THESIS OF THE DOCTORAL (PhD) DISSERTATION

FINANCIAL PERFORMANCE ANALYSIS OF STOCK EXCHANGE LISTED MONGOLIAN COMPANIES

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Debrecen

2020

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INTRODUCTION

Performance evaluation plays an essential role in every type of business; used for revealing their deficiencies and comparing current business activities with that of their peers. However, the importance of performance measurement is underestimated in Mongolia.

As for business entities, one of the most crucial goals is producing and selling their goods and services, which are assured for customers' satisfaction with their quality and design. Every manager and investor aim to work efficiently to raise the company's value. However, every business and sector have uncertainty, which is needed to be determined and managed. It is important to evaluate the financial performance to protect a business, with that of their peer companies, as well as to be able to take corrective steps. The systematic comparison of the performance of one entity against other entities (benchmarking) helps to detect disadvantages the company investigated and helps to find out the way to improve its performance. Performance evaluation ratios can be an action guide on what should be done (Tehrani et al., 2012).

Producing goods and services without any waste is important for companies to survive economically, which is called efficiency, which had been achieved by a company for a specific period. Although efficiency is determined in many ways, yet there is not perfect and exact determination. The most widely used efficiency approach is Farrel efficiency, which seeks the possibility to reduce input without changing output or increase output without increasing input. Another important efficiency measurement tool is allocative efficiency. "Allocative efficiency (AE) is related to the choice of the least costly resource mix; in terms of output, it relates to the choosing a revenue-maximizing product mix" (Bogetoft & Otto, 2011). Allocative efficiency seeks the optimal products, and services must be produced without waste and by the minimal costs to maximize the profit.

Efficiency measurement methods can be divided into three main categories: ratio indicators, parametric, and non-parametric methods (Vincová, 2005). Efficiency measurement usually applies one of the following analyses: DEA (Data Envelopment Analysis) or SFA (Stochastic Frontier Analysis). However, it is not common to use and compare both models in one study. It is important to mention that there is not any research concerning performance measurement, which used Mongolian companies' financial data. Therefore, financial ratios were used as variables to execute parametric and non-parametric methods in the case of Mongolia.

Mongolian companies are divided into public companies (listed companies) and private companies (unlisted companies). As stated in the Mongolian law of auditing, listed companies' financial statements must be audited before stockholders' general meetings. This regulation increases the reliability of data compared with unlisted companies' financial statements. Because of data availability and reliability, listed companies' financial statements can be used to analyze the Mongolian economy since they cover the main sectors of the Mongolian economy. The thesis analyzes the financial performance of 100 Mongolian companies - listed on the Mongolian Stock Exchange (MSE) from 2012 to 2018.

Researchers aimed to examine financial performance determinants for a long time (for instance, Elliot (1972); Capon et al. (1990); Kipesha and James (2014), etc.) However, industrial characteristics are one of the most important aspects to consider when it comes to analyzing performance. In other words, every sector differs considering its operations and characters; therefore, different sectors can have different determinants. If we compare financial ratios of companies in different sectors, the financial analysis would be inadequate due to the different sector characteristics. The thesis applied panel regression (fixed and random effect model) to identify the financial performance determinants of each sector. Agriculture and mining are the predominant sectors in the Mongolian economy, followed by construction and industrial sectors. Businesspeople and investors have often criticized Mongolian economic sectors due to their inefficiency. Based on the importance of industrial characteristics, companies are divided into three different sectors in financial analysis: heavy industry, manufacturing, and service. Each sector was analyzed separately and compared by their efficiencies.

The importance of the thesis is twofold. Firstly, the thesis compares the Mongolian economy with three other Asian countries' economies, studies Mongolian current economic situation, and determines economic growth factors. Secondly, it evaluates the financial performance of Mongolian companies in different sectors and with corporate sizes. Accordingly, output variables and their determinants are diagnosed by panel regression. Also, the thesis uses frontier efficiency techniques across parametric and non-parametric approaches to estimate corporate efficiency. Frontier efficiency estimations applied were the following: output-oriented DEA, input-oriented DEA, DEA combined with Principal Component Analysis (PCA), DEA with k-medoids clustering, and SFA.

Research justification

Businesspeople and investors often debate Mongolian economic sectors due to their inefficiency. Therefore, the financial performance of Mongolian three main sectors (heavy industry, manufacturing, and service) and different sizes (SMEs and big corporates), are examined and compared to recommend appropriate suggestions to improve their efficiency.

In the thesis, financial performance is measured by DEA and SFA using secondary data published by Mongolian Stock Exchange from 2012 to 2018.

Research hypotheses

Hypothesis 1 (H1): The heavy industry is the most efficient sector in the Mongolian economy like other selected Asian countries.

Hypothesis 2 (H2): Big corporates are more efficient than SMEs.

Hypothesis 3 (H3): The k-medoids clustering improves the performance measurement of the Mongolian companies investigated.

Hypothesis 4 (H4). Efficiency results by SFA are compatible with that of DEA and PCA-DEA in the case of Mongolian listed companies.

Hypothesis 5 (H5). IC has a significant positive impact on financial performance.

