square. The cash ratio in Model 3 is significant at 0.05 with the coefficient of 0.1307, which is lower compared with 0.3647 for low-cash holding firms in Korea Exchange. The difference between the findings in Korea Exchange and Bursa Malaysia are limited as the results seen are akin to each other.

The results and discussion of each objective begins with descriptive statistics for the relevant variables involved in the stud, follow by two sample t test on the mean of several interested elements that might be difference due to the amount of cash holdings hold by firm.

CONCLUSION

The aim of this study is to examine corporate cash holdings from different sentiments and aspects, in two selected Asia-Pacific countries, namely South Korea and Malaysia. The DEA estimation that yielded TE is employed to enhance the accuracy of the evaluation of firms' ability in generating earnings and offering comparative figures to compete with other firms. Besides, since the DEA model is a non-parametric technique, the measure of efficiency generated is regressed with other relevant firm-specific and macroeconomic variables in order to obtain statistical evidence to support the linear relationship between firm's efficiency and other tested variables. Findings supported by combining non-parametric and parametric tests are capable of providing more comprehensive evidence at a relatively higher degree of reliability (Kriebel, 1999) as they can overcome the disadvantages of non-parametric and parametric methods. In the second stage, the findings of the regression compare firm's efficiency with internal and external variables.

The findings on Bursa Malaysia and Korea Exchange conclude that cash holdings do aid in improving the firm's efficiency model as the adjusted R-square is significantly increased for all models. However, cash holdings are not related with the efficiency of high-cash holding firms for these two stock exchanges. Overall, the results for high-cash holding firms and low-cash holding firms for listed firms in both Bursa Malaysia and Korea Exchange are akin to each other. The contribution of cash holdings to firm's efficiency is higher for a developed country (Korea Exchange), compared with a developing market (Bursa Malaysia); this shows that the development level of the country impacts the contribution of cash holdings to firm's efficiency.

REFERENCES

Acharya, V.V., Davydenko, S.A. and Strebulaev, A.A. (2011) Cash holdings and credit risk. NBER Working paper no. 16995.

Anagnostopoulou, Seraina C. (2012) Cash Holdings: Determinants and Impact on Future Operating Performance for Listed vs. Unlisted Firms. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2028605

Berg, S. (2010) Water Utility Benchmarking: Measurement, Methodology, and Performance Incentives. International Water Association.

Cabbalero, S.B., Teruel, P.G. and Solano, P.M. (2010) Working capital management in SMEs. *Accounting and Finance*. 50. pp. 511-527.

Chang, K. and Noorbakhsh, A. (2006) Corporate cash holdings, foreign direct investment, and corporate governance. *Global Finance Journal*. 16(3), pp. 302-316.

Coelli, T., Rao D. and Battese, G. (1998) An Introduction to Efficiency and Productivity Analysis. Boston: Kluwer Academic Publishers, pp. 158.

Cooper, W.W., Park, K.S. and Yu, G. (2001) An illustrative application of idea (imprecise data envelopment analysis) to a Korean mobile telecommunication company. *Operations Research*. 49(6), pp. 807-820.

Couderc, N. (2005) Corporate cash holdings: financial determinants and consequences. 2005 EFMA Corporate Governance Symposium, working paper.

Dittmar, A., Mahrt-Smith, J. and Servaes, H. (2002) International corportae governance and corrporate cash holdings. Journal of Financial and Quantitative Analysis.

Fazzari S.M. and Petersen B.C. (1993) Working Capital and Fixed Investment: New Evidence on Financing Constraints. *RAND Journal of Economics, The RAND Corporation*. 24(3), pp. 328-342.

Ferreira, M.A. and Vilela, A. (2004) Why do firms hold cash? Evidence from EMU countries. *European Financial Management*. 10, pp. 295-319.

Harford, J., Mansi, S.A. and Maxwell, W.F. (2008) Corporate Governance and Firm Cash Holdings in the US. *Journal of Financial Economics*. 87, pp. 535-555.

Jensen, M.C. (1986) Agency costs of free cash flow, corporate finance and takeovers. *American Economic Review*. 76, pp. 323-39.

Julea Binti Supar, Siti, Bujang, Imbarine and Abdul Hakim, Taufik. (2018) Effect of Cash Holding Towards Firm's Efficiency: Moderating Effect of Earning Quality. pp. 123-133. 10.1007/978-981-10-6053-3_12.

Kao, C., Hwang, S.N. and Sueyoshi, T. (2003) Management Performance Evaluation: Data Envelopment Analysis (in Chinese). Taipei: Hwatai.

Kauffmann, P., Unal, R., Fernandez, A. and Keating, C.B. (2000) A Model for Allocating Resources to Research Programs by Evaluating Technical Importance and Research Productivity. *Engineering Management Journal*. 12 (1), pp. 5-8.

Keynes, J.M. (1936) The General Theory of Employment. In: Interest and Money. Harcourt Brace, London.

Kim, C.S., Mauer, D.C. and Sherman, A.E. (1998) The determinants of corporate liquidity: theory and evidence. *Journal of Fianncial and Quantitative Analysis*. 33, pp. 335-359.

MacMillan, I.C. and Day, D.L. (1987) Corporate ventures into industrial markets: Dynamics of aggressive entry. *Journal of Business Venturing*. 2(1), pp. 29-39.

Mikkelson, W.H. and Partch, M.M. (2003) Do persistent large cash reserve hinder performance?. *Journal of Financial and Quantitative Analysis*. 38, pp. 275-294.

Mulligan, M. (1992) Nike gets rights to Jordan apparel. Chicago Sun-Times, pp. 91.

Opler, T., Pinkowitz, L., Stulz, R. and Williamson, R. (1999) The determinants and implications of corporate cash holdings. *Journal of Financial Economics*. 52, pp. 3-46.

Opler, T., Pinkowitz, L., Stulz, R. and Williamson, R. (2001) Corporate cash holdingsJournal of Applied Corporate Finance. 14, pp. 55-67.

Ozkan, A. and Ozkan, N. (2004) Corporate cash holdings: an empirical investigation of UK companies. *Journal of banking & Finance*. 36 28(9), pp. 2103-2134.

Pan, C.H. (2006) Why are firms with entrached managers more likely to pay dividends? Working paper, Ohio State University.

Rafinda, Ascariena. (2018) Determinants of Cash Holdings in Developed and Developing Countries. *Jurnal Dinamika Manajemen.* 9, pp. 1-11. 10.15294/jdm.v9i1.14647.

Shao, B.B.M. and Lin, W.T. (2002) Technical efficiency analysis of information technology investments: a two-stage empirical investigation. *Information and Management*. 39(5), pp. 391-401.

Shinada Naoki (2012) Firms' Cash Holdings and Performance: Evidence from Japanese corporate finance. Discussion papers 12031. *Research Institute of Economy, Trade and Industry (RIETI).*

Whited, Toni M. (1992) Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data. *Journal of Finance, American Finance Association.* 47(4), pp. 1425-60.

Wu, W.Y., Tsai, H.J., Cheng, K.Y. and Lai, M. (2006) Assessment of intellectual capital management in Taiwanese IC design companies: using DEA and the Malmquist productivity index. *R&D Management*. 36, pp. 531-545.

Zariyawati Mohd Ashhari and Annuar Md Nassir. (2009) Practices of Working Capital Mangement Policies in Malaysia. *Academy of Taiwan Business Management Review*. 5(1), pp. 56-61.