Degree of Doctorate of International Trade and Economics

# A COMPARATIVE ANALYSIS ON THE EFFICIENCY OF THE BANKS IN SOUTH KOREA AND UZBEKISTAN: BASED ON THE DEA AND SFA USING MULTI- INPUT-OUT MODEL

한국과 우즈베키스탄의 은행의 효율성 비교 분석: DEA와 SFA 방식을 적용한 다투입-다산출모형을 중심으로

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# Abstract

## A COMPARATIVE ANALYSIS ON THE EFFICIENCY OF THE BANKS IN SOUTH KOREA AND UZBEKISTAN: BASED ON THE DEA AND SFA USING MULTI- INPUT-OUT MODEL

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In this paper we used Data Envelopment Analysis (DEA), The Stochastic Frontier Analysis (SFA) to measure the efficiency of the Uzbekistan and South Korean banks. The analysis period was from 2010 to 2014 for five years and the study analyzed 14 South Korean and Uzbekistan banks. The inputs for the analysis were the number of employees, total assets and equity and the outputs were total loan, operating revenue and total profit. The results of the research are summarized as follows:

First, the results are from the comparative analysis of efficiency of South Korean and Uzbekistan banks. In terms of technical efficiency, the banks of South Korea showed CRS and IRS trends within the analysis period, but technical efficiency for the Uzbekistan banks showed DRS trends. In terms of scale efficiency, the banks of South Korea increased and showed mostly CRS, whilst scale efficiency of the Uzbekistan banks decreased from 2010 to 2013 bur rose in 2014.

Second, the results are from the comparative analysis of economies of scale between the banks in South Korea and Uzbekistan. South Korean banks experienced increasing return to scale (IRS) while many banks in Uzbekistan experienced decreasing return to scale (DRS).

Third, the efficiency of the banks in South Korea and Uzbekistan by using the SFA analysis shows that the efficiency in the South Korean banks increased from 2010 to 2012 and showed constant from 2013 to 2014. The efficiency in the Uzbekistan banks from 2010 to 2014 generally decreased.

Fourth, the efficiency of DEA and SFA are compared. Since there is no statistically significant difference between the CCR value calculated by DEA and the efficiency of SFA, it shows that there is a similar trend.

Fifth, we examined the changes in efficiency of South Korea and Uzbekistan banks by using productivity index between 2010 and 2014. In terms of the changes in efficiency of the banks in South Korea, the productivity index value exceeded 1 between 2010-2011 periods and 2013-2014 periods, indicating that the efficiency increased from the previous year. However, the productivity index was less than 1 during 2010-2012 period and the efficiency decreased from the previous year. In the case of Uzbekistan banks, the productivity index exceeded 1 from 2011-2011 periods to 2013-2014 periods and the efficiency increased from the previous year.

Six, the portfolio was used to compare the technical analysis and productivity index. Most South Korean banks were high growth potential. And for Uzbekistan banks, Aloqa Bank, People's Bank, Hamkor Bank was the most likely banks with high competitiveness

and high growth potential. There were no banks with high competitiveness and low growth potential. The banks with low competitiveness and low growth potential were Shinhan Bank and Woori Bank.

In this research we suggest the following limitations. First, DEA and SFA for efficiency analysis only analysis relative efficiency, so banks' absolute efficiency cannot be measured. Therefore, the efficiency and its changes can vary depending on input and output variables. The efficiency changes of banks can be measured more accurately when more variables and added. However, for DEA and SFA have limitations that not only the number of variables but also the number of decision units should be taken into consideration. Therefore, both input and output variables need to be carefully considered in order to measure the efficiency and the efficiency changes for conducting a comparative analysis, such as the number of banks, the global financial environment variable during the analysis period, and economic policy of both countries.

**KEY WORDS:** Data Envelopment Analysis, Stochastic Frontier Analysis, Technical efficiency, Scale efficiency, Productivity, Bank, Uzbekistan, South Korea.

# 한국과 우즈베키스탄의 은행의 효율성 비교 분석: DEA와 SFA 방식을 적용한 다투입-다산출모형을 중심으로

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## 초록

이 논문에서 우즈베키스탄과 한국 은행의 효율성을 측정하기 위해 데이터 포락 분석 (Data Envelopment Analysis, DEA), 확률적 프론티어 분석 (Stochastic Frontier Analysis, SFA) 을 사용했다. 분석 기간은 2010 년부터 2014 년까지 5 년간이며,이 연구는 14 개의 한국 및 우즈베키스탄 은행을 분석했다. 분석을위한 투입물은 종업원수, 총자산 및 자본이었으며, 산출물은 총대출, 총이익이었다. 연구 결과는 다음과 같이 요약되었다.

첫째, 한국과 우즈베키스탄 은행의 효율성 비교 분석 결과. 기술 효율성 측면에서 한국 은행은 분석 기간 동안 불변규모수익(Constant Returns to Scale) 과 규모의 증대 (Increase Return to Scale) 추세를 보였으, 우즈베키스탄 은행의 기술 효율성은 규모의 축소(Decrease Return to Scale) 추세를 보였다. 규모 효율성 측면에서 볼 때 한국 은행은 CRS가 대폭 증가한 반면 우즈베키스탄 은행의 효율성은 2010 년에서 2013 년까지 2014 년에 감소했다.

둘째, 한국과 우즈베키스탄의 은행 간 규모의 경제를 비교 분석한 결과. 우즈베키스탄의 많은 은행들이 규모의 축소 (DRS)를 경험하는 동안 한국 은행은 규모의 증대 (IRS)를 경험했다.

셋째, SFA 분석을 이용한 한국과 우즈베키스탄의 은행 효율성은 한국 은행의 효율성이 2010 년에서 2012 년까지 증가하였고 2013 년부터 2014 년까지 지속적으로 나타났다. 2010 년부터 2014 년까지 우즈베키스탄 은행의 효율성은 일반적으로 감소하였다.

넷째, DEA와 SFA의 효율성을 비교한 결과. DEA에서 계산 한 CCR 값과 SFA의 효율성 간에는 통계적으로 유의미한 차이가 없기 때문에 비슷한 추세가 있음을 알 수있다.

다섯째, 2010 년과 2014 년 사이에 생산성 지수를 사용하여 한국과 우즈베키스탄 은행의 효율성 변화를 조사하였다. 한국의 은행 효율성 제고 측면에서 생산성 지표는 2010-2011 기간과 2013 년 사이에 1을 초과하였다. 2014년 효율성이 전년도보다 증가했다. 그러나 2010-2012년 생산성 지수는 1 미만이었고 효율성은 전년도에 비해 감소하였다. 우즈베키스탄 은행의 경우 생산성 지수는 2011-2011년에서 2013-2014년까지 1을 초과했으며 효율성은 전년 대비 증가했다.

여섯째, 포트폴리오는 기술 분석 및 생산성 지수를 비교하는 데 사용되었다. 대부분의 한국 은행은 높은 성장 잠재력을 지니고 있었다. 우즈베키스탄의 Aloqa Bank, People 's Bank, Hamkor Bank 는 높은 경쟁력과 높은 성장 잠재력을 가진 은행으로 가장 발전 가능성이 높다. 한국에서 경쟁력이 낮고 성장 잠재력이 낮은 은행은 신한 은행과 우리 은행이었다.

이 연구에서는 다음과 같은 한계점이 있다:

첫째, 효율성 분석을 위한 DEA와 SFA는 상대효율을 분석하기 때문에 은행의 절대 효율을 측정 할 수 없다. 따라서 효율성과 그 변화는

입력 및 산출 변수에 따라 달라질 수 있다. 은행의 효율성 변화는 더 많은 변수가 추가되고 더 정확하게 측정되어야 하지만, DEA와 SFA에는 변수의 수뿐만 아니라 결정 단위의 수를 고려해야한다는 한계가있다.

**KEY WORDS:** Data Envelopment Analysis, Stochastic Frontier Analysis, Technical efficiency, Scale efficiency, Productivity, Bank, Uzbekistan, South Korea.

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# Chapter One: Introduction

## 1.1 Research Background

Banks play an important role as the financial intermediaries in the financial market and efficiency is the key indicator of the competitive strength of the banks. But, the current global financial situation presents obstacles, challenges and crises for the banking industry worldwide. Bank crises happened many time throughout history. Prominent examples include the bank run that occurred during the Great Depression, the U.S. Savings and Loan crisis in the 1980s and early 1990s, the Asian banking crisis during 1990s, the sub-prime mortgage crisis[1] in the 2000s and the global financial crisis during 2007~2008 years.

With the entering of the WTO, the accelerated pace of financial reform and entry of foreign banks, Uzbekistan commercial banks face impingement and challenges, especially the state-owned banks. The big state-owned banks dominate the Uzbekistan financial market, control the most assets and have the large amounts of non-performing loans. Most studies of the banks' efficiency demonstrate that the state-owned banks show relatively low efficiency and performance[2]. Though the government controls the state-owned banks and can effectively avoid the financial crisis, the banks need to reform.

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[1] The U.S subprime mortgage crisis was a set of the event and conditions that led to a financial crisis and subsequent recession that began in 2008. It was characterized by a rise in subprime mortgage delinquencies and foreclosures, and the resulting decline of securities backed by said mortgages. Several major financial institutions collapsed in September 2008, with significant disruption I the flow of credit to businesses and consumers and the onset of a severe global recession.

[2] Asror Nigmonov. (2004). Banking Performance and Efficiency in Uzbekistan

Especially several joint-stock commercial banks established in Uzbekistan and this bank shows the high efficiency, better performance and low NPLs (non-performing loans). Meanwhile, some foreign banks entered, according to the WTO rules, and many businesses opened for the foreign banks gradually. Uzbekistan commercial banks take on much pressure from these policies. So, it is necessary to research the banks performance and efficiency and find the right way to improve it.

South Korean banks achieved wonderful economic performance and played an important role in the financial sector in East Asia. But the South Korean financial sectors still have deficiencies; a critical event happened during the Asian banking crisis, and many South Korean institutions suffered. The problem was exacerbated by non-performing loans at many of the South Korean's merchant banks. By January 1998, the government had shut down a third of South Korean's merchant banks.[3] Meanwhile, South Korean's currency experienced massive fluctuations, declining by 34% against the dollar. So, after the crisis, the government carried out many policies on the banking sector. This will be elaborated on chapter three.

Taking into consideration the power of South Korea's influence on Central Asia as a whole relative to Beijing and Moscow, the Central Asian strategy of Seoul is being built through the development of bilateral relations with the best countries.

[3] Koo, Ja Hyeong and Kiser, Sherry L. (2001). "Recovery from a financial crisis: the case of South Korea" (w). Economic & Financial Review. Retrieved 2009-05-05

South Korea is unable to influence the results of geopolitical and economic events in the region compared to China and Russia. South Korea is able to present Uzbekistan's economic potential without threats to national sovereignty.[4]

Seoul and Tashkent have approached the newest developments in their bilateral trade relations from a strong basis. South Korea is one of the top five sources of Uzbekistan's imports. South Korean economic ties with Uzbek organizations and firms have largely been government-led, unlike economic relations with South Korea's other main partner in Central Asia, Kazakhstan, which has been spearheaded largely by private firms.

According to the Uzbek president, Uzbekistan has become a regional leader in rebuilding relations with other Central Asian countries. According to a report by Johns Hopkins University, Uzbekistan's trade with Central Asian neighbors increased by 13% in the first half of 2017. Economic relations with Uzbekistan have the potential to boost South Korea's economic position in Central Asia.

On November 2017, the president of the republic of Uzbekistan Shavkat Miromonovich Mirziyoyev arrived in the South Korea on a state visit at the invitation of President Mun Jae-in. South Korean and Uzbekistan delegates signed a slew of deals totaling just short of $9 billion. The deals focused primarily on energy, banking, and infrastructure. In Uzbekistan, a state-owned joint stock company focused on producing textile goods, also agreed to export $70 million worth of goods to some of South Korea's largest retail corporations,

[4] Anthony V. Rinna. 2017. Eurasia analyst. A Key to South Korea's Central Asia Strategy.

including the Lotte Group.

South Korea is one of Uzbekistan's most important partners. Over the past twenty years, the two countries have set up strong political and economic cooperation and have developed a legal and regulatory framework for bilateral and multilateral cooperation.[5] South Korea has a strong positive image in Central Asia and is one of the largest investors in Uzbekistan with Russia, China, the United States, Japan and the European Union. The Republic of Korea - Central Asia and Japan also represents new formats for regional and interregional cooperation. At the same time, the active implementation of bilateral and multilateral agreements between Uzbekistan and South Korea and expansion of cooperation between the participating states are of great importance. The strong partnership between Uzbekistan and South Korea is crucial for the economic and technological renewal and development of the region. It is important for trade relations, economic development.[6]

Therefore, improving the efficiency of commercial banks is the basic guarantee of avoiding financial risks and driving the sustainable development in the banking system. Now the urgent mission for Uzbekistan and South Korean commercial banks is to enhance the banks' competition and improve the efficiency.

## 1.2 The aim of the thesis

In this research we measure the bank's efficiency and

[5] UzA Abu Bakir Urozov reports; http://uza.uz/en/politics
[6] Mirzokhid R. and Sung Dong Ki, (2016). Uzbekistan & South Korea: towards a special relationship.

performance, using the data envelopment analysis and stochastic frontier analysis. DEA and SFA are linear programming techniques which offer many advantages on handle inputs and outputs at the same time. The application of the DEA and SFA has been adopted to analyze a bank's efficiency in numerous banking literatures.

The objectives of the paper included:

1) To access the structure and overall performance of the banking sector: it allows the author to investigate the background information and build the foundations of hypothesis and methodology to be used.

2) To estimate the technical and scale efficiency of banks over the sample period, 2010-2014, using both input-oriented and output-oriented approaches in the DEA and SFA model

3) To compare the empirical DEA and SFA results between two countries, and to find out the reasons or determinants of the efficiency differences.

Therefore, based on non-parametric methods and parametric methods, this research estimates production frontier and measures efficiency as the distance from the observed input-output combinations to this frontier. The study specifically examines the performance of banks in Uzbekistan and South Korea, and makes the comparisons between them.

### 1.3 The structure of the thesis

The reminder of the thesis is organized as follows. Chapter one

outlines the research study including the background, the aim of the thesis and contributions to the literature. Chapter two reviews the prior studies on bank efficiency in Uzbekistan and South Korea. It also describes Uzbekistan and South Korean banking systems and respectfully introduces the main banks in these two countries. Chapter three reviews different theoretical efficiency concepts and the research methodology related to this study. Chapter four analyzes the empirical results, which are measured by DEA and SFA approaches. Chapter five presents summaries and conclusions.

### 1.4 The Objective of the study

This thesis contributes to understanding the characteristics of South Korean and Uzbekistan banks during past 5 years after the global financial crisis. Based on microeconomic theory, we try to estimate the parameters of Uzbekistan and South Korean banks structure and understand the trends of efficiency. This thesis compares the DEA and SFA methods in measuring the efficiency in Uzbekistan and South Korean banks.