1 PERFORMANCE MEASUREMENT SYSTEM

The Performance Measurement System (PMS) is used by an organization not just to determine whether its objectives have been met but also as a means of comparing the performance with that of other DMUs (Masri, 2013). DMUs can be firms, organizations, divisions, industries, projects, or individuals. PMS may be considered as one of the most interesting managerial innovations over recent years because they pose as the important organizational-informative link between strategic planning and operational control (Tonchia & Quagini, 2015). Understanding performance measurement will give managers insight into what makes a good measurement system. Performance measurement has been challenging, since what can be evaluated and what is wanted to be evaluated differs. If we want to manage performance, we have to be able to measure it: you can manage what you can measure (Tonchia & Quagini, 2015). In other words, we can only measure how the firm performed in the past, which does not always have to be the same in the future. Measuring performance solely based on the financial metrics would be like driving a car by looking in the rear-view mirror since financial metrics show only the performance of the past. Therefore, Robert Kaplan and David Norton introduced the Balanced Scorecard (BSC), which is one of the most popular PMS models. BSC uses financial and non-financial information in four different area so-called legs, as can be seen from Figure 1.1. Firms may fail regardless of their sizes, often due to incapacity to execute on a balanced strategy. BSC is also designed to ensure that performance metrics and strategic goals are balanced with financial and non-financial, operational and financial, leading and lagging indicators (Nair, 2004).

DMUs usually overanalyse financial perspective; however, they tend to forget the link between the company's strategy and financial goals. From the financial perspective, we should remember that financial ratios are lagging indicators as they are recorded based on past activities. Customer Perspective measures how satisfied our customers are based on the service and products delivered. Internal Business Processes Perspective measures how the company educate their employee and use the knowledge to maintain its competitiveness in the market. Organizational Capacity Perspective: measures the critical-to-customer process requirements and measures. If one of these perspectives is not measured, analyzed, and improved, and operating business would be like sitting on the chair with a broken leg and ends with failure. A

PMS should be integrated with at least three other types of systems (Tonchia & Quagini, 2015), as shown in Figure 1.1.

- The Accounting or Management Control System (including internal and external accounting such as cost performance data)
- The Production Management System (material requirements, production capacity, integration to all corporate areas provides mostly non-cost data, i.e., performance targets)
- The Strategic Planning System

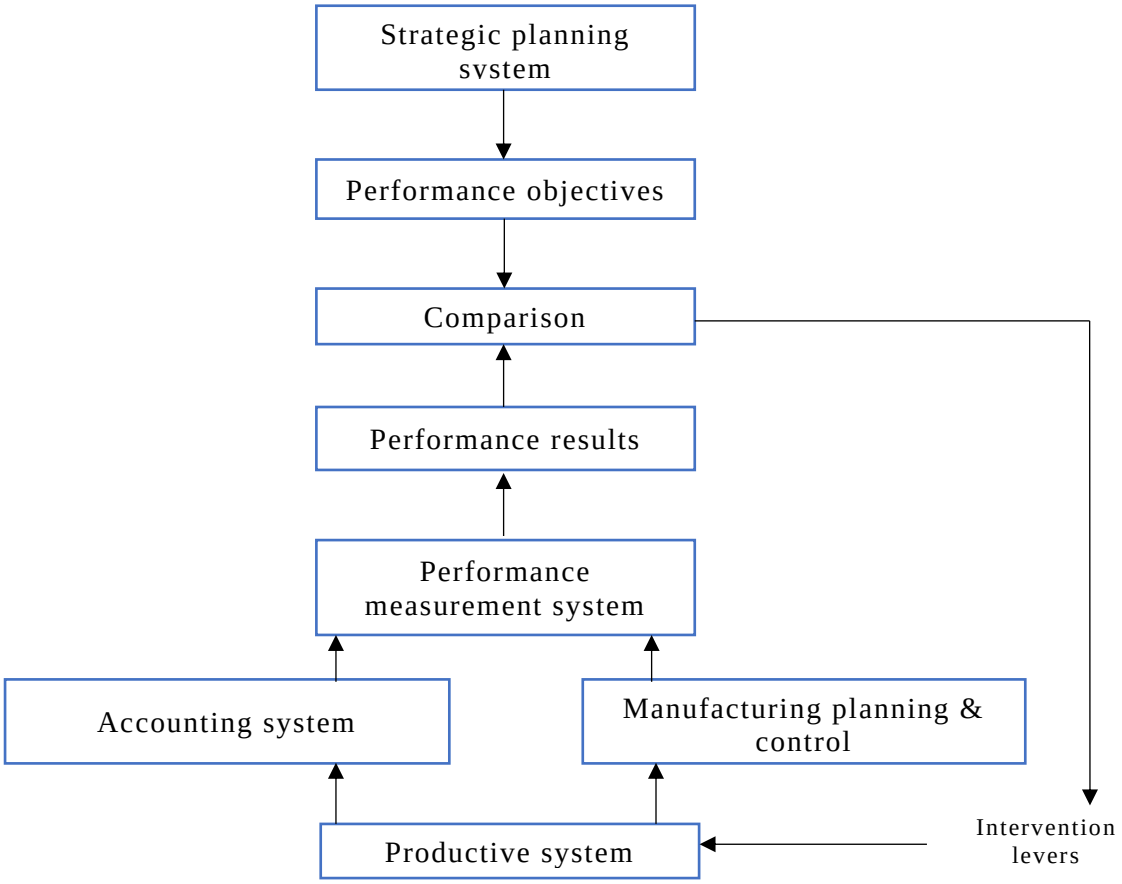

Figure 0.1 Integration between PMS and other firm's systems

Source: Tonchia & Quagini, 2015

"Efficiency measurement methods can be divided into three main categories: ratios, parametric, and non-parametric methods" (Vincová, 2005). A main difference between the parametric and the non-parametric approaches is the estimation method. Data Envelopment Analysis (DEA) is a non-parametric approach to weigh the inputs/outputs and measure the relative efficiency of DMUs (Ablanedo-Rosas et al., 2010). "Stochastic Frontier Analysis (SFA) is a parametric

approach and is suited to measure efficiencies of the industry using input/output information" (Lin and Tseng 2005). "Whereas the DEA methods rely on the idea of minimal extrapolation, the parametric approaches use classical statistical principles, most notably the *maximum likelihood principle"* (Bogetoft and Otto, 2011).

2 DATA AND METHODOLOGY

This chapter explains performance measurement methodologies employed in the thesis, along with its data. The thesis utilizes two sets of secondary data. The first data set is financial reports which are collected from the Mongolian Stock Exchange's (MSE) website. The second's data set is statistical information, which is provided by the National Statistics Office of Mongolia, Statistics of the Central Bank of Mongolia, Central Intelligence Agency, and the World Bank's statistics.

To reveal the characteristics of the Mongolian economy, Mongolian economic growth was compared with some Asian countries' economic growth (i.e., Kazakhstan, Kyrgyzstan, and Indonesia). The macroeconomic variables, which cover 26 years from 1991 to 2017, are obtained from the World Bank website. The criteria to choose the countries are to be dependent on mining export economically and to be classified as lower-middle-income countries like Mongolia. However, Kazakhstan is an exception since it is classified as an upper-middle-income country. Nevertheless, Kazakhstan is located in a similar geographical area and possesses oil reserves and minerals.

Mongolian companies are organized in either of two ways: public and non-public companies. According to statistics from the Mongolian General Department of Taxation (2018), 334 public companies are registered as taxpayers by the end of June 2018, while the number of registered non-public companies is enormously high, which is 135,850. As stated by the Mongolian law of auditing, public companies' financial statements must be audited before stockholders' general meetings, which increases the reliability of the data compared with non-public companies' financial statements (Law of Auditing, 2015). In 2018, 85.9% of the companies reported their financial statements to the Departments of Taxation. From the above companies, 50.6% of the financial statements were declared with loss, while 40% of the companies stayed dormant. As for 2019, 100,909 companies reported their corporate income tax. From that above, 42,549 companies (42.1%) declared X statements – stayed dormant. It shows that performance measurement is needed for those companies to reveal their failures and to improve their competitiveness. Competitiveness is determined by effectiveness and efficiency (Csath, 2007). The "competitiveness of the corporation and its performance is judged by comparison with its peers and against the best practice" (Manzoni, 2007).

A researcher cannot cover all the companies' financial statements within the constraints of time and resources. Therefore, I chose public companies' financial reports as my secondary data. Since the public companies' financial reports are required to be audited, their data are more reliable than of the non-public companies, and they are publicly available from the MSE website. Moreover, public companies cover the main sectors and different sizes so they can provide a good representation of the population.

MSE was established in connection with the transition period from a centrally planned economy to a market economy in Mongolia on 18 January 1991. Mongol Shiltgeen company became a public company by issuing 10 million shares, and 1 million shares of them offered to the public and registered at Mongolian Stock Exchange on 25 May 2005, which was the first IPO launched in Mongolia ("Mongolian Stock Exchange - History," 2015). From 2009, MSE started uploading downloadable financial statements, which included only 9 companies' financial statements at that time. In 2010, the number of publicly available financial statements rose dramatically from 9 to 100. However, the form of financial statements was changed in 2012, which made it difficult to compare the financial statements before and after 2012. Although there are 334 registered public companies, I could not use the statements of all the companies in my analysis. Some companies' financial reports were deducted from research due to bankruptcy; others had no annual reports, or their reports contained zero values in their majority. Out of 334 companies, only 137 companies reported their financial statements of 2017 publicly. After excluding the companies that possessed not adequate financial statements and which did not do any activities, the actual unbalanced sample for the 100 public companies remained as a database (this number includes three companies went bankrupt in 2016 and 1 bankruptcy in 2017). The financial statements of 100 public companies were available for the period 2012-2018, which met the requirements of consistency and accuracy. The data of the unbalanced panel is divided into three main sectors: heavy industry 33, manufacturing 31, and service companies 36 (Table 2.1).

The methods applied in the research were: panel regression, DEA, SFA, Principal Component Analysis (PCA), k-medoids clustering, and Unconditional Quantile Regression (UQR). Since the database contained cross-sectional and time-series data, the panel data analysis was employed. Panel models with fixed or random effects were used, and the choice was based on the results of the Hausman specification test in the thesis. One of the main methods of the thesis

were DEA and SFA, which have been widely applied to evaluate efficiency in different countries and different sectors, but not yet in Mongolian case.