### 1.5 Literature review

An early study that compares alternative frontier techniques is Ferrier and Lovell (1990). They analyze the cost structure of 575 US banks for the year 1984 using both the SFA and DEA methodologies. They find higher efficiency scores with DEA compared to SFA, namely 80% and 74%, respectively. They concluded that DEA is sufficiently flexible to envelop the data more closely than the translog cost frontier. However, efficiency scores are not significantly correlated thus indicating that other factors not controlled for may drive the obtained

wedge between the two measures.

Sherman and Gorld,[7] (1985) applied DEA to banking first. They used the DEA analysis to evaluate operating efficiency of 14 saving bank branches. As the result of analysis they not only measured the level of efficiency, but also defined how to eliminate inefficiency by adjusting input and output of inefficient bank branches. Motivated by the DEA results, management indicated that the service outputs and the resources used to provide these would be further evaluated as distinct from the liquidity issues.

Pastor, (1997) analyzed efficiency of banks in US and in selected countries of Europe. For comparison of different European and US banking systems they used the value added approach. They found out, that France, Spain, and Belgium appeared as the countries with the most efficient banking systems, whereas the UK, Austria, and Germany showed the lowest efficiency levels.

Gilbert and Wilson (1998)[8] used distance functions to estimate the productivity growth of South Korean banks between 1980-1994 years. They found a positive impact of privatization and deregulation on bank productivity growth as well as a change in the output and input mix.

Park and Kim (2002)[9] estimated the efficiency and productivity changes for the period 1995-2000 and found that regional banks were less efficient and experienced fewer gains in efficiency than

[7] Kristina K. (2014). Application of DEA to Measure Cost, Revenue and Profit Efficiency.
[8] Gilbert and Wilson, (1998). South Korean banks for 1980-1994.
[9] Park and Kim (2002).South Korean banks efficiency and productivity during 1995-2000.

nationwide banks.

Park and Yi (2002)[10] used data from the period 1995-1999 to estimate efficiency and simulate the effects of various hypothetical merger scenarios. They found evidence of decreasing returns to scale for mergers of two technically efficient banks, but if those same two banks produce different mixes of outputs, strong scope economies might arise via the merger.

Casu and Molyneux, (2003) in their study used the intermediation approach to evaluate efficiency of 750 selected European banks. Overall, the results showed relatively low average efficiency scores, nevertheless, it was possible to detect a slight improvement in the efficiency levels through time.[11]

Asror Nigmonov (2004) found that the ownership structure of a bank does not affect the relative efficiency, while medium sized banks tend to be more efficient than the small banks. These findings lead us to conclude that the entry of foreign banks should not substantially affect the performance of the banking sector in Uzbekistan. While the better performance of medium sized banks probably resulted from the better management of the available resources.[12]

Das et al, (2004) examined the efficiency of Indian banks by using the DEA model. Four input measures: deposits and other borrowings, number of employees, fixed assets, and equity, and three output measures: investments, performing loan assets, and other non-

[10] Park and Yi (2002). Technical efficiency of banks during 1995-1999.

[11] Casu and Molyneux,(2003). European banks efficiency.

[12] Asror Nigmonov, (2010). Bank performance and efficiency in Uzbekistan.

interest fee based incomes were used in the analysis. He found that Indian banks did not exhibit much of a difference in terms of input or output oriented technical and cost efficiency. However, in terms of revenue and profit efficiencies prominent differences were seen. He also found that size of the bank, ownership of the bank, and listing on the stock exchange had a positive impact on the average profit and revenue efficiency scores.

Cho and Shin (2004) found that although the five biggest South Korean banks experienced a decline in profitability during 1992-1997, they maintained greater cost efficiency and technical efficiency relative to other South Korean banks.[13]

Soori et al, (2005) analyzed efficiency of the Iranian banking system and the main purpose of the study was to investigate the comparative efficiency of commercial banks in Iran using a stochastic frontier function as a parametric and data envelopment analysis as a non-parametric approaches. The data used covered the period 1996-2004. The findings of this paper show that there is a significant difference between non–parametric and parametric methods in measuring the efficiency in the commercial banks of Iran.

Debasish (2006) also attempted to measure the relative performance of Indian banks, using the output-oriented CRR DEA model. The analysis used nine variables and seven output variables in order to examine the relative efficiency of commercial banks over the

[13] Cho and Shin, (2004). South Korean banks profitability during 1992-1997.

period 1997 – 2004.[14]

Mostafa, M. (2007) investigated the efficiency of top 85 Arab banks using DEA and Neural networks for the year 2005. He found that, eight banks as per the CCR Score and four banks as per BCC Score were positioned on the efficient frontier. He suggested that future studies should test the existence of positive rank-order correlations between efficiency scores obtained from DEA analysis and traditional efficiency measures such as financial ratios. His results further demonstrate that, Al-Rajhi Bank and National Commercial Bank were placed among the top ten Arab banks with a relative ranking of eight and ten respectively.[15]

Moh'd Al-Jarrah (2007) used the data Envelopment Analysis (DEA) approach to investigate cost efficiency levels of banks operating in Jordan, Egypt, Saudi Arabia and Bahrain between 1992-2000. The estimated cost efficiency is further decomposed into technical and allocative efficiency at both variable and constant return to scale. Later on the technical efficiency is further decomposed into pure technical and scale efficiency. Cost efficiency scores ranged from 50 to 70% with some variations in scores depending on bank's size and its geographical locations. The results suggested that the same level of output could be produced with approximately 50- 70% of their current inputs if banks under study were operating on the most efficient frontier.[16]

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[14] Majid Karimzadeh, (2012). Efficiency Analysis by using Data Envelop Analysis Model.

[15] Mostafa, M. (2007).Efficiency of top 85 Arab banks using DEA & Neural networks for 2005.

[16] Moh'd Al-Jarrah (2007). Cost efficiency levels of banks operating in Jordan, Egypt, Saudi Arabia and Bahrain over 1992-2000.

Chansarn (2008) conducted a study aimed to examine the relative efficiency of Thai commercial banks during 2003 – 2006 by utilizing Data Envelopment Analysis (DEA). Based on the sample of 13 commercial banks, findings revealed that the efficiency of Thai commercial banks via an operation approach is very high and stable while the efficiency via an intermediation approach is moderately high and somewhat volatile. In terms of size, large, medium and small banks, on average, were efficient via an operation approach with the average efficiencies of 100%. However, small banks were the most efficient banks via the intermediation approach.[17]

San O et al, (2011) in their study utilizes non parametric Data Envelopment Analysis (DEA) to analyze and compare the efficiency of foreign and domestic banks in Malaysia. The analysis was based on a panel data set of 9 domestic banks and 12 foreign banks in Malaysia over the period of 2002- 2009. The intermediation approach is used to define the inputs and outputs in computerizing the efficiency scores. Surprisingly, the findings are inconsistent with most of the findings of previous studies where the foreign banks were outperforming their domestic peers in term of efficiency. Conversely, the finding of this study shows that domestic banks have a higher efficiency level than foreign banks, this imply that domestic banks are relatively more managerially efficient in controlling their costs. The second stage of the empirical results was based on the Tobit model, which suggests that the pure technical efficiency (PTE) of banks in Malaysia is mainly

[17] Chansarn (2008). Examine the relative efficiency of Thai commercial banks during 2003 – 2006 by utilizing Data Envelopment Analysis (DEA).

affected by capital strength, loan quality, expenses, and asset size.[18]

Yilmaz, (2013) measured efficiency of 30 Turkish commercial banks between 2007 and 2010, where the intermediation approach was used. In their study they compared the efficiency of foreign and domestic banks and found that the domestic banks were more efficient in all evaluated years.[19]

It is possible to distinguish different kinds of efficiency, such as scale, allocative and structural efficiency

The scale efficiency has been developed in three different ways. Farrell (1957) used the most restrictive technology having constant returns to scale (CRS) and exhibiting strong disposability of inputs. This model has been developed in a linear programming framework by Charnes, Cooper and Rhodes (1978). Banker, Charnes and Cooper (1984) have shown that the CRS measure of efficiency can be expressed as the product of a technical efficiency measure and a scale efficiency measure. A third method of scale uses nonlinear specification of the production function such as Cobb-Douglas or a translog function, from which the scale measure can be directly computed (see Sengupta, 1994 for more details).

The allocative efficiency in economic theory measures a firm's success in choosing an optimal set of inputs with a given set of input prices; this is distinguished from the technical efficiency concept associated with the production frontier, which measures the firm's

[18] San O et al, (2011). Data Envelopment Analysis (DEA) to analyze and compare the efficiency of foreign and domestic banks in Malaysia.

[19] Yilmaz, (2013). Efficiency of 30 Turkish commercial banks during 2007 and 2010 years.

success in producing maximum output from a given set of inputs.

The concept of structural efficiency is an industry level concept due to Farrell (1957), which broadly measures the extent an industry keeps up with the performance of its own best practice firms; thus it is a measure at the industry level of the extent to which its firms are of optimum size (i.e. the extent to which the industry production level is optimally allocated between the firms in the short run). A broad interpretation of Farrell's notion of structural efficiency can be stated as follows: industry or cluster A is more efficient structurally than industry B, if the distribution of its best firms is more concentrated near its efficient frontier for industry A than for B. In their empirical study, Bjurek, Hjalmarsson and Forsund (1990) compute structural efficiency by simply constructing an average unit for the whole cluster and then estimating the individual measure of technical efficiency for this average unit. On more general aggregation issues see Fare and Zelenyuk (2003) and Fare and Grosskopf. (2004, p. 94 ff).[20]

[20] Daraio, C. Simar, L. 2007. Advanced Robust and Nonparametric methods in efficiency Analysis, pp. 248

# Chapter Two: Development of Banking System

## 2.1 Uzbekistan banking system

For this historically short yet comparable to centuries period, under the leadership of the head of state, wide-ranging reforms in all spheres of socio-economic life, including the banking system, have been implemented. As a result, in a short period of time the banking system with a firm basis and an advanced infrastructure has been founded, which currently plays a crucial role in reforming and modernizing the economy, as well as in overall modernization of the country. It is noteworthy that the main factor behind these achievements is the implementation of 'The Uzbek Model' of social and economic development with five main principles formulated by former president of the republic of Uzbekistan Islam Karimov.[21]

It is worth of mentioning that for the past twenty-five years of independent development Uzbekistan's economy has grown 4.1 times, income per capita 8.2 times, and for the past 9 years GDP grew by 8% or higher, annually. It is also worthy to note the milestones achieved in the social and humanitarian sphere, including rising living standards of the population, as a result of which average life expectancy has increased from 66 to 73.5 years, and for women it is now equal to 75 years.

Of course, the path to these achievements has been full of challenges. It is known that the process of modernization and implementation of economic reforms has been carried out during the

[21] Doing Business in Uzbekistan (2016).

quite difficult period in Uzbekistan, a time of a totalitarian regime's decline and the outliving of a planned distribution administrative system. The country had to address various urgent and essential tasks such as macroeconomic stability, the introduction of national currency, the creation of a highly sophisticated monetary and banking system as well as provision of social protection, and ensuring the continuous provision of food and essential public services.

The pillars of the society - It is now impossible to imagine a modern country without a developed banking system. In 1991, after attaining independence, the government of Uzbekistan had a most important task – to immediately organize its own independent national banking system. This task envisaged the formation of a full-fledged system of payments among business entities, attraction of spare funds of the population to banks and their redirection to the development of the economy in the form of bank loans, and the most of all, the creation of a two-tier banking system based on an international experience to restore public confidence in the banking system.

Two-tier banking system controls by the Central Bank of the Republic Uzbekistan. Primary functions and tasks of the central bank are set down in the Law on the Central Bank adopted in December 1995. Nowadays CBU is fulfilling the functions of a typical central monetary authority. The main aim of the Central Bank is to maintain stability of the national currency. The Central Bank's major tasks are the following:

- Working out/implementation of the monetary, credit and foreign exchange policy of the country.

- Introduction of effective payment system in Uzbekistan.
- Licensing and regulation of banking and finance activities.
- Management of the cash service of the public budget and the execution of commercial activities on behalf of the government.
- Management of state reserves of the republic of Uzbekistan.

The commercial banking system, which is a kind of a component of the Uzbekistan banking system, today consists of about 32 licensed banks. The total number is relatively small, 1) in relation to the size of the economy and the population of Uzbekistan, and 2) compared with the banking systems in the main neighboring state such as Kazakhstan and the Russian Federation. But this situation is intentional. The political leadership of Uzbekistan has defined a strategic development strategy for the financial and banking sector.[22] Therefore the licensing policy of the Central Bank at present has three main aims:

- To create a core group of strong, well-capitalized banks, either on the basis of the large specialized state banks of the former USSR, or from scratch.
- To avoid mushrooming growth of small, weak banks existing for their own sake, or that of a single major shareholder (pocket-banks).
- To attract foreign financial institutions of high quality and reputation to participate in local institutions (joint-venture banks).

Among the commercial banks of Uzbekistan the National Bank

[22] www.uz.mofcom.gov.cn/

for Foreign Economic Activity (NBU)[23] is in a class of its own in Central Asia and is the leading financial institution in Uzbekistan. The first bank in Uzbekistan to adopt IAS, with a well-developed network of 96 offices NBU boasts a nationwide presence catering to both corporate and retail clients and is ranked 562nd in The Banker's Top 1000 world's largest banks. The bank has over 560 correspondent banks.

The bank has a sound reputation internationally. With tier-one capital of over US$ 485 million, NBU ranks among the strongest capitalized new financial institutions of the former USSR. NBU offers all types of banking and finance services to domestic and foreign customers. In order to attract international capital to the republic, NBU actively cooperates with its foreign partners - investment banks.