Table 0.1 Financial statements by sectors and years

Industry	2012	2013	2014	2015	2016	2017	2018	Total
Heavy Industry (total):	33	33	33	33	32	32	32	228
- *Thermal Power Station*	10	10	10	10	10	10	10	70
- *Construction*	9	9	9	9	8	8	8	60
- *Heavy manufacturing*	3	3	3	3	3	3	3	21
- *Mining*	11	11	11	11	11	11	11	77
Manufacturing (total):	31	31	31	31	30	29	29	212
- *Food industry*	13	13	13	13	13	13	13	91
- *Light industry*	8	8	8	8	7	6	6	51
- *Agriculture*	10	10	10	10	10	10	10	70
Service (total):	36	36	36	36	35	35	35	249
- *Transportation*	5	5	5	5	5	5	5	35
- *Trade*	6	6	6	6	6	6	6	42
- *Other services*	25	25	25	25	24	24	24	172
Total number of financial statements	100	100	100	100	97	96	96	689

Source: Author's computation

Both DEA and SFA require input and output data; therefore, measuring the input and output attributes is fundamental. However, it is hard to acquire these data for outsiders. Moreover, companies use different inputs and produce different outputs. Therefore, inputs and outputs are generally replaced by financial ratios. Also, when data appertain companies of different sizes, financial parameters expressed in monetary values should be avoided. Considering above mentioned problems, I used financial ratios as variables, which can be an output of each 3 sectors. Three ratios were used as dependent variables (ROE, ROA, and ROS) separately and were determined the financial performance impacts for each of the three sectors.

Multidimensional scaling was applied to determine the differences in comparable countries to Mongolia's economy. Stepwise regression was used to select the variables for further examinations. Pearson correlation was applied to examine the correlation between variables. MANOVA and one-way ANOVA were used to determine statistically significant differences among the sectors' efficiency results. R-Excel and SPSS software were used for the calculations throughout the thesis.

Table 0.2 Variables used in the estimation

Variables		Measured by
Dependent variables:		
Y1	Return on assets (ROA)	Net profit divided by total assets
Y2	Return on equity (ROE)	Net profit divided by equity
Y3	Return on sales (ROS)	Net profit divided by sales
Independent variables:		
X1	Cost to revenue ratio	Cost divided by revenue
X2	Gross profit margin	Gross profit divided by revenue
X3	Return on costs	Net profit divided by costs
X4	Asset turnover ratio	Revenue divided by total asset
X5	Assets to equity ratio	Assets divided by equity
X6	Debts to total asset	Debts divided by total asset
X7	WC turnover ratio	Sales divided by working capital
X8	Current assets/Total assets	Current assets divided by total assets
X9	Operating cash flow ratio	Operating cash flow divided by revenue
X10	Quick ratio	Liquid assets divided by short-term debt
X11	Current ratio	Current assets divided by short-term debt
X12	Cash ratio	Cash divided by short-term debt
X13	Operating cycle	Inventory turnover plus receivables turnover
X14	Net operating cycle	Operating cycle subtracted by payables turnover
X15	Receivable turnover (days)	365 divided by receivables turnover (times)
X16	Inventory turnover (days)	365 divided by inventory turnover (times)
X17	Payable turnover (days)	365 divided by payables turnover (times)
X18	Assets growth	Assets (current year) divided by assets (previous year)
X19	Sales growth	Sales (current year) divided by sales (previous year)

Source: Author's compilation

3 RESEARCH FINDINGS AND EVALUATION

This chapter includes empirical analysis and discussions about the results of the research. There are four subchapters in this section. At first, Mongolian economic growth is compared with that of some other Asian countries (i.e., Kazakhstan, Kyrgyzstan, and Indonesia). Secondly, the characteristics of Mongolian economic growth and crucial sectors of the Mongolian economy are investigated. Although the companies are in many different sectors, the thesis deals with three main sectors, which are manufacturing, heavy industry, and service sectors. The appropriate descriptive analyses preceded the empirical analyses. A fixed or a random

effects model, what was adequate based on a test, were used the variables examined in the thesis. By k-medoids clustering, companies were classified by their size to measure their performance properly and to offer appropriate suggestions. The financial performance of Mongolian listed companies was determined in the case of sectors and the sizes using DEA, PCA-DEA, and SFA methods. The objectives and chosen analysis are summarized in **Table 0.1**.

Table 0.1 Empirical strategies

	Research objectives	Data analysis strategy
1	Comparing Mongolian economic growth with that of other Asian countries.	Stepwise regression Multidimensional scaling
2	Examining Mongolian economic growth and economic sectors, identifying Mongolian economic growth determinants	Descriptive analysis Regression analysis
3	Examining ratios which can determine the financial performance of three main sectors in the Mongolian economy.	Ratio analysis Panel regression
4	Analyzing the heterogeneity of data	k-medoids clustering
5	Performance measurement	DEA, SFA, PCA-DEA methods
6	Analyzing the impact of Intellectual Capital on financial performance	ANOVA, MANOVA, UQR methods

Source: Author's compilation

As for DEA, input-oriented VRS and CRS models, as well as super efficiency, were implemented. Size and sector-related suggestions and recommendations were made. Results of the DEA, PCA-DEA, and SFA methods were compared, and the results' consistency was evaluated. Descriptive analysis and regression analysis were computed by SPSS, while k-medoids, DEA, PCA-DEA, and SFA methods were calculated by R-Excel (an add-in for Microsoft Excel).

The procedures for the efficiency analysis of the integrated PCA-DEA model in this thesis can be seen in Figure 3.1.

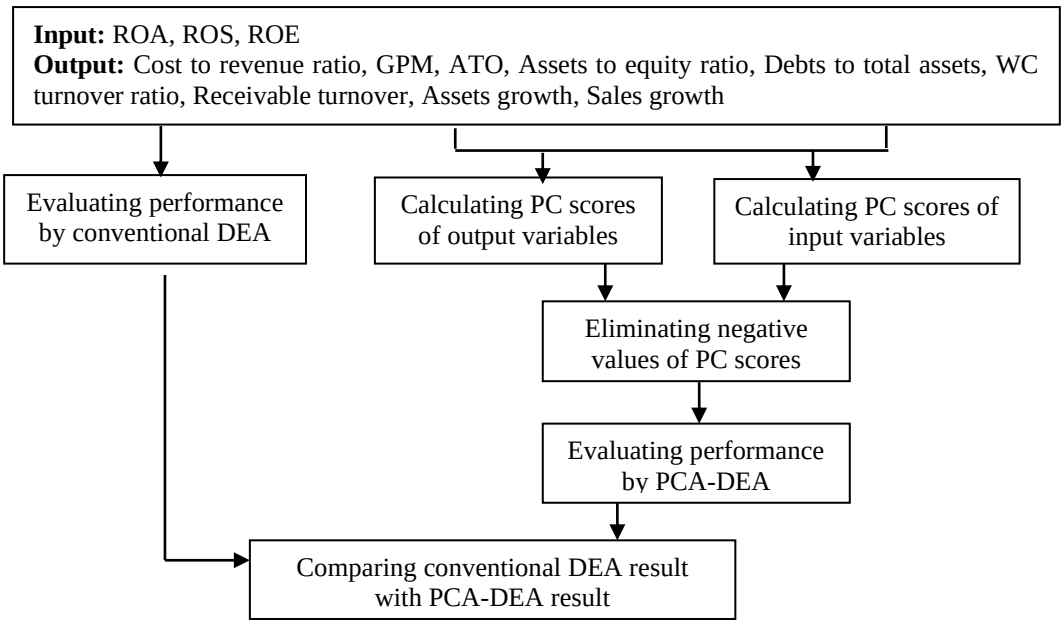

Figure 0.1 Flowchart of the stages of the thesis

Source: Author's compilation

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions to Comparison of Some Asian Countries' Economic

Mongolian economic growth is compared with the selected three Asian lower-middle-income countries' economic growths, i.e., Kyrgyzstan, Kazakhstan, and Indonesia. Economic growth is determined by two dependent variables and 20 independent variables. ANOVA test revealed that the most independent variables are significantly different among countries, except inflation rate and consumer price index. On the contrary, none of the dependent variables is significantly different among the countries. Consumer price index and employment to population ratios are significantly important ratios for all the four countries' economic growth. The urban population significantly affects economic growth except for Kyrgyzstan. Although the inflation rate and consumer price index together determine 80.5% of the economic growth, there is high multicollinearity among the macroeconomic variables.

According to multidimensional scaling results, the Indonesian economy is significantly different from other countries' economies, while Kyrgyzstan's economy is the most similar to the Mongolian economy. As for Mongolian and Kyrgyzstan economic growth, only 38.9% and 23.8% are explained by the given variables. Moreover, both countries' economic growth is explained by different variables. Consequently, it is assumed that the Mongolian economy is unique and inappropriate to compare with that of other countries, which suggests that there are significant differences between the Mongolian economic growth and the other selected Asian countries' economic growth.

Therefore, it is not appropriate to compare Mongolian companies with foreign companies from different economic situations. Companies are compared to their sectors and sizes.

4.2 Conclusions to Mongolian Economy and Economic Growth

Mongolian economy relies heavily on mineral extraction, particularly copper, coal, and gold. The mining sector's exports can explain it constituted up to 89.2% of the total export. The mining sector constitutes 20.7% of the GDP (in 2016); however, only 3.3% of the workforce is related to the mining sector. On the contrary, the agricultural sector provides most of the workplace, which is 30.36% of the total workforce (348,487 people) in 2016, although this sector constitutes only 11.68% of the total GDP (2,796.1 million MNT). The number of

herdsmen is relatively small in comparison to the total population, which is about 10% of the population; however, the number of livestock is approximately 19.72 times more than the population. Surprisingly, the output growth of the animal husbandry was shown to be statistically insignificant to the NDP growth rate, although Mongolia has traditionally been based on agriculture or rather animal husbandry. In 2016, the construction sector made up 3.96%. This sector faces challenges due to the harsh climate and the shortness of the business activity period. The service sector also plays an essential role in the Mongolian economy by constituting 41.65% of total GDP and employing 37.35% of the total workforce.