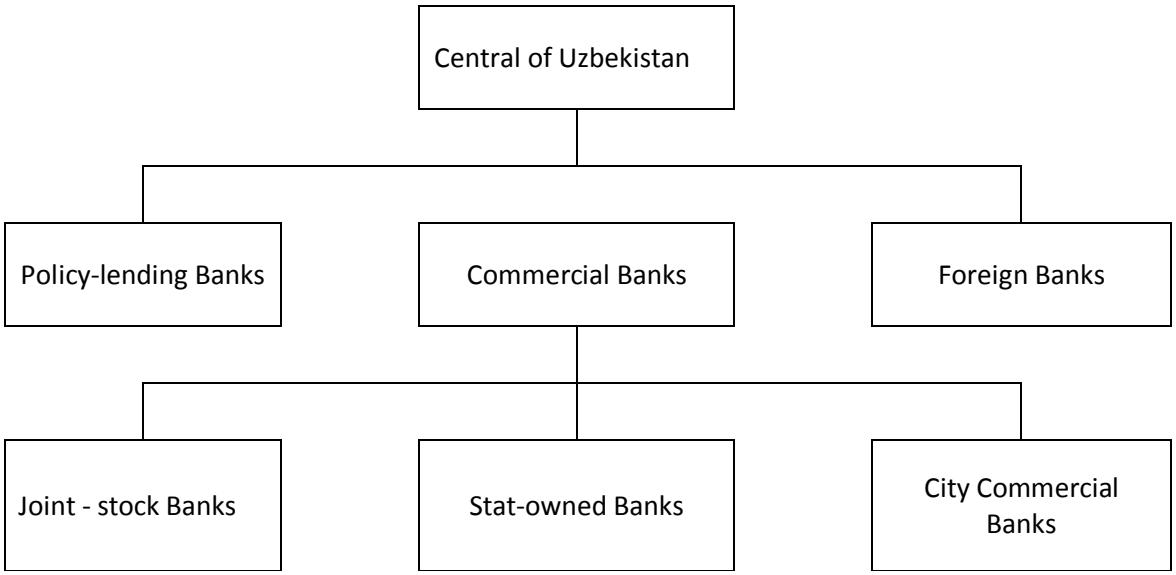
The other commercial banks of Uzbekistan can be divided into three categories:

- Joint stock banks with variable state participation. At present this group still constitutes the majority of Uzbekistan banks.
- Fully privately owned joint-stock banks (to date only two small banks).
- Joint-venture banks between local and foreign financial institutions.

Nowadays there are more than 30 banks and financial institutions in Uzbekistan, 18 of them have received a license for hard currency operations, and 11 also have a General License for all categories of international transactions and domestic operations.

[23] http://www.nbu.com/

Figure -1. Uzbekistan's banking system




Pak Mo Zhong, president of the newspaper, "The Korea Times": In your country during the years of independence carried out major reforms in the banking sector. The result is a stable and reliable banking system that fully meets international standards. It became one of the decisive factors in the process of economic modernization.[24]

According to foreign experts, there are negative trends in the banking system of some countries today, when the volume of problem loans increase up to 40 percent of the loan portfolio. This leads to problems when returning money to investors who entrusted their money to the bank for safekeeping.

In such circumstances, the successive reforms of the banking system of Uzbekistan receive high recognition from the international community. In turn, it strengthened the confidence of foreign investors.

[24] Pak Mo Zhong,(2016) president of the newspaper "The Korea Times"

The same high level of trust and business people of South Korea. Therefore, we express gratitude to the leadership of the country that has created all necessary conditions for work.[25]

Nam Ki Sab, chairman of the South Korea Export-Import bank: Uzbekistan has great potential to further improve its rating on the indicator "Getting credit" because your country has accumulated some experience in the field of credit information sharing and the implementation of agreements on collateral.[26]

According to the report of the International Finance Corporation and the World Bank's Doing Business 2016, Uzbekistan received in terms of "Index sharing credit" 7 points. This is significantly higher Estimates than the Member States of the Organization for Economic Cooperation and Development (OECD).

In the banking system of Uzbekistan, work is focusing on the optimization of the conditions of deposits, the development and introduction of new deposit products, and the improvement of the quality of service. All of these factors will create a solid foundation for the banking system of Uzbekistan and high growth in 2016.

Utkir Kayumov, Deputy Director of the Center for Study of Public Opinion "Ijtimoiy Fikr", Doctor of Economics: In recent years, our center holds a lot of polls to determine the role and place of the banking system in the community. I am glad that these respondents expressed positive opinions. So, in the latest study of they received the following answers to the questions: "Bank employees perform their

[25] Doing Business in Uzbekistan (2015)
[26] Nam Ki Sab, chairman of the Korea Export-Import bank/ Doing business in Uzbekistan (2016)

duties conscientiously, politely and professionally," "provide operational assistance in providing advice and problem-solving," "timely implementation of all the operations of storage deposits" "fully complied with the established order, the offense is not allowed."[27]

## 2.2 The main banks in Uzbekistan

The Uzbekistan banking sector appeared to arrive in 1991 after independence of the Republic of Uzbekistan. Now it consists of two levels, one is the central bank of the Republic of Uzbekistan wielding control over a range of commercial banks and the second consists of commercial banks. The central bank is in charge of establishing national monetary policy, issuing currency, and operation of the national payment system. Currently the second level of banking system consists of 29 commercial banks, including 3 state-owned banks. Although these three banks are state-owned their main goal is profit and the government participates in the bank's capital as a shareholder. Two of them (National Bank for Foreign Economic Activity of Uzbekistan, and the state joint stock commercial Asaka Bank) own about 70% of all Uzbekistan banks assets and both of them were to be privatized during 2006-2010. Nowadays the banking system of Uzbekistan is progressively changing.

There were 32 commercial banks at the end of 2004. Currently their number has decreased to 29 due to the merger of "Zamin Bank" with "Uz Uy Joy Jamgarma Bank" and "Kapital Bank" with "Avia Bank" and closure of "Business Bank".[28] I have selected to measure

[27] Utkir Kayumov, (2016). Doctor of Economics/ Deputy Director of the Public Opinion.
[28] http://www.uzbekistanitalia.org/home/economia-e-affari/list-of-banks

efficiency of the following banks:

### (1) Trust Bank

Private Joint Stock Exchange Bank "Trust Bank", was founded in 1994, and is a universal financial institution that offers a wide range of banking products and services.

For the long years of its activity, "Trust Bank" has gained its place in the financial markets of Uzbekistan through winning the confidence of its clients, who really appreciate the professionalism and quality of services provided by the bank.[29]

As a partner of choice for many of its customers, "Trust Bank" is committed to striving for excellence in all aspects of business, creating new business solutions for meeting personal and business needs of all clients.

"Trust Bank" looks forward to raising the bar in customer experience and delivering the promise of product and customer excellence to all its clients who create their future with the bank.

### (2) Microcredit Bank

Joint-Stock Commercial Microcredit Bank has been established under decree No PF-3750 of the President of Republic of Uzbekistan dated May 5, 2006. re: "Establishment of Joint-Stock Commercial Microcredit Bank in order to provide for development of small businesses, private entrepreneurship and private farming, to create new individual self-employment opportunities by activating family

[29] http://trustbank.uz/ru/

businesses and cottage industries, especially to further enhance financing by providing large rural populations access to microfinance services.[30]

### (3) People's Bank

On the basis of the Presidential Decree of 24 April 2015 UP-4720 "On measures for the introduction of modern methods of corporate governance in joint stock companies" the bank's name changed to "Joint-Stock Commercial People's Bank."[31]

After the independence of Uzbekistan, "People's Bank" acted as financial agent of the Government in the process of reforms in the monetary sphere of the economy, with honor deciding set before him responsible tasks. The Bank has made every effort to stabilize its potential to increase confidence in the population, strengthen its place and its role in the domestic banking market.

Today People's Bank is one of the largest parts of the banking system of Uzbekistan. Its 197 regional and district (city) branches, 33 mini-banks and more than 1,000 savings and special cash desks are different banking entities of the real economy - small businesses and population of the republic.

The staff of the People's Bank continually sets themselves new tactical and strategic goals. At the moment, it is a qualitatively new level of customer service, achieving a competitive position against the largest bank in the country. To ensure the investment attractiveness

30 https://mikrokreditbank.uz/en/about/
31 https://xb.uz/eng/info/information-about-bank

and the leading positions on a number of indicators of the financial services market, it has upgraded its managerial and technological processes.

### (4) Hamkor Bank

Hamkor Bank was incorporated in Uzbekistan in 1991 in Andijan, Uzbekistan's fourth largest city.[32] Hamkor Bank's shares are listed on the Uzbekistan Stock Exchange. As of the end of 2009, Hamkor Bank had 4,532 shareholders (1,210 corporate entities and 3,322 individuals). Hamkor Bank is a leading privately owned commercial bank in Uzbekistan and the foremost in the Fergana Valley— the country's most densely populated region and a fertile region that specializes mainly in agricultural production such as cotton and related processing industries.

Hamkor Bank's primary business comprises targeting micro, small, and medium-sized enterprises and offering the entire range of retail banking products. Hamkor Bank has expanded its presence throughout the country, establishing branches and mini-banks in 11 out of the 14 regions. Currently, it has 26 full-service branches and 119 mini-banks. At the end of 2009, Hamkor Bank had an estimated 1.9% market share of banking sector assets, and 1.3% of capital stock. On 27 August 2009, Fitch Ratings affirmed Hamkor Bank's long-term IDR of "B," with a "stable" outlook. The short-term IDR of "B" was also affirmed.

[32] http://hamkorbank.uz/

### (5) Aloqa Bank

The Open Joint Stock Commercial "Aloqa Bank" was established by the Decree of the Cabinet of Ministers of the Republic of Uzbekistan under №502 from October 12, 1994, purposed to provide economic support to the enterprises of the Uzbekistan Communications and Information Agency and small- and medium-scale business entities.

The mission of the bank[33] — is creating maximum economic value for its shareholders and clients, promoting the intensive development of the economy of Uzbekistan, and making high quality bank products and services available to our clients. Fulfilling its mission the bank adheres to the following principles:

- Individual approach – service to customers is exclusively based on an individual approach, study, and meeting of needs for partners with a variety of technologically modern banking products and services.
- Professionalism - the formation of a highly professional and motivated team aimed at success and united by common corporate values.
- Innovation - creation of high-tech universal financial institution able to provide each customer with a full range of banking products and services based on the latest achievements of the banking world and innovative ideas.

[33] http://www.aloqabank.uz/en/page/about/missiya-banka#content_text

- Positioning – Achieving a position in the market as one of the largest universal bank consistently occupying leading positions among the subjects of the banking system of the country.

### (6) UzKDB Bank

The bank was founded as UzKDB bank CJSC in 2006 after the acquisition of UzDaewoo bank CJSC, which was founded in 1997 as a part of the international expansion of Daewoo Group and its financial department Daewoo Securities. In 2011, RBS NB Uzbekistan CJSC became part of KDB Financial Group.[34]

The integration of UzKDB bank CJSC and RBS NB Uzbekistan CJSC was successfully finalized on the 25th of March, 2013 with the start of KDB bank of Uzbekistan CJSC, which, after changing on its form of property to JSC KDB bank of Uzbekistan, is now a leading foreign bank in Uzbekistan offering a wide range of banking services covering corporate and individual clients.

### (7) Ravnaq Bank

Joint-stock commercial bank "Ravnaq Bank" was founded in June 2001. On June 23, 2001, the bank obtained license No. 70, which gives the right to conduct banking operations.[35]

Since November 2002, the bank has been a member of the deposit guarantee fund of the Republic of Uzbekistan, a member of the RSE "Tashkent", and a member of the association of banks of the Republic of Uzbekistan.

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[34] http://www.kdb.uz/en
[35] http://www.ravnaqbank.uz/

The implementation of the infrastructure expansion program will allow the bank to ensure a steady growth in the scope of its activities. At the same time, the bank focuses its attention on financing small businesses and private entrepreneurship.

## 2.3 South Korean banking system

South Korea has achieved miraculously fast economic growth and played an important role in the financial sector of Northeast Asia in the last half century. Nevertheless, during the 1997-1998, South Korea suffered a serious financial crisis. During the crisis four regional banks were closed or merged with nationwide banks. The problems of the crisis were exacerbated by non-performing loans held by many of South Korea`s merchant banks. A number of banks went bankrupt or were merged by foreign banks. In response, the South Korean government proposed an ambitious plan to develop South Korea into a financial center in Northeast Asia. But, first we should review the South Korean banking system.[36]

A few modern commercial banks were established in South Korea during the Japanese occupation (1910-1945) and South Korea inherited these banks when the Japanese colonial rule ended in 1945. Same like the People`s Bank of China (PBC), South Korea also has a central bank: The Bank of South Korea (BOK). The Bank of South Korea was originally established on June 12, 1950 under the Bank of South Korea Act.[37]

The primary purpose of the bank, as prescribed by the act, is the

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[36] Ludik Kouba, (2010). The South Korean economy after the financial crises in 1997 and 2008.

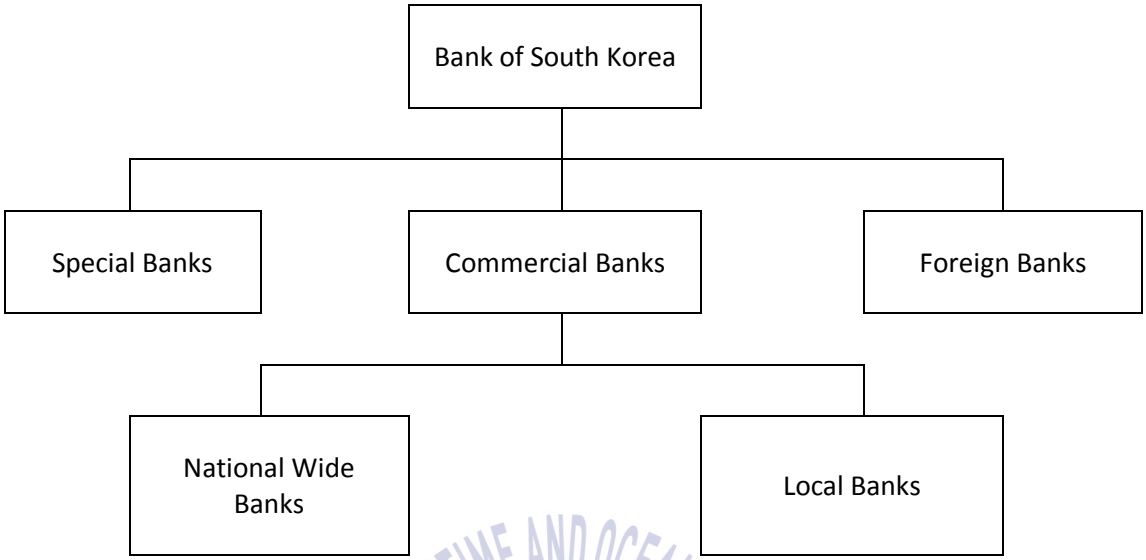
[37] https://en.wikipedia.org/wiki/Bank_of_Korea

pursuit of price stability. The bank sets a price stability target in consultation with the government and draws up and publishes an operational plan for monetary policy. The bank performs the typical functions of a central bank: issuing banknotes and coins; formulating and implementing monetary and credit policy; serving as the bankers` bank and the government`s bank. In addition, the Bank of South Korea undertakes the operation and oversight of the payment and settlement systems, and manages the nation`s foreign exchange reserves. It also conducts supervisory functions for financial institutions as stipulated in the Bank of South Korea Act.[38]

After the Korean War, the South Korean banking sector has grown at least as fast as the South Korean economy. The government formulated a fiscal and monetary stabilization plan to time inflation and to peg the exchange rate. Nationwide commercial banks were nationalized as the government sought financing for targeted industries under a series of 5-year economic development plans. In November 1959, the first regional bank, Seoul Bank was engaged in general banking in Seoul and Gyeonggi Province.

[38] hhtp:/eng.bok.or.kr

**Figure – 2. South Korean banking system[39]**




In the 1960s, the government expanded and improved the financial system to sustain high economic growth. In order to promote regional economic development, 10 regional banks were established, as fully privately-owned regional banks, such as Daegu Bank and Busan Bank in 1967, Chungchong Bank and Kwangju Bank in 1968, Jeju Bank, Gyeonggi bank and Jeonbuk Bank in 1969, Kangwon Bank and Kyongnam Bank in 1970, and Chungbuk Bank in 1971. South Korea Trust Bank was meanwhile founded in December 1968, to specialize in trust operations. During that period the banking sector went through a cycle of nationalization and privatization, re-nationalization, financial liberalization, financial crisis, and restructuring. Commercial banks were the main instrument for carrying out government-initiated economic development plans during

[39] https://www.export.gov/article?id=Korea-Banking-Systems

the 1960s and 1970s.[40]

In the 1980s, a number of structural problems stemming from government- led economic development had begun to surface, such as inflation and inefficient in banking sections. The South Korean government introduced a series of reforms beginning with visions to the general banking act in order to improve the banks` inefficiency and deal with the financial difficulties and competition from the market. To ensure the managerial autonomy of banks, the government completed the privatization of all commercial banks nationwide by selling its controlling stakes to the private sector. And to promote competition among financial institutions, two new banks were established, Shinhan Bank in 1982 and KorAm Bank in 1983. During this period, the number of nationwide commercial banks were established.

From 1991 to 1997, South Korea began a series of revisions to the general banking act. Interest rates were deregulated, policy loans were eliminated, reductions in non- performing loans were targeted, foreign exchange transactions were deregulated, and bank ownership was structured to allow individual shareholders a 12% equity stake. Contributing to the over-lending to South Korean banks was a moral hazard effect, as foreign lenders perceived explicit or implicit government loan guarantees. A lack of appropriate supervision and regulation also allowed serious asset-liability mismatches to develop as long-term domestic loans were financed through short-term foreign borrowing. As non-performing loans increased, foreign creditors

[40] http://countrystudies.us/south-korea/54.htm

became less willing to refinance, igniting speculative attacks. In South Korea, non-performing loans as a share of total loans reached 16% in June 1997 and then 22.5% in the first quarter of 1998.[41]

In 1997s, because of the Asian financial crisis, the South Korean Won started to heavily depreciate in October 1997. The problem was exacerbated by the accumulation of non-performing loans at many of South Korea`s merchant banks. By December 1997, the IMF had approved a USD $21 billion loan that would be part of a USD $58.4 billion bailout plan. By January 1998, the government had shut down a third of South Korea`s merchant banks. Throughout 1998, South Korea`s economy would continue to shrink quarterly at an average rate of -6.65%.

After the 1997 financial crises, the South Korean government proposed an ambitious plan to develop South Korea into a financial center in the Northeast Asia. The South Korean government began a two-stage financial restructuring. In the first stage, the financial reforms conducted from 1998 were focused on enhancement of the financial infrastructure. Two banks were nationalized for later sale to foreigners; five insolvent banks were closed and then merged with blue-chip banks; foreign capital injections were given to seven banks; and public funds were used to normalize operations of the remaining surviving banks; the government induced some banks to improve their managements.

At the same time, the government worked actively to enhance the financial infrastructure in order to allow the ongoing efforts for

[41] Park. K., 2003. Asian financial crisis of 1997-1998: Global Business and Finance 8, 61-70

financial liberalization and openness to produce the expected results.[42] Regarding greater financial openness, measures to liberalize foreign currency exchange were enforced in December 1997, by transitioning from a managed floating to a free floating exchange rate system and through the all-out deregulation of overseas remittances.

The second stage of financial restructuring process began in the latter half of 2000 and focused on restoring bank profitability. In 2000, the Financial Holding Company Act was enacted. Financial holding Companies were created to make merger and acquisition easier and help banks realize scale economies. Hanvit Bank, Seoul Bank, Peace Bank of South Korea, Kwangju Bank, Jeju Bank and Kyongnam Bank were merged into financial holding companies. As a result, the number of banks was reduced to 22 at the end of 2000, from 33 at the end 1997.

When the US subprime crisis spilled over into the global credit market and pushed the globe financial system to the brink collapse, the South Korean government and central bank still retained crucial roles and responsibilities in maintaining the soundness of financial institutions.[43]

In the process of overcoming the global financial crisis, the restructuring of the financial institutions is still implementing at this time. At the end of 2014, the numbers of banks decreased from 63 in 2000 to 19 in 2014.

Although banks are more focused on profitability, profitability still remains poor, due to a high share of non-performing loans and

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[42] Krishna Gidwani,(2002). Korea and the Asian Financial Crisis.
[43] https://en.wikipedia.org/wiki/Subprime_mortgage_crisis

inefficient pricing of credit risks. So the bank must continue its efforts to ensure the efficiency and stability of the payment and settlement system. In short, after the financial reform, South Korean financial institutions were available to handle the global financial crisis and were able to compete with the foreign banks.

**Table - 1. Financial Institutions**

| | |
|---|---|
| Central Bank | The Bank of South Korea |
| Banking institutions | Commercial banks<br>Specialized banks |
| Non-bank depository institutions* | Merchant banking corporations<br>Mutual savings banks<br>Credit institutions, etc. |
| Insurance institutions* | Life insurance companies<br>Non-life insurance companies<br>Postal insurance, etc. |
| Securities related companies* | Securities companies<br>Asset management companies<br>Futures companies<br>Securities finance companies, etc. |
| Other financial institutions* | Credit specialized financial companies<br>Venture capital companies, etc |
| Financial auxiliary institutions* | Financial supervisory service<br>South Korea Deposit Insurance Corporation<br>Financial Telecommunications & Clearings Institute, etc. |

Source: *http://www.asifma.org/uploadedfiles/resources/financial-system-korea*

## 2.4 The main banks in South Korea

In South Korea, there are two kinds of commercial banks, general banks and special banks. General banks are separated into nationwide banks, and local banks. The former include the Hana financial group, KB financial group, Shinhan financial group, Woori financial group, Korean Exchange Bank and Citibank South Korea. The latter are including Busan Bank, Daegu Bank, Jeonbuk Bank and Kyeongnam Bank. All South Korean banks are controlled by the banking act, except several banks.[44] In this thesis NH is special bank, which controlled by National Agricultural Cooperatives Acts.

### (1) Hana Bank

Hana Bank, Hana Financial Group's primary banking subsidiary was converted to a commercial bank in 1991. These years were characterized by remarkable growth, driven by successful transformational M&A and operational excellence. In 1995, Hana Bank became the first South Korean bank to introduce a private banking model in South Korea, and his maintained its leading position in the South Korean private banking market based on its accumulated market expertise and experience.

Hana Bank went through P&A with Chungchong Bank and M&A with Boram Bank in 1998 and acquired Seoul Bank in 2002.[45] In May 2005, it acquired Daehan Investment and Securities, South Korea's second largest asset management company. Hana Bank was

[44] Nonghyub Financial Holding Company, KDB Financial Group, Industrial Bank of South Korea, National Federation of Fisheries Cooperatives and Export-import Bank of Korea.
[45] https://www.kebhana.com/easyone_index_en.html

named “The best private bank in South Korea” by euro money for the seventh consecutive year on February 16, 2011. The world renowned financial magazine selected Hana Bank in recognition of its effective risk management associated with its financial products, the high quality of its private banking services, and its customized asset management, which focuses on balancing customer portfolios. In 2012 Hana Financial Group acquired KEB. Hana Bank is one of the nation’s leading lenders and has been recognized as one of the best banking in South Korea by the international financial press including Euro money, The Banker, Finance Asia and others.[46]

### (2) Woori Bank

Woori Bank was founded in 1989. The bank changed its name in 2002, and includes the former Commercial Bank of South Korea, Hanil Bank, and Peace Bank. Woori Bank is a part of the Woori Financial Group. In 2001, the bank became the first financial holding company, Woori Financial Group, and first among South Korean banks to sell securities in trust, and the first among South Korean financial institutions to acquire certification for internet banking. From 2008, WRB cooperate with other world banks widely. The Banker Magazine selected Woori Bank as the best bank in South Korea in 2011.[47]

### (3) Kookmin Bank

Kookmin Bank, the flag ship of KB Financial Group[48], is the largest bank by both asset value and market capitalization in South

[46] www.hanabank.com and Hana bank annual report.
[47] www.wooribank.com and bank annual report.
[48] https://www.kbstar.com/

Korea, and is a dominant leader in the South Korean banking industry, priding itself on having the largest customer base, the most extensive branch network, the highest credit ratings, and the best customer satisfaction.

In 2010, Kookmin Bank ranked first in each of the National Customer Satisfaction Index, for an unprecedented five consecutive years, the South Korea Customer Satisfaction Index, for four consecutive years, and the National Brand Competitiveness Index, for seven consecutive years. Kookmin Bank, under the slogan of "profit and value focused growth," will concentrate on regaining profitability as soon as possible through sustainable income models, maintain preemptive risk management policies, build up a more customer-focused mindset, and grow into a more responsible corporate citizen.[49]

### (4) Korea Exchange Bank

The Korean Exchange Bank (KEB) is a specialized currency bank in South Korea. The headquarters of the company is located in Seoul and was founded in 1967. Korea Exchange Bank is the fifth largest bank in South Korea, measured by assets (except for IBK and KDB) and the largest currency bank in South Korea, which provides the widest range of foreign exchange products.[50]

The South Korean Foreign Exchange Bank was acquired in 2003 by the Lone Star Funds, a private equity fund of the United States, as part of a general reorganization of the South Korean financial sector after the Asian financial crisis. In 2006, Lone Star tried to sell the

[49] www.KBFNG.com
[50] https://en.wikipedia.org/wiki/Korea_Exchange_Bank

company to the highest bidder, Kookmin Bank, but the plan was canceled when it encountered investigations by South Korean prosecutors and regulators.

In September 2007, HSBC agreed to acquire a controlling stake for $ 6 billion, but the sale was not approved by the government of South Korea.

In September 2008, Kookmin Bank and Hana Bank were considered for the takeover of KEB after HSBC failed to acquire the bank in 2007.[51]

The Korean Exchange Bank is the largest and longest exchange bank in South Korea, with 40% of the South Korean currency market.

### (5) NongHyup Bank

An extension of the National Agricultural Cooperative Federation's financial operations, NH Bank was established in March 2, 2012. [52]

Since its foundation in 1961 as a comprehensive agricultural cooperative, it has been recognized as the safest bank in South Korea and as one of the most advanced cooperative financial institution around the world. Banks serve over 20 million customers.

### (6) Shinhan Bank

Shinhan Bank is the descendant of Hanseong Bank, the first modern bank in South Korea. It was established by Kim Jong-Han in 1897, but began operating around 1900. It was originally located in a

[51] Kookmin, Hana Jockeying for KEB Takeover
[52] https://banking.nonghyup.com/

small house with only two rooms. One room was for the president, Yi Jae-Won, and the other room was for the staff. The bank operated by borrowing money from Japanese banks at low interest rates and then loaning it out for twice the rate to the South Korean market. The Bank was successful because despite lending out money at twice the rate it borrowed it at; the bank's interest rates were still far lower than what could be obtained elsewhere in South Korea at that time.[53]

### (7) IBK Bank

Since its inception in 1961, the Industrial Bank of Korea (IBK) has committed itself to complying with its charter for small and medium-sized enterprises (SMEs). Keeping this traditional role and helping to promote economic development of the country, in recent years the bank has expanded its knowledge to provide a wide range of financial services to individual clients. In pursuit of this goal, IBK makes every effort to improve its competitiveness, ensure balanced growth and strengthen its global presence.[54]

The bank employs about 10,000 employees and operates a distribution network of 612 branches, including 12 foreign branches. In 2008, IBK Investment & Securities was launched, focused on meeting the needs of SME clients for services such as IPOs and M & As. Moreover, a strategic alliance with South Korea Investment Holdings increases the competitiveness of products and connectivity with the national post office.

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[53] Lankov, Andrei. EunHaeng NaMu. (2007). The dawn of modern South Korea.
[54] http://eng.ibk.co.kr/lang/en/index.jsp

# Chapter Three: Methodology of Analysis

## 3.1 Efficiency of measurement concept

The main purpose of this section is to review a number of different efficiency measures, and to discuss how they may be estimated relative to an efficient technology, which is generally represented by the form of frontier functions.

First of all, we begin to discuss some efficiency concepts. Technical efficiency and allocative efficiency were proposed by Ferrell. Technical efficiency, sometimes it's called technological efficiency, which reflects the ability of a firm to obtain maximal outputs from a given set of inputs. In order to get the most technical efficiency, a bank must either minimize its inputs given outputs or maximize its outputs given inputs. Most of early non-parametric frontier models and some of parametric frontier models focuses on technical efficiency. Allocative efficiency focuses on level of inputs relative to level of outputs in optimal proportions. Economic efficiency is a broader concept than technical efficiency, in that economic efficiency also involves optimally choosing the levels and mixes of inputs or outputs base on reactions to market prices. If a bank wants to get the most economic efficiency, it needs to choose its input or output level and mixes so as to optimize cost minimization or profit maximization. But economic efficiency requires both technical and allocative efficiency. Technical efficiency values will tend to be higher than economic efficiency values on average, because economic efficiency sets a high standard which includes allocative efficiency.

## 3.2 The non-parametric frontier analysis (DEA)

### 3.2.1 Decision making unit (DMU) and DEA

DEA can be roughly defined as a non-parametric mathematical programming approach to measure the relative efficiency of multiply DMUs based on multiple inputs and multiple outputs. In DEA, the organization under study is called a DMU (decision Making Unit). The definition of DMU is rather slipping to allow flexibility in its use over a wide range of possible applications. Generically as DMU is regarded as an entity responsible for converting inputs into outputs and whose performances are to be evaluated. In managerial applications, DMUs may include banks, department stores and supermarkets, and extend to car markets, hospitals, public libraries, and the like in engineering; DMUs may take such forms as airplanes or their components such as jet engines. For the purpose of securing relative comparisons, a group of DMUs is used to evaluate each other with each DMU having a certain degree of managerial freedom in decision making.

Suppose there are n DMUs: $DMU_1$, $DMU_2$… and $DMU_n$. Some common input and output items for each of this j=1… n DMUs are selected as follows:

1. Numerical data are available for each input and output, with the data assumed to positive for all DMUs.

2. The item (inputs, outputs and choice of DMUs) should reflect an analyst's or a managers' interest in the components that will enter into the relative efficiency evaluations of the DMUs.

3. In principle, smaller input amounts are preferable and larger

output amounts are preferable so the efficiency scores should reflect these principles.

4. The measurement units of the different inputs and outputs need not to be congruent. Some may involve number of persons, or areas of floor space, money expended, etc.