NDP is chosen as a dependent variable representing the Mongolian economy. Mongolian economic determinants are the growth rate of export, which have a robust positive correlation with the NDP growth rate. Dollar rate growth showed a very strong negative relationship with the rate of economic growth: the correlation coefficient equals -0.65 with the p-value of 0.005. The inflation rate exhibits a significant correlation with economic growth: a coefficient of 0.60 with a p-value of 0.01. The dollar rate growth, inflation rate, and growth of export were responsible for 81.4% of the variation in NDP growth rates of Mongolia. Export growth itself can explain 63.9% of Mongolian economic growth. Export growth is the most influential determinant in Mongolian economic growth. Dollar exchange rate growth is responsible for 42.2% of economic growth. The high values of the coefficients of variation indicate that the variability and inhomogeneity are also enormously high.

4.3 Conclusions to Performance Evaluation

The chosen variables had huge variability, and the more significant part of their total range was in the fourth quarter. Therefore, k-medoids is applied to classify companies based on their sizes. According to the silhouette method, 90 companies are classified in the 1st cluster (SMEs), while only 10 companies were in the 2nd cluster (big companies). The second cluster's companies (big companies) earn approximately 108 times more profit than SMEs on average, which also demonstrates the substantial difference between the two clusters.

As for SMEs, only manufacturing companies have positive profitability ratios, while service and heavy industry have negative ones. SMEs have a low and negative amount of NWC turnover ratio (-21.03). It shows that SMEs invest in excessive receivables and inventories to support their sales, which could lead to an excessive amount of bad debts or obsolete inventory.

ROS ratio is much higher in big companies than SMEs, which means that larger companies pay greater attention to cost management than the smaller ones. Moreover, the value of ROA is about ten times higher in big companies than SMEs, which means the efficiency of asset management in larger companies is much better than smaller companies. Hypothesis 2 is supported. *Big corporates are more efficient than SMEs.*

Panel regression is employed on the whole dataset as well as separately on each sector to calculate sector-specific performance determinants. Debts to total assets ratio have significant positive impacts on ROE only, while this ratio has significant effects on all output variables on the whole dataset. Although sales growth and asset growth have significant positive effects on the ROA of the whole dataset, growth does not determine the manufacturing sector significantly. As for the service sector, operational flow is tightly connected with current assets rather than non-current assets. Therefore, it can be concluded that the proportion of liquid assets influences the service sector's profitability positively. Also, it is noteworthy that liquidity does not determine the financial performance of Mongolian companies. The operating cycle determines only the service sector. On the one hand, the payables turnover ratio is significant only for heavy industry. On the other hand, the cash ratio is significant only for the heavy industry. VRS model using general ratios determined more than half of the companies as efficient regardless of sector and output variables (ROA, ROE, ROS). In contrast, the CRS model defined most of the companies working under the efficiency range of 0.0-0.4. Therefore, the selection of VRS and CRS models is vitally important, which must be made carefully. The change of the model significantly changes the efficiency score.

Furthermore, it is assumed that either the input ratios are too many compared with the number of DMUs, or the VRS model is not appropriate as it cannot discriminate between efficient and inefficient companies.

On efficiency scores, unrelated ANOVA was executed using the sector as a factor. The F-test was significant (significance level = 0.05). Therefore, it is concluded that the significant difference exists efficiency results among the sectors. To identify which sector, differ from other sectors, I continued unrelated ANOVA on pair of sectors separately. As for the Heavy industry and service sector, unrelated ANOVA on CRS (sector as a factor), revealed significant difference, F-test showed a significant difference at a significance level 0.01. Likewise, there

was also a significant difference between the Heavy industry and manufacturing sector; F-test was significant at a significance level of 0.01. However, the efficiency of service and manufacturing did not differ significantly based on F-test.

Sectors' efficiency results show that sector-specific determinants do not necessarily mean better efficiency results. Hypothesis 1 is refuted. *(H1): The heavy industry is the most efficient sector in the Mongolian economy.*

PCA-DEA model used the first two PCs of output variables and the first five PCs of input variables. The efficiency scores were either too low (between efficiency range 0.0-0.3) or too high (more than half of the companies are efficient) in DEA. However, PCA-DEA gave similar consistent results in the case of 3 sectors and two sizes. For example, PCA-DEA by VRS determined 17 efficient companies, while 15 companies were efficient in the case of the CRS model. If we classified companies by sector, 9 service companies were efficient, including only one big corporate (both VRS and CRS model). As for the manufacturing sector, big companies were inefficient by PCA-DEA, while four efficient companies (VRS) and three efficient companies (CRS) were determined. In heavy industry, the number of efficient companies was the same as the manufacturing sector' (4-VRS, 3-CRS); however, one of the efficient companies was the biggest mining company in Mongolia. In PCA-DEA, efficiency scores were closer to a normal distribution. This shows that the level of information reduction has a considerable effect on the classification of efficiency. It suggests that DEA efficiency scores can be improved by using principal component analysis.