DEA is a fine method for evaluating the performance of the bank in that bank purses multi production with multiple inputs. The term DMU was used for the first in the CCR model proposed by Charnes, Cooper and Rhode (1978) based on Ferrell's (1957) idea on production efficiency, which assumes CRS (constant returns to scale). We call it DEA-CRS model. The DEA-BCC model was first proposed by Banker Charnes and Cooper (1984) based on CCR model. The efficiency of each DMU is defined as a ratio between the weighted sum of outputs to the weighted sum of inputs, and it can be express as:

$$\text{Efficiency} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}} \qquad (1)$$

Let's assume that there are N banks (DMUs), using I different inputs and producing J different outputs. Also, let's assume that Xi represents the amount of input employed and Yi represents the amount of output produced by the -th banks. Thus, the data of all banks in the sample are represented by the J*N output matrix, Y, and I*N input matrix, X. Since there are N banks, the linear programming problem is solved N times, once for each bank in the sample.

The efficiency of the objective unit j can be achieved as solution of the maximization problem of the unit j efficiency, subject to the efficiency of every unit. The weights are the variables of this problem, and the solution gives the most favorable weights for the unit j, and an efficiency measurement, the basic algebraic model (DEA-CCR) is:

$$\text{Max} \qquad h = \frac{\sum_r u_r y_{rj}}{\sum_i v_i x_y}$$

$$\text{Subject to: } h = \frac{\sum_r u_r y_{rj}}{\sum_r v_i x_y} \leq 1 \quad (\text{i} = 1,2,3\ldots\text{I};\ \text{r} = 1,2,3\ldots\text{R};\ \text{j} = 1,2,3\ldots\text{J})$$

$$u_r, v_i \geq \varepsilon > 0 \qquad (2)$$

Where h= banks efficiency,

$y_{rj}$ =indicates the amount of rth output produce by the jth DMU,

$x_{ij}$ =indicate the amount of ith input use by the jth DMU,

$u_r$ =weigh given to output r,

$v_i$ =weigh given to input i,

ε= a non-Archimedean value designed to enforce strict positivity on the variables.

The variables of the problem u and v must be bigger or equal than $\varepsilon$. This is necessary in order to avoid that any input or output

were ignored in the efficiency analysis and moreover, in order to be sure that the denominator of the function and the restrictions are different from zero. The quotient constraint has a superior limit with value 1, for being the reference to the different scales. The model solution gives a value to h the unit j efficiency and weights that give that efficiency. From the mathematical point of view, it is a problem of fractional or linear hyperbolical programming, which can be easily turned into a linear problem. That is, the DEA is a non-linear problem but the process to make it linear is relatively easy.

We can use specific programs to solve the DEA problems[55], and the equation (2) can be converted to a linear programming model as follows:

$$\begin{aligned} & Max_{\mu,v}(\mu y_i \\ & \text{s.t: } v'x_i = 1 \\ & \mu' y_j - v' x_j \leq 0 \\ & \mu, v \ \geq \varepsilon \end{aligned} \qquad (3)$$

Since the following approach and model are drive from the basic DEA model in equations (2) and (3). For more detail about the methodological development of the DEA method can be found in Seaford and Cook.[56]

[55] Use the **DEAP version 2.1** software.
[56] Seiford, L.M., and Cook, W.D. (2009). Data envelopment analysis (DEA)-Thirty years on. European Journal of Operational Research 192 (2009) 1-17.

### 3.2.2 Input-orientated measures

Farrell used two inputs ( $x_1$ and $x_2$) and a single output ($y$) to illustrated the efficiency, and the function can be expressed by $y = f$ ( $x_1$,$x_2$).

$$1=f\left({}^{x_1}/_{y},\ {}^{x_2}/_{y},\right)$$

The concepts of efficiency are presented in graph- 1. The assumption of constant returns to scale (CRS) allows the efficient production function to be characterized through the unit isoquant

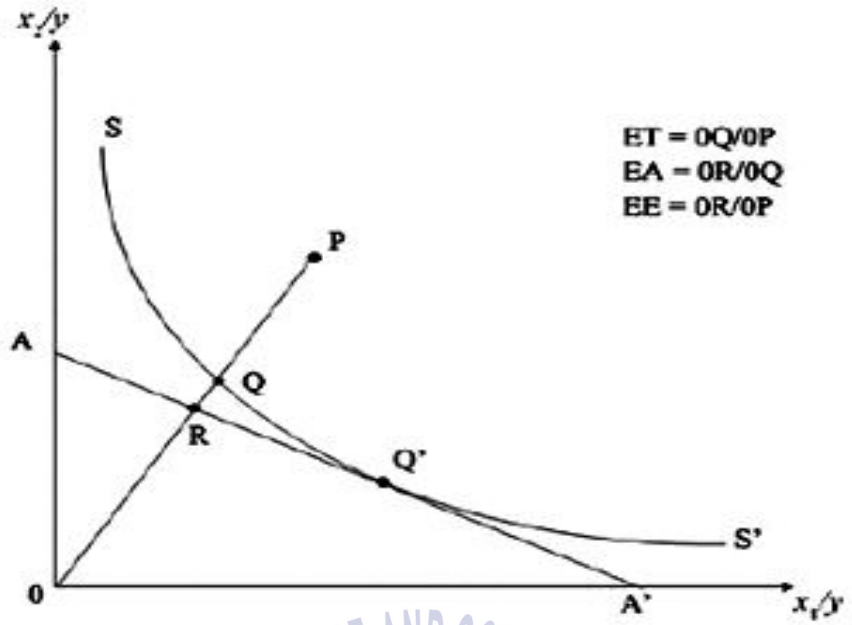
(SS` curve). In the graph 1, there are two unit of inputs $x_1$*$x_2$* defined by the point P, to produce a unit of output y*. Point Q is technically efficient because it lays on the efficient isoquant curve SS`, so the distance QP represents the technical efficiency. The distance QP means the amount by which two inputs could be proportionally reduced without a reduction in output. This is usually expressed in percentage terms by the ratio QP/0P, which represents the percentage by which all inputs could be reduced. The technical efficiency ($TE_{I}$[57]) of a bank is most commonly measured by the ratio

$$TE_1 = 1 - \frac{QP}{OP} = \frac{OQ}{OP}$$

This ratio takes values between one and zero. 1 means fully technically efficient, and 0 is fully technically inefficient.

[57] The subscript "I" is used on the TE measure to show that it is an input-orientated measure.

Figure -3. Technical and allocative efficiency




If given the straight o cost curve AA`, whose slope is equal to the ratio of the prices of the inputs. In this situation, even though both points, Q and Q`, represent full technical efficiency, given the prices of the inputs, the cost of production is only minimized in point Q`, the allocative efficiency of the bank operating at R is defined to be the ration

A value of 1 of this quotient indicates allocative efficiency and values below the unit indicate the degree of allocative efficiency achieved by the bank. Since the distance RQ represents the reduction in production costs that would occur if production were to occur at the allocative (and technically) efficient point Q`, instead of at the technically efficient, but allocative inefficient, point Q`.

$$AE_I = {}^{0R}/_{0Q}$$

The product of technical and allocative efficiency provides the

overall economic efficiency. So, the economic efficiency (EE) is defined as the following:

$$AE_I = TE_I \times AE_I \left( {}^{0Q}/_{0P} \right) \times \left( {}^{0R}/_{0Q} \right) = {}^{0R}/_{0P}$$

Note that all three values are bound by zero and one.

### 3.2.3 Output-orientated measures

The following output-orientated measure is opposite to the input-orientated measure discussed. The output-orientated measures would be defined in graph 2. Opposite to the input-orientated measure, there are two outputs $y_1$ and $y_2$, and a single input $x_1$. It can be depicted in graph 2 where the line ZZ` is the unit production possibility curve. The point A is an inefficient because it lies below the curve ZZ`. The distance AB represents technical inefficiency. That is, the amount by which outputs could be increased without requiring extra inputs. Hence the out-orientated technical efficiency ($TE_O$[58]) is defined as:

$$TE_O = {}^{0A}/_{0B}$$

DD` is the o revenue line, so, the allocative efficiency can be defined:

$$AE_O = {}^{0B}/_{0C}$$

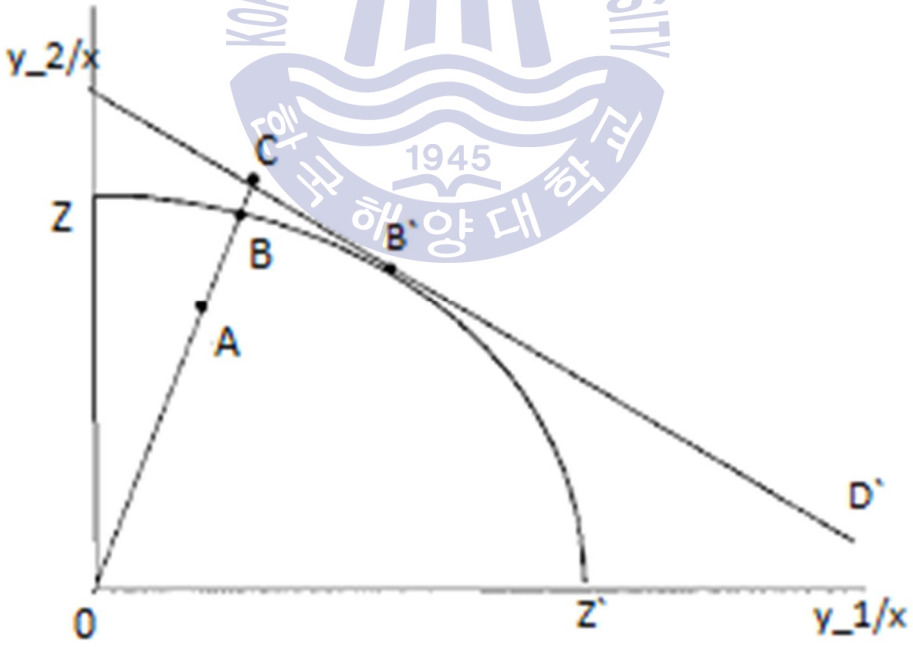
[58] The subscript "I" is used on the TE measure to show that it is an output-orientated measure.

Furthermore, overall economic efficiency can be defined as the product of these two measures

$$EE_o = AE_o \times TE_o \left( {}^{0A}/_{0B} \right) \times \left( {}^{0B}/_{0C} \right) = {}^{0A}/_{0C}$$

All of these three ratios are bounded by zero and one.

**Figure -4. Technical and allocative efficiencies from an output orientation**



### 3.2.4 Constant returns to scale (CRS) DEA model (DEA-CRS)

First, we use DEA-CRS model to measure the bank`s technical efficiency. In this paper, we choose to apply input- oriented and output-oriented to measure the banks` efficiency. To simplify the problem, let`s assume that these N banks, operate under the CRS and employ J inputs ($X_j$, j=1, 2, 3…J) to produce I output ($Y_i$, i=1, 2…I). The formal problem for the technical efficiency ($TE_k$) can conveniently be expressed in the following way:

Input-orientated approach

$$\begin{aligned} &Max_{TEk,Wk}\ TE_k \\ &\text{s.t: } Y_k \cdot w_k \geq y_i, \\ &X_k \cdot w_k \leq TE_k \cdot x_i, \\ &W_k \geq 0, \end{aligned} \qquad (4)$$

Output-orientated model

$$\begin{aligned} &Min_{TEk,Wk}\ TE_k \\ &\text{s.t: } Y_k \cdot w_k \geq TE_k \cdot y_i, \\ &X_k \cdot w_k \leq x_i \\ &W_k \geq 0, \end{aligned} \qquad (5)$$

Were $TE_k$, is a scalar and represents the technical efficiency measure for the k-th bank, $w_k$ is the vector of input prices for the i-th bank.

The inequality $(Y_k \cdot w_k \geq y_i)$ implies that the observed outputs must be less or equal to a linear combination of outputs of the banks forming the efficient frontier. The inequality $(Y_k \cdot w_k \geq TE_k \cdot x_i)$ assures that the use of inputs at the linear combination of the efficient banks must be less or equal to use of inputs of the k-소 bank. The combination will show that $TE_k \leq 1$.

### 3.2.5 Variable returns to scale (VRS) DEA model (DEA-VRS)

We use the DEA-VRS model to measure the scale efficiency, which is introduced by Banker, Charnes and Cooper (1984). The CRS assumption will be incorrect if all banks are not operating at an optimal scale. In this case, the CRS specification will bias the estimation of the technical efficiency by confounding scale effects. But, the substitution of the CRS wit variable returns to scale (VRS) assumption brings about the estimation assumption brings about the estimation of the pure technical efficiency (PTE), i,e., TE devoid of the scale effects. All the variables in the VRS model have the same definition as in the CRS model. This can be achieved by adding a convexity constraint $(N_1 \cdot w_i = 1)$ to (4 and 5) which allows VRS as described below:

Input-orientated model

$$Max_{TEk,Wk}\ TE_k$$

$$\text{s.t: } Y_k \cdot w_k \geq y_i, \qquad (6)$$

$$X_k \cdot w_k \leq TE_k \cdot x_{i,}$$

$$N_1 \cdot w_i = 1$$

$$W_k \geq 0,$$

Output-orientated model

$$Min_{TEk,Wk}\ TE_k$$

$$\text{s.t: } Y_k \cdot w_k \geq TE_k \cdot y_i, \qquad (7)$$

$$X_k \cdot w_k \leq x_i$$

$$N_1 \cdot w_i = 1$$

$$W_k \geq 0,$$

Where $N_1$ is a 1*N vector of ones, the VRS frontier obtained this way envelops the data more tightly than the CBS frontier and thus generates technical efficiency scores that are bigger than equal to those obtained from the CRS frontier.

### 3.3 The Stochastic Frontier Analysis model (SFA)

In order to estimate the technical efficiency of bank production by stochastic frontier analysis (SFA), we assume Cobb-Douglas production frontier function[59], which is estimated by using Maximum likelihood techniques to examine factors influencing the output of bank production. The stochastic production frontier can be written as

$$\ln(y_i) = \beta_0 + \Sigma \quad \beta_i ln X_{ij} + \varepsilon_i \qquad (8)$$

Where $y_i$ is output of the $i$ producers, $X_{ij}$ is the $j$ input used by the banks i. the essential idea behind the stochastic frontier model is that $\varepsilon_i$ is a composed error term. The error term $(\varepsilon_i)$ is now defined as

$$\varepsilon_i = v_i - u_i$$
$$i = 1, 2, 3 \ldots N \qquad (9)$$

Where $v_i$ is two-sided $(-\infty < v < \infty)$ normally distributed random error $(v \sim N[0, \ \sigma_v^2])$ that captures the stochastic effects outside the bank's control, measurement errors, and other statistical noise? The term $u_i$ is one-sided $(u \geq 0)$ efficiency component that captures the technical inefficiency of the banks. In other words, $u_i$ measures the shortfall in output $Y_i$ from its maximum value given by the stochastic frontier $lny_i$. This one side term can fallow such distributions as half-normal, exponential, and gamma.

In this study, it's assumed that $u_i$ follows a half-normal distribution $(u \sim N[0, \sigma_v^2])$ as it is typically done in the applied stochastic frontier literature. The two components $v_i \ and \ u_i$ are also

[59] This software can be downloaded from the website www.uq.edu.au

assumed to be independent each other. The maximum likelihood estimation of equation ($e_i = v_i - u_i$) yields consistent estimators for $\alpha, \beta, \lambda$ and $\sigma_v^2$ where $\beta$ is a vector of unknown parameters,

$$\Lambda = {}^{s_u}/_{s_v} \quad \text{and} \quad s_u = s_u^2 + s_v \quad (10)$$

Banks specific technical efficiency will be obtained by using the relationship:

$$TE_i = exp\left({}^{-\tilde{u}_i}/_{\Sigma\beta_i}\right) = exp\left[-E\ \left({}^{u_i}/_{\beta_i}\right)\right] \qquad (11)$$

Where derive the estimates for v and u by replacing e, s, and λ in equations (9) and (10). Subtracting v from the both sides of equation (10) yields the stochastic production frontier.

Given the specifications of the stochastic frontier production function, defined by equation (11) the null hypothesis, that technical inefficiency is not present in the model, and is expressed by $H_0: y^* = 0$, where $y^*$ is the variance ratio, explaining the total variation in output from the frontier level of output attributed to technical efficiencies and defined by $y^* = {}^{\sigma_u^2}/_{(\sigma_u^2 + \sigma_u^2)}$. This is done with the calculation of the maximum likelihood estimates for the parameters of the stochastic frontier model by using the computer program Frontier version 4.1.[60] The parameter $y^*$ must lie between 0 and 1. If the null hypothesis is accepted, this would indicate that $\sigma_u^2$ is zero and hence that the $u_{it}$ term should be consistently estimated using ordinary least squares. The hypotheses are tested using the generalized likelihood ratio test and the generalized likelihood statistic, $y^*$ is

[60] Tim Colli, Frontier version 4.1.

defined by$\lambda = -2ln[L(H_0)/L(H_1)]$, where $H_0$ and $H_1$ are the null and alternative hypotheses involved. If the null hypothesis $H_0$ is true, then λ is asymptotically distributed as a Chi-square random variable. If the null hypothesis involves$y^* = 0$, then λ has mixed Chi-square distribution because $y^* = 0$ is value on the boundary of the parameter space for $y^*$.[61]

### 3.4 The Scale Efficiency

If there is a difference between the CRS technical efficiency (CRSTE) and the VRS technical efficiency (VRSTE) for the bank, it means that the banks have scale efficiency. Scale efficiency measures the traditional theory of economies of scale, which refers to decrease per unit cost when output increases. When the proportional increase in output is greater than the proportional increase in input, increase return to scale (IRS) occurs. In contrast, when increase in output required more than the proportional increase in input, decrease return of scale (DRS) exist. Also, there is a third situation, the CRS technical efficiency equals to the VRS technical efficiency, constant return of scale (CRS) occurs.

The scale efficiency for the bank, thus, can be compute from the difference between the CRSTE and the VRSTE. Since, CRSTE = VRSTE*SE. then SE=CRSTE/VRSTE.

In graph- 3, there is one-input and one-output, and it draws the CRS and VRS DEA frontier. Under CRS-input-orientated technical inefficiency of the point P is the distance $PP_c$, while under VRS the

[61] Coelli, T.J. 1995, 1996.

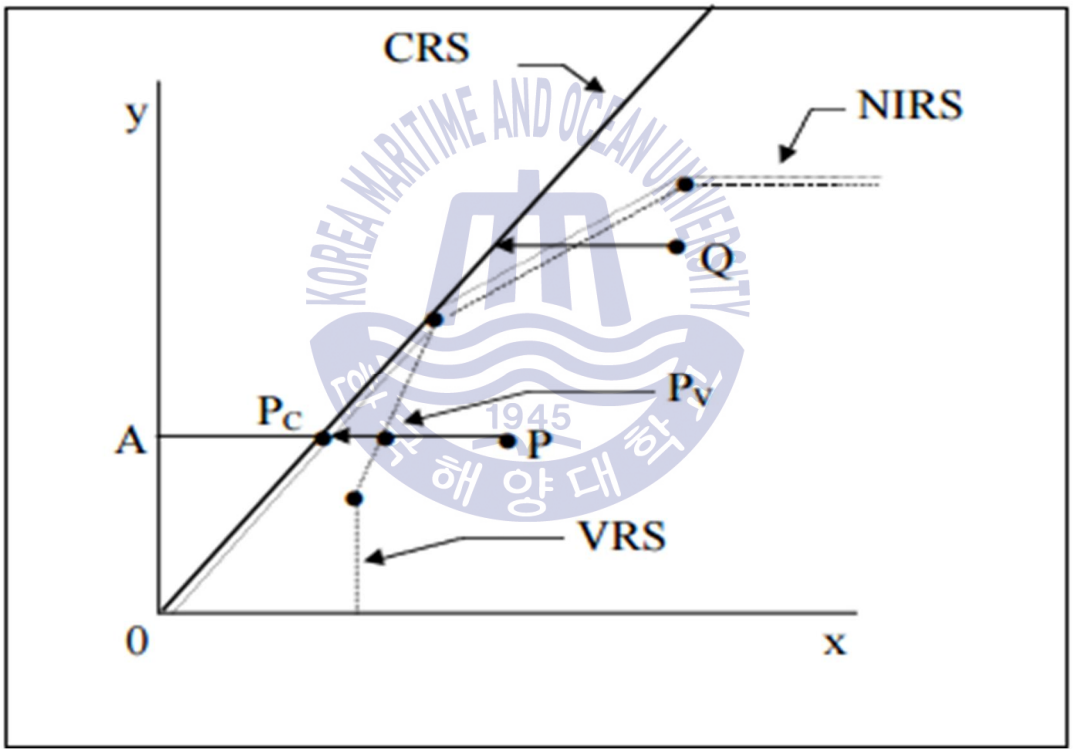
technical inefficiency would only be $PP_v$. The difference between these two measures, $P_cP_v$, is put down to scale inefficiency. All of these efficiency measures can be expressed as the following ratio:

$$TE_{I,CRS} = AP_C/AP$$

$$TE_{I,VRS} = AP_V/AP$$

$$SE_I = AP_C/AP_V$$

**Figure- 5. Calculation of Scale Economies in DEA[62]**




Note that all of these ratios are bounded by zero and one.

The study uses the software DEAP version 2.1 to measure DEA's efficiency.[63]

[62] Tim Coelli, Centre for Efficiency and Productivity Analysis. Page- 19.

[63] This software can be briefly introduced in this website: www.uq.dea.au

# Chapter Four: Results and Interpretations

## 4.1 Input and output specifications

Berger and Humphrey identify two main approaches for the selection of inputs and outputs. There are two ways to determinate the input and output variables in the efficiency model. These are the "production approach", also called the service provision or value added approach; and the "intermediation approach", also called the asset approach. The production approach was first proposed by Benston. Under the production approach, a bank is considered as a firm generating deposits and loans using both labors and capital and the objective are to minimize the consumption of the resources which are used to provide services, whereas the outputs are measured by the number of accounts or transactions. The intermediate approach was proposed by Sealey and Kindley. Under the intermediation approach, the bank acts as the intermediary raising funds from savers and lending funds to investors to generate profit, where the inputs and outputs are measured in monetary units.

Berger and Humphrey[64] argue that either production approach or intermediation approach has weakness, and each method cannot fully capture the dual roles of the financial institutions. To the contrary, production approach may be more suitable for evaluating the branches' efficiency of the financial institutions, because branches are more focus on process customer documents and have limited influence over bank funding and investment decisions. The intermediation

[64] Berger AN, Humphrey DB (1997). Efficiency of financial institutions: international survey and directions for future research. EUR J Oper Res 98: 175-212

approach is appropriate for measuring the whole bank level efficiency and this approach may be somewhat better than the production approach to measure the efficiency of the entire financial institutions. As the result, the intermediation approach as the one favored in the former literatures.

Therefore, as in the majority of the empirical literature, we adopted a modified version of the intermediation approach as opposed to the production approach for selecting input and output variables for computing technical efficiency. Hence, the input variables used in this study are employees, total assets and total equity. The output variables include total loans and total profit. Summary information on the input and output variables are shown in table 2.

**Table-2 Preliminary studies on input and output variables**

| Authors | Input variables | Output variables |
|---|---|---|
| Asror Nigmonov (2004) | Operational expenses, Fixed assets, Total Deposits | Total credits - Reserve for possible loan losses, Total non-interest income, Other non-interest income |
| Paek Jauk (2001) | Loans, Deposits | Total expenses, Operating fixed assets |
| Kim Sangho (2001) | Deposits, debts, employees, Tangible fixed assets | Loans, Commission income, Securities |
| Isik and Hassan (2002) | Labor, Capital, Loanable funds | Short-term and long-term loans, B / S items under risk control, Other revenue assets |

| | | |
|---|---|---|
| Hwang Jinsoo (2005) | Employees, total assets, Operating fixed assets | Deposits, loans, net profit |
| Fukuyama (1993) | Employees, Capital, Funds from customers | Loan revenue, other revenues |
| Avkiran (1999) | Deposits, employees | Net loans, Non-interest income |
| Seiford and Zhu (1999) | Employees, assets, capital stock | Revenue, Profits |
| Park Chengrok and Lee Insil (2002) | Employees, Fixed assets | Loans, Deposits, Securities investment |
| Fries and Taci (2005) | Labor, capital | Total expenses |
| Drake et al. (2009) Intermediation approach | Total deposits, Total operating expenses, Total provision | Total loans, Total other assets, commission, Fee and trading income, total other operating income |
| Lee Min Hee (2010) | Employees, Branches, Fixed assets | Deposits, Loans, Securities investment |
| Yang Ook Chol, Lee Yon Hoo (2013) | Employees, Fixed assets, Total equity | Loan, Net profit |
| Viacheslav Den (2016) | Employees, Equity, Fixed assets | Total Loans, Operating revenue |
| Ho-Soo Na (2016) | Number of employees, Number of branches, Fixed assets, Equity capital | Total loans, Interest income, Net income |

## 4.2 Research background

As it was mentioned earlier, DEA does not account for the random error term and is being used for the performance evaluation of identical units. Oral and Yololan(1990) suggest to use DEA models for firms employing similar resources and providing the same services. Quey-Jen Yeh (1996) states that it is important to take into account the homogeneity condition during the choice of DMUs for the model.

For that reason, we should exclude from the model the large Uzbek state banks (MKB, Aloqa Bank, People's Bank). The reason for this is that the asset size of these banks is not comparable (they possess too large a level of assets) with other banks from the system and their inclusion into our analysis will largely distort our findings. On the other hand, these three banks control more than 40% of all banks' assets in Uzbekistan; which prevents us from generalizing the paper's results to the entire banking sector of a country.

The data is obtained from the weekly magazine "Bank Akhborotnomasi" which provides audited annual financial reports of almost all banks in Uzbekistan. Additionally, any further detailed information is found from the annual reports of banks or during the unstructured interviews with bank representatives.

Then, the model was worked using the software of DEAP v 2.1 (online)[65] which gives detailed and advanced results. The use of software is explained by the fact that both models present the results in a different format. Therefore, the results for the banking system are

[65] Tim Colli. DEAP v 2.1 Software

presented using DEAP V 2.1; while for the analysis of individual banks are presented using the online software of DEAP V 2.1.

**Table -3. Banks in the sample**

| | Short code | Establishing year |
|---|---|---|
| **Uzbekistan Banks** | | |
| People's Bank | SCPB | 1995 |
| Hamkor Bank | JSCHB | 1991 |
| Aloqa Bank | JSCAB | 1994 |
| Trust Bank | JSCAB | 1994 |
| UZKDB Bank | UzKDB | 1997 |
| Ravnaq-Bank | JSCRB | 2001 |
| Microcredit Bank | JSCMKB | 2006 |
| **Korean Banks** | | |
| Hana Bank | HNB | 1971 |
| Korea Exchange Bank | KEB | 1967 |
| Shinhan Bank | SHB | 1897 |
| Woori Bank | WRB | 1899 |
| Kookmin Bank | KB | 1963 |
| National Agricultural Cooperative Federation | NH | 1961 |
| Industrial Bank of Korea | IBK | 1961 |

# Chapter Five: Data Sources

In this research, we have used employees, total assets and total equity as the input variables. And we have used total loans and total profit as the output variables. Summary information on the input and output variables are shown separately of both countries in tables 4 - 5.

**Table- 4. Input and Output Variables of South Korea Banks**

| *Variable* | *Description* | *Unit* | *Mean* | *Min* | *Max* | *S. D* |
|---|---|---|---|---|---|---|
| $Y_1$ | T- Loans | Million dollar | 5.3E+11 | 1.0E+11 | 8.9E+11 | 2.9E+11 |
| $Y_2$ | T- Profit | Million dollar | 2.1E+11 | 9.9E+08 | 5.3E+11 | 1.9E+11 |
| $X_1$ | Employees | People | 59386 | 7690 | 109201 | 30825 |
| $X_2$ | T- assets | Million dollar | 8.5E+11 | 4.5E+11 | 1.2E+12 | 2.8E+11 |
| $X_3$ | T- equity | Million dollar | 3.3E+11 | 4.1E+10 | 7.7E+11 | 2.6E+11 |

Table- 5. Input and Output Variables of Uzbekistan Banks

| *Variable* | *Description* | *Unit* | *Mean* | *Min* | *Max* | *S. D* |
|---|---|---|---|---|---|---|
| $Y_1$ | T- Loans | Million dollar | 6.5E+08 | 2.8E+07 | 1.5E+09 | 5.3E+08 |
| $Y_2$ | T- Profit | Million dollar | 1.9E+07 | 1.1E+06 | 3.8E+07 | 1.5E+07 |
| $X_1$ | Employees | People | 6086 | 921 | 12001 | 4426 |
| $X_2$ | T- assets | Million dollar | 1.5E+09 | 6.5E+07 | 3.2E+09 | 1.0E+09 |
| $X_3$ | T- equity | Million dollar | 7.8E+08 | 1.5E+07 | 1.8E+09 | 6.3E+08 |

The data for the research is collected from a variety of sources. Uzbekistan banks data are obtained from Uzbekistan's finance and banking for the period 2010 through 2014 and each bank's annual report. All South Korean banks` data are collected from the finance statistics and each bank's annual report from 2010 to 2014. All money values are converted into the dollar applying Uzbekistan currency exchange rate to US currency and South Korean currency exchange rate to US currency.