The mean efficiency score of SFA was comparatively higher than that of DEA. As for the DEA method, 11 companies were efficient, while the SFA model did not determine any efficient company. However, more than half of the DMUs were determined as working in the efficiency range of 0.9-1. As two methods showed entirely different efficiency results, correlation of efficiency scores from DEA and SFA were calculated. Pearson's correlation results showed a moderate negative correlation (-0.34) on efficiency scores from SFA and ROA. Efficiency results were inconsistent. Also, the variables determined by panel regression were insignificant in the case of SFA. Therefore, SFA is assumed as an inappropriate model to evaluate Mongolian companies' financial performance. Hypothesis 4 is rejected. *H4: Efficiency results by SFA are compatible with that of DEA in the case of Mongolian listed companies.*

In the final stage of the research, the impact of IC on financial performance is analyzed - via UQR. ROA was chosen as dependent variables, while MVAIC and its four components were regarded as independent (CEE, SCE, HCE, and RCE). Uqr packages of the R statistical program was used for the analysis.

As data contains outliers, companies were classified into four ranges based on their sizes representing revenue. From the descriptive analysis, it can be concluded that SMEs (1st and 2nd quartiles) have difficulties with making profits as ROA has negative values -0.14 and -0.02, respectively. Moreover, the mean of CEE is highest in the 4th quartile. It indicates that big companies create value more efficiently through physical and financial assets. HCE is highly correlated with the profitability of the bigger companies, i.e., 3rd and 4th quartiles (0.73 and 0.83, respectively). It shows the importance of using human capital efficiently.

The impact of CEE on performance is greater in SMEs (1-3rd quartiles) than in big companies (4th quartile). According to Pearson's correlation, there is a weak correlation between ROA and MVAIC (0.285). ROA is significantly influenced by four components of IC, except RCE in the 2nd quartile and CEE in the 4th quartile. Based on the results, it can be concluded that IC affects significantly and positively on Mongolian public companies' financial performance regardless of their sizes. Hypothesis 5 is supported. *H5: IC has a significant positive impact on financial performance.*

However, the significant difference does not exist between IC and sectors based on F-test. Pearson correlation is executed on MVAIC and efficiency scores if each sector. The heavy industry has the highest correlation of 0.356, followed by service sector 0.34 and manufacturing 0.276.

4.4 Main Conclusions and Novelty of thesis

Performance measurement is one of the topics that attract attention and analyzed in the case of many countries. However, there is not any published research that used Mongolian companies as data. The thesis aims to analyze Mongolian listed companies' financial performance, from 2012 to 2018. As listed companies are required to be audited before publishing their financial statements, their financial statements are more reliable. Data covers 100 companies' financial statements from 2012 to 2018. Four companies went bankrupt during this period; therefore, the thesis used unbalanced data.

At first, it is important to evaluate the Mongolian current economic situation to evaluate the performance of Mongolian companies. The thesis compares Mongolian economic determinants with that of the selected three Asian countries. According to Multidimensional scaling, Kyrgyzstan's economy is the closest economy to the Mongolian economy. However, it is impossible to determine well both countries' economic growth based on the given variables (adjusted R^2 are 38.9% and 23.8%). Mongolia is a mining-based unique country; therefore, it would be inappropriate to analyze horizontally.

Mongolian economic growth is analysed to figure out what sector is the most crucial in the Mongolian economy. To do so, NDP is chosen as a dependent variable representing economic growth, and 20 macroeconomic variables are chosen as independent variables. Dollar rate growth, inflation, and export are the main determinants of Mongolian economic growth (based on the regression results executed by SPSS). Mongolian economy directly depends on mining export; therefore, as export increases, so does the economy. Since the exports are made mostly by the dollar, it also affects the dollar exchange rate. Moreover, the dollar exchange rate has an effect on consumer products, which has a direct impact on inflation.

Data includes companies from different sectors and with different sizes. Some of the companies are the biggest companies in Mongolia, while some of the companies are rather start-up businesses. In performance measurement, it is advisable to use companies from the same sector as different factors determine every sector. Unfortunately, data contained companies from 17 different sectors. So, it is impossible to analyze by their exact sector and tried to generalize companies into three different sectors. When it comes to horizontal analysis, it is recommended to use financial ratios as input and output variables. Therefore, financial ratios are used as variables that allow analyzing companies with different sizes. Although financial ratios are used in the thesis, it was clear from the descriptive analysis that the data contains outliers. Therefore, k-medoids clustering is used to classify companies into two groups. Revenue and total assets are used to represent the sizes. According to the k-medoids results, only 10 companies are in the second cluster (big corporates), while the rest of the companies are SMEs (90 companies in the first cluster). Unrelated ANOVA on VRS efficiency scores is executed using cluster as a factor. The F ratio = 2.416, which is insignificant. Therefore, it is concluded that there is not a significant difference between big corporates and SMEs' performance.

Hypothesis 3 is rejected. *(H3): The k-medoids clustering improves the performance measurement of the Mongolian companies investigated.*

Initially, 20 variables were chosen as input variables; however, some of the variables are excluded due to multicollinearity, i.e., cash ratio, current ratio, net operating cycle, operating cycle, and return on cost. After excluding those variables, panel regression was executed by R excel to define the determinants for each 3 output variables and each sector. Both FE and RE models are executed and based on the Hausman test, it is decided which model to choose. Although there were the same variables that are specific for the sector, i.e., current assets to total assets ratio for the service sector, variables determined for a certain sector did not differ widely.