## 5.1 Empirical results of DEA model

### Table-6. Uzbekistan and South Korean bank's efficiency

| Year | Nation | CRSTE | VRSTE | SE |
|---|---|---|---|---|
| 2010 | Uzbekistan | 0.362 | 0.467 | 0.766 |
| | Korea | 0.662 | 0.902 | 0.731 |
| 2011 | Uzbekistan | 0.489 | 0.584 | 0.815 |
| | Korea | 0.645 | 0.930 | 0.685 |
| 2012 | Uzbekistan | 0.629 | 0.699 | 0.853 |
| | Korea | 0.577 | 0.932 | 0.615 |
| 2013 | Uzbekistan | 0.453 | 0.531 | 0.834 |
| | Korea | 0.731 | 0.948 | 0.755 |
| 2014 | Uzbekistan | 0.483 | 0.549 | 0.840 |
| | Korea | 0.623 | 0.977 | 0.639 |

SE: scale efficiency = CRSTE/VRSTE.

CRSTE: technical efficiency VRSTE: Pure technical efficiency

### Figure - 6. Efficiency Level Trends of Uzbekistan

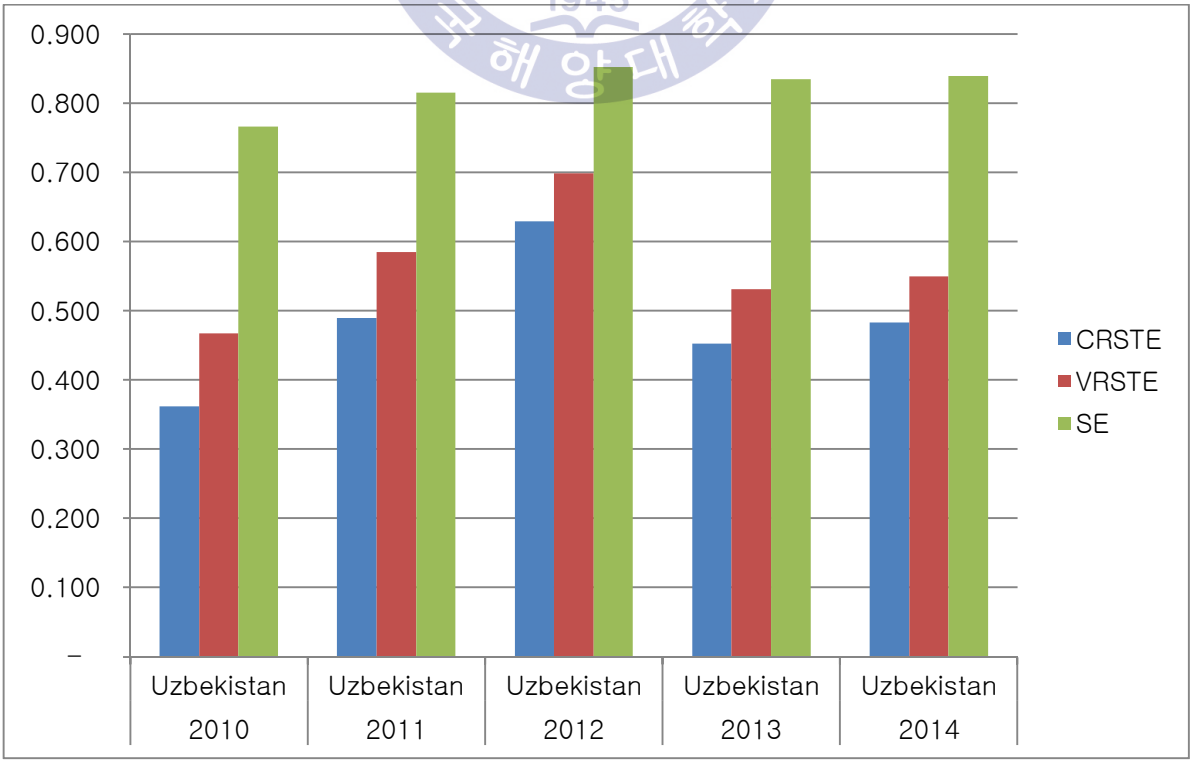


Figure - 7. Efficiency Level Trends of South Korea

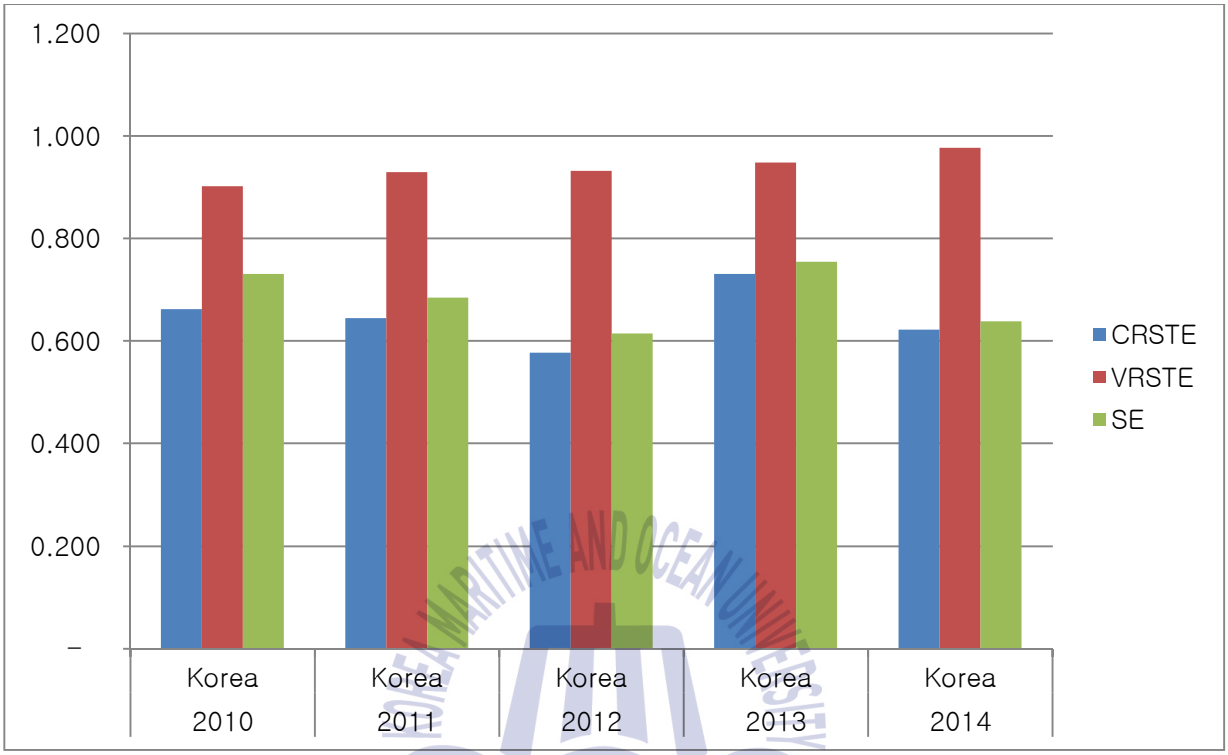


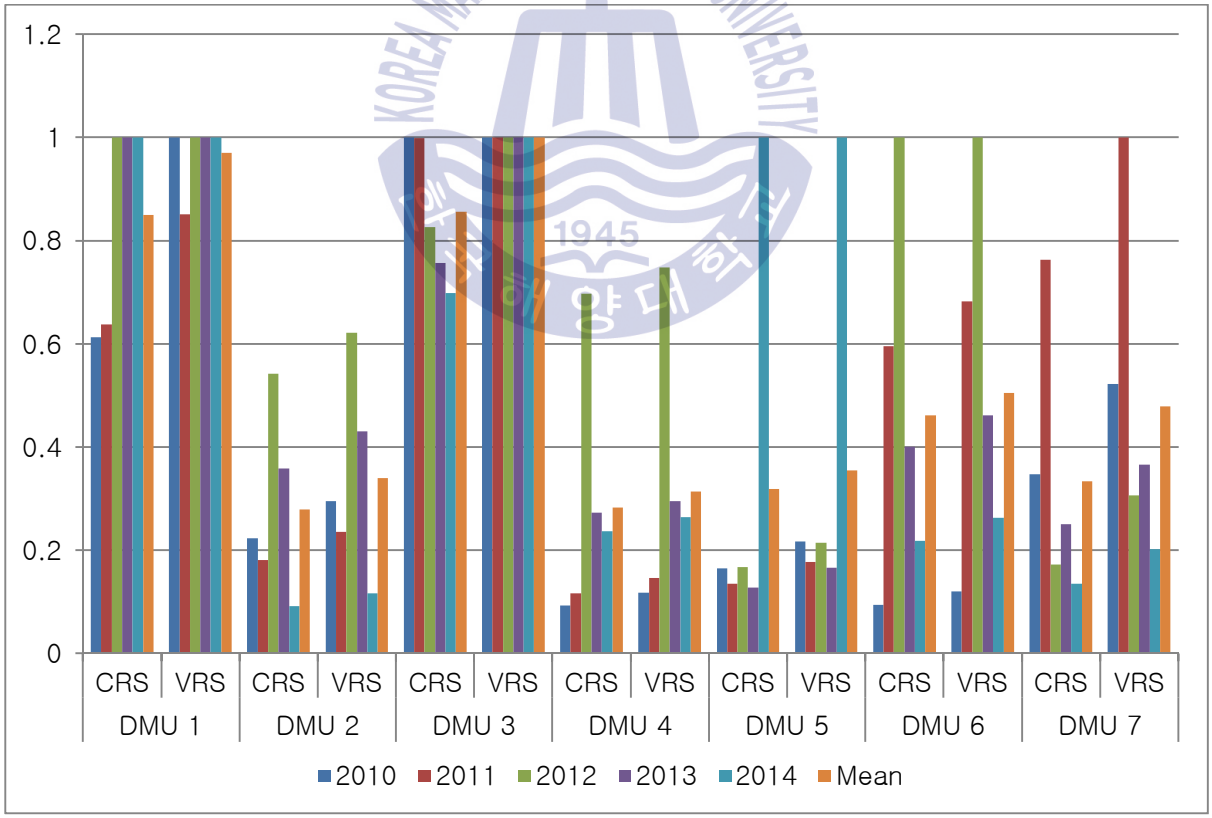

Table 6 and figures 6-7 show the efficiency level of two country's banks. The results showed that the banks of South Korea have relatively higher CRSTE and VRSTE than Uzbekistan banks, and scale efficiency (SE) of South Korean banks is a little lower than that of Uzbekistan banks'.

Table-7. The efficiency level of input-oriented DEA_CRS and DEA-VRS model

| | | 2010 | 2011 | 2012 | 2013 | 2014 | Mean |
|---|---|---|---|---|---|---|---|
| DMU 1 (PB) | CRS | 0.613 | 0.637 | 1.000 | 1.000 | 1.000 | 0.850 |
| | VRS | 1.000 | 0.851 | 1.000 | 1.000 | 1.000 | 0.970 |
| DMU 2 (AB) | CRS | 0.223 | 0.181 | 0.542 | 0.359 | 0.092 | 0.279 |
| | VRS | 0.295 | 0.235 | 0.621 | 0.430 | 0.116 | 0.339 |
| DMU 3 (HB) | CRS | 1.000 | 0.999 | 0.826 | 0.757 | 0.698 | 0.856 |
| | VRS | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| DMU 4 (UZKDB) | CRS | 0.093 | 0.116 | 0.697 | 0.273 | 0.237 | 0.283 |
| | VRS | 0.118 | 0.146 | 0.748 | 0.295 | 0.264 | 0.314 |
| DMU 5 (MKB) | CRS | 0.165 | 0.135 | 0.167 | 0.128 | 1.000 | 0.319 |
| | VRS | 0.217 | 0.177 | 0.215 | 0.166 | 1.000 | 0.355 |
| DMU 6 (TB) | CRS | 0.094 | 0.595 | 1.000 | 0.401 | 0.218 | 0.462 |
| | VRS | 0.120 | 0.682 | 1.000 | 0.461 | 0.263 | 0.505 |
| DMU 7 (RB) | CRS | 0.347 | 0.763 | 0.172 | 0.250 | 0.135 | 0.333 |
| | VRS | 0.522 | 1.000 | 0.306 | 0.366 | 0.202 | 0.479 |
| DMU 8 (HB) | CRS | 0.924 | 0.552 | 0.800 | 1.000 | 0.567 | 0.769 |
| | VRS | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| DMU 9 (IBK) | CRS | 0.935 | 0.610 | 0.638 | 1.000 | 0.680 | 0.773 |
| | VRS | 0.997 | 0.925 | 0.856 | 1.000 | 0.861 | 0.928 |
| DMU 10 (KEB) | CRS | 0.857 | 0.957 | 0.843 | 0.881 | 1.000 | 0.908 |
| | VRS | 1.000 | 1.000 | 0.995 | 0.990 | 1.000 | 0.997 |
| DMU 11 (KB) | CRS | 0.416 | 0.366 | 0.369 | 0.364 | 0.372 | 0.377 |
| | VRS | 0.634 | 0.815 | 0.785 | 0.845 | 1.000 | 0.816 |
| DMU 12 (NHB) | CRS | 0.654 | 0.486 | 0.465 | 1.000 | 0.909 | 0.703 |
| | VRS | 0.767 | 0.767 | 1.000 | 1.000 | 1.000 | 0.907 |
| DMU 13 (SHB) | CRS | 0.399 | 0.657 | 0.411 | 0.378 | 0.357 | 0.440 |
| | VRS | 0.914 | 1.000 | 0.888 | 0.845 | 0.981 | 0.926 |
| DMU 14 (WB) | CRS | 0.450 | 0.889 | 0.515 | 0.491 | 0.473 | 0.564 |
| | VRS | 1.000 | 1.000 | 1.000 | 0.957 | 1.000 | 0.991 |