The performance of every sector was evaluated by output-oriented DEA, VRS-DEA, CRS-DEA, PCA-DEA, and SFA methods. For DEA, input variables determined for certain sectors and general ratios (same for every sector) are used separately. Efficiency results were similar to each other in the case of sector-specific variables and general input variables, however, depending on which model efficiency results significantly differ. For example, many efficient companies from the VRS model turned into inefficient in the CRS model. Even inefficient companies' efficiency scores reduced significantly. Discriminative power might be declined due to an insufficient number of DMUs in data when sectors are evaluated separately. Therefore, the DEA-VRS model is executed for all data set, and then the efficiency scores of companies are classified by sector and compared with separately performed efficiency scores. The number of efficient companies is always less when the sector unbiased efficiency scores are rearranged into the sector. It can be explained by the efficient companies in a certain sector that might not be efficient than other companies from another sector. Unrelated ANOVA is executed to reveal whether a significant difference exists in the sector's efficiency scores. According to ANOVA results, a significant difference exists between heavy industry and service, heavy industry and manufacturing sector. However, the efficiency results of the manufacturing sector and service sector do not differ significantly.

DEA determines the majority of DMUs as efficient when the number of variables is relatively high and the number of DMUs insufficient. Therefore, PCA is combined with DEA using the same variables. Also, the efficiency scores were either too low (between efficiency range 0.0-

0.3) or too high (more than half of the companies are efficient) in conventional DEA. However, PCA-DEA gives similar consistent results in the case of 3 sectors and two sizes. In PCA-DEA, efficiency scores are closer to a normal distribution. This shows that the level of information reduction has a considerable effect on the classification of efficiency.

The mean efficiency score of SFA is comparatively higher than that of DEA; however, the SFA model did not determine any efficient company. SFA proved more than half of the DMUs between the efficiency range of 0.9-1. As the SFA model showed entirely different efficiency scores (efficiency scores of DEA and SFA negatively correlates -0.34) and the variables determined by panel regression are insignificant when it comes to SFA. Therefore, SFA is assumed as an inappropriate model to evaluate Mongolian companies' financial performance. IC is an essential and integral part of revenue creating process. However, due to the hardness of valuation, IC is often ignored in performance measurement. MVAIC and its four components are used representing IC, while ROA is used representing profitability (performance). The impact of IC on financial performance is conducted by UQR on R excel.

4.5 Summary

This thesis includes four major chapters. The thesis starts with discussing the aim, objectives, research approaches, and ethical considerations.

The first chapter demonstrated the literature review of the business analysis and performance measurement. The business analysis comprises of four parts: strategy analysis, accounting analysis, financial analysis, and prospective analysis. The main scope of the thesis is financial analysis. Therefore, the financial analysis was explained in detail, while strategy analysis, accounting analysis, and prospective analysis were briefly described as they are also parts of business analysis. Financial analysis is extended by ratio analysis. Afterwards, performance measurement was explained, which started from the definition of effectiveness and efficiency and followed performance measurement approaches.

Chapter 2 described data and the general research methodology used in the thesis. The chapter examined research data sources and described a comprehensive review of the DEA, SFA, PCA, and k-medoids analysis. The basic DEA concepts, together with the formulations, were explained and moved forward to more advanced issues development of DEA. Moreover, the concepts of SFA with a discussion of its advantages and disadvantages and a comparison between DEA and SFA methods were illustrated.

Chapter 3 began with a comparison between the Mongolian economy and three other Asian countries' economies. Afterwards, an introduction to the main features of Mongolia, its current economic situation, and main sectors, which are fundamental for the Mongolian economy, were introduced in this chapter. Then the empirical results of DEA and SFA for each sector were discussed.

Chapter 4 briefly summarized each chapter's key aspects and findings of the entire research and provided the main conclusion of the thesis with the novelty of this thesis.

Summary of the Results

Abb	Hypotheses	Acceptance
H1	The heavy industry is the most efficient sector in the Mongolian economy like other selected Asian countries.	Refuted
H2	Big corporates are more efficient than SMEs.	Accepted
H3	The k-medoids clustering improves the performance measurement of the Mongolian companies investigated.	Rejected
H4	Efficiency results by SFA are compatible with that of DEA and PCA-DEA in the case of Mongolian listed companies.	Rejected
H5	IC has a significant positive impact on financial performance.	Accepted

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Registry number: DEENK/187/2020.PL
Subject: PhD Publikációs Lista

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MTMT ID: 10063070

List of publications related to the dissertation

Articles, studies (6)

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Total IF of journals (all publications): 1,855
Total IF of journals (publications related to the dissertation): 1,855

The Candidate's publication data submitted to the iDEa Tudóstér have been validated by DEENK on the basis of the Journal Citation Report (Impact Factor) database.

11 June, 2020

DEBRECENI EGYETEM * Egyetemi és Nemzeti Könyvtár *