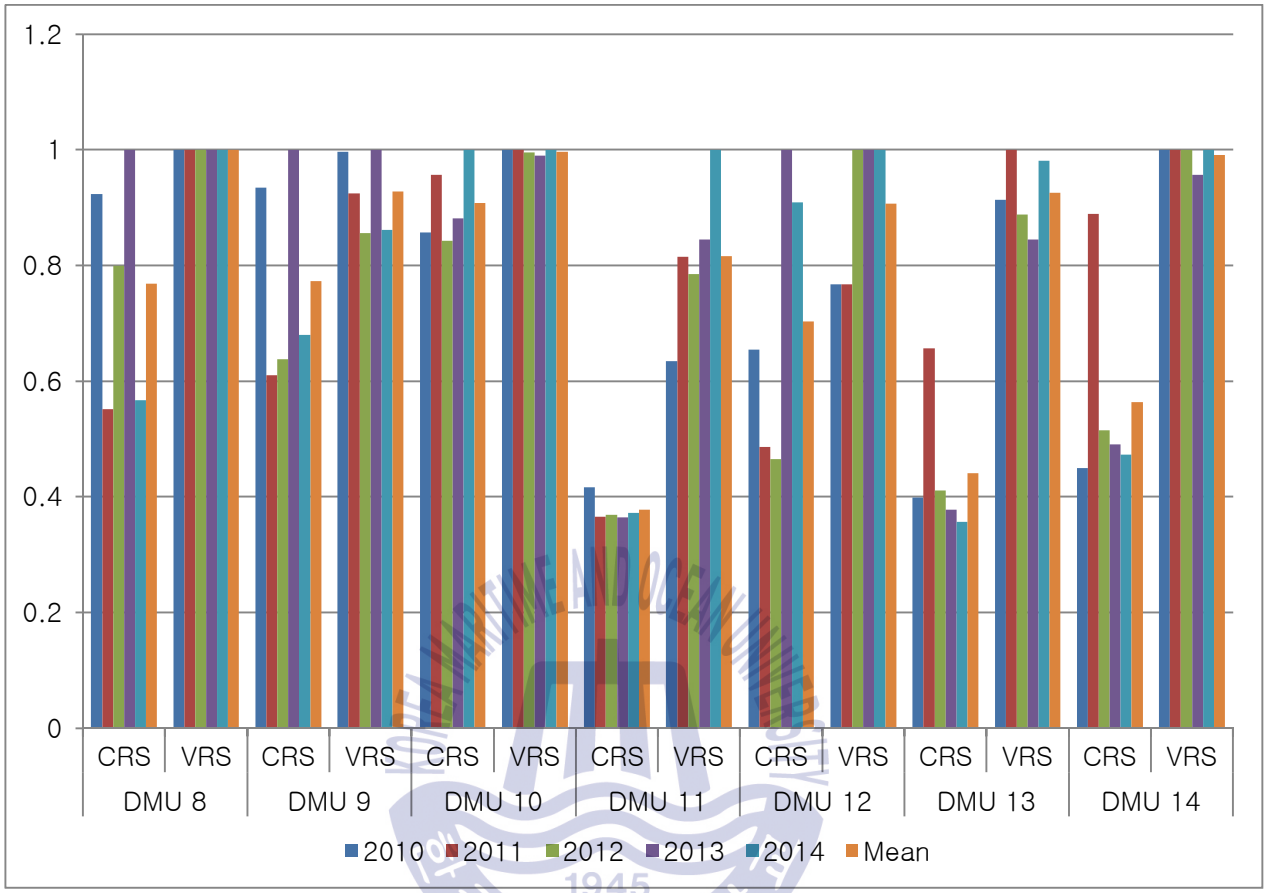
Table-7 shows the efficiency levels which are measured from the assumptions of CRS and VRS by using input-oriented DEA method. The average efficiency of DMU3 (HB) is highest (equal to 1) in both CRS and VRS model; DMU2 (AB) and DMU6 (TB) is the lowest in CRS and VRS model. About South Korean banks, the average efficiency of DMU8 (HB) and DMU10 (KEB) is the highest (equal to 1) in VRS. DMU11 (KB) is relatively low in both models. The efficiency values showed that the Uzbekistan banks efficiency are lower than South Korean banks.

**Figure -8. Uzbekistan banks technical efficiency trends in the Input-oriented DEA-CRS-VRS model**




**Note:** DMU1-People's Bank, DMU2-Aloqa Bank, DMU3-Hamkor Bank, DMU4-UZKDB Bank, DMU5-MKB Bank, DMU6-Trust Bank DMU7-Ravnaq Bank

Figure -9. South Korean banks technical efficiency trends in the Input-oriented DEA-CRS-VRS model



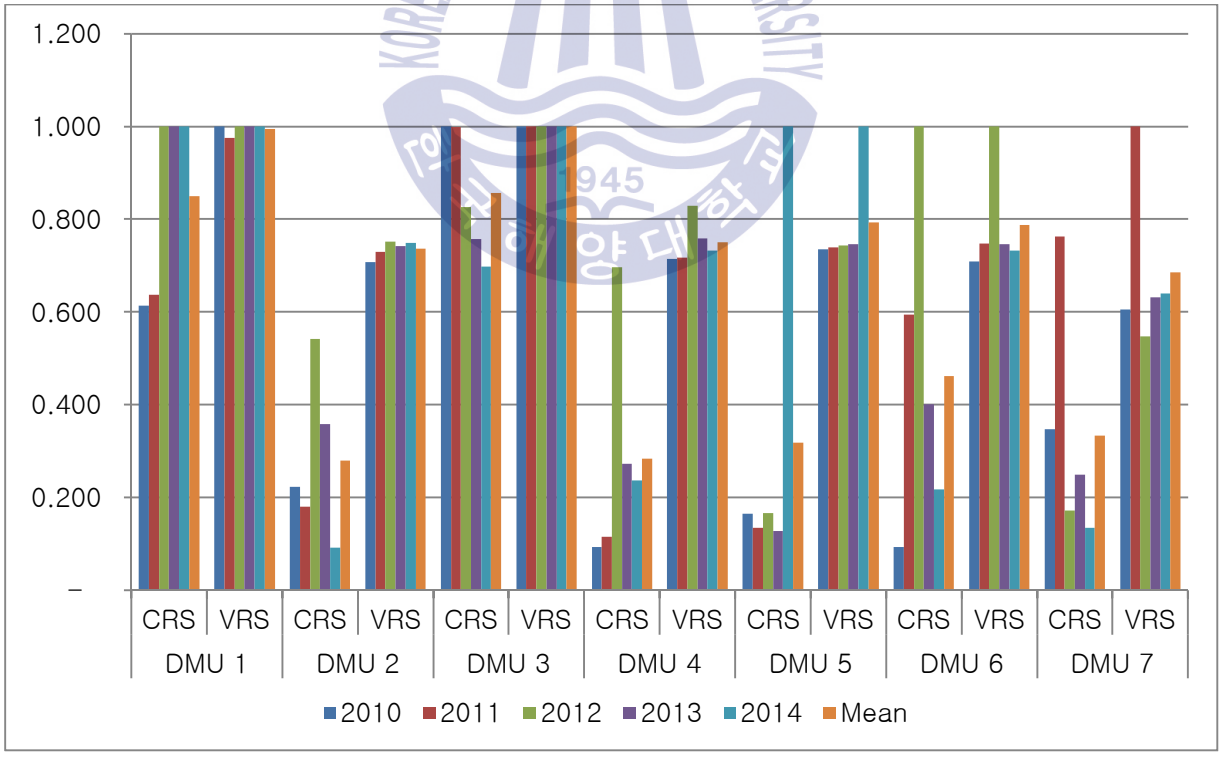

**Note:** DMU8-Hana Bank, DMU9-IBK Bank, DMU10-KEB Bank, DMU11-KB Bank, DMU12-NH Bank, DMU13-Shinhan Bank, DMU14-Woori Bank

Table- 8. The Efficiency Level of Output-Oriented DEA_CRS and DEA-VRS Model

| | | 2010 | 2011 | 2012 | 2013 | 2014 | Mean |
|---|---|---|---|---|---|---|---|
| DMU 1 | CRS | 0.613 | 0.637 | 1.000 | 1.000 | 1.000 | 0.850 |
| (PB) | VRS | 1.000 | 0.975 | 1.000 | 1.000 | 1.000 | 0.995 |
| DMU 2 | CRS | 0.223 | 0.181 | 0.542 | 0.359 | 0.092 | 0.279 |
| (AB) | VRS | 0.708 | 0.729 | 0.752 | 0.742 | 0.749 | 0.736 |
| DMU 3 | CRS | 1.000 | 0.999 | 0.826 | 0.757 | 0.698 | 0.856 |
| (HB) | VRS | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| DMU 4 | CRS | 0.093 | 0.116 | 0.697 | 0.273 | 0.237 | 0.283 |
| (UZKDB) | VRS | 0.715 | 0.717 | 0.829 | 0.759 | 0.733 | 0.751 |
| DMU 5 | CRS | 0.165 | 0.135 | 0.167 | 0.128 | 1.000 | 0.319 |
| (MKB) | VRS | 0.735 | 0.739 | 0.744 | 0.746 | 1.000 | 0.793 |
| DMU 6 | CRS | 0.094 | 0.595 | 1.000 | 0.401 | 0.218 | 0.462 |
| (TB) | VRS | 0.709 | 0.748 | 1.000 | 0.746 | 0.732 | 0.787 |
| DMU 7 | CRS | 0.347 | 0.763 | 0.172 | 0.250 | 0.135 | 0.333 |
| (RB) | VRS | 0.605 | 1.000 | 0.547 | 0.632 | 0.640 | 0.685 |
| DMU 8 | CRS | 0.924 | 0.552 | 0.800 | 1.000 | 0.567 | 0.769 |
| (HB) | VRS | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| DMU 9 | CRS | 0.935 | 0.610 | 0.638 | 1.000 | 0.680 | 0.773 |
| (IBK) | VRS | 1.000 | 0.996 | 0.991 | 1.000 | 0.994 | 0.996 |
| DMU 10 | CRS | 0.857 | 0.957 | 0.843 | 0.881 | 1.000 | 0.908 |
| (KEB) | VRS | 1.000 | 1.000 | 0.999 | 0.999 | 1.000 | 1.000 |
| DMU 11 | CRS | 0.416 | 0.366 | 0.369 | 0.364 | 0.372 | 0.377 |
| (KB) | VRS | 0.994 | 0.997 | 0.996 | 0.997 | 1.000 | 0.997 |
| DMU 12 | CRS | 0.654 | 0.486 | 0.465 | 1.000 | 0.909 | 0.703 |
| (NHB) | VRS | 0.984 | 0.987 | 1.000 | 1.000 | 1.000 | 0.994 |
| DMU 13 | CRS | 0.399 | 0.657 | 0.411 | 0.378 | 0.357 | 0.440 |
| (SHB) | VRS | 0.995 | 1.000 | 0.994 | 0.996 | 1.000 | 0.997 |
| DMU 14 | CRS | 0.450 | 0.889 | 0.515 | 0.491 | 0.473 | 0.564 |
| (WB) | VRS | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

Table-8 and figures 10-11 shows the efficiency levels which are measured from the assumptions of CRS and VRS by using output-oriented DEA method. Uzbekistan bank's average efficiency of DMU3 (HB) is highest (equal to 1) in both CRS and VRS model; DMU2 (AB) and DMU4 (UZKDB) is the lowest sing in CRS and VRS model. About South Korean banks, the average efficiency of DMU10 (KEB), DMU8 (HB) and DMU14 (WB) is the highest (equal to 1) in VRS. DMU1 (KB) is relatively low in both models. The efficiency values showed that the Uzbekistan banks are lower, but the efficiency of these banks has been increasing year by year.

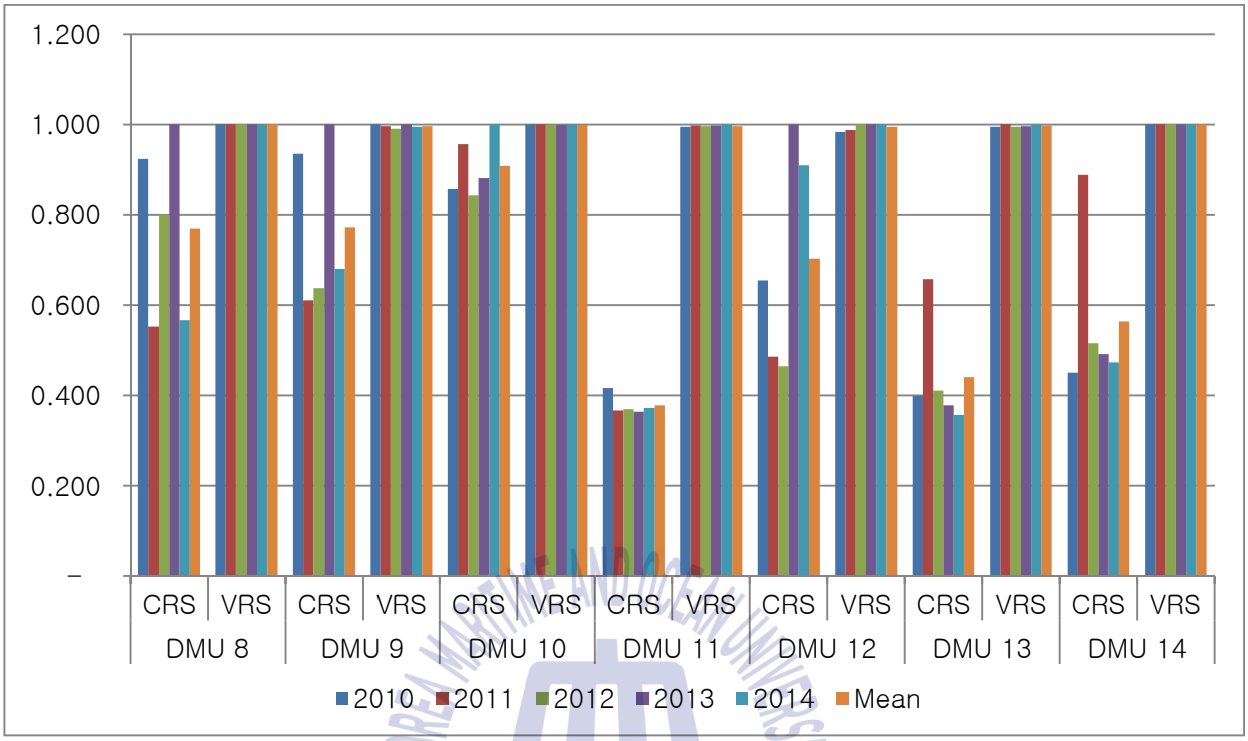
**Figure -10. Uzbekistan banks technical efficiency trends of Output-oriented DEA_CRS and DEA-VRS model[66]**




**Note:** DMU1-People's Bank, DMU2-Aloqa Bank, DMU3-Hamkor Bank, DMU4-UZKDB Bank, DMU5-MKB Bank, DMU7-Ravnaq Bank

[66] Calculated in DEAP 2. 1 software

Figure -11. South Korean banks efficiency level of Output-oriented DEA_CRS and DEA-VRS model[67]




**Note:** DMU8-Hana Bank, DMU9-IBK Bank, DMU10-KEB Bank, DMU11-KB Bank, DMU12-NH Bank, DMU13-Shinhan Bank, DMU14-Woori Bank

Table 9 - The average efficiency values of Uzbekistan and South Korean banks on input-oriented DEA CRS and VRS

| BANKS | | 2010 | 2011 | 2012 | 2013 | 2014 | Mean |
|---|---|---|---|---|---|---|---|
| UZBEKISTAN | CRS | 0.362 | 0.489 | 0.629 | 0.453 | 0.483 | 0.483 |
| UZBEKISTAN | VRS | 0.467 | 0.584 | 0.699 | 0.531 | 0.549 | 0.566 |
| SOUTH KOREA | CRS | 0.662 | 0.645 | 0.577 | 0.731 | 0.623 | 0.648 |
| SOUTH KOREA | VRS | 0.902 | 0.930 | 0.932 | 0.948 | 0.977 | 0.938 |

[67] Calculated in DEAP 2. 1 software

Figure 12 - The average efficiency values of two countries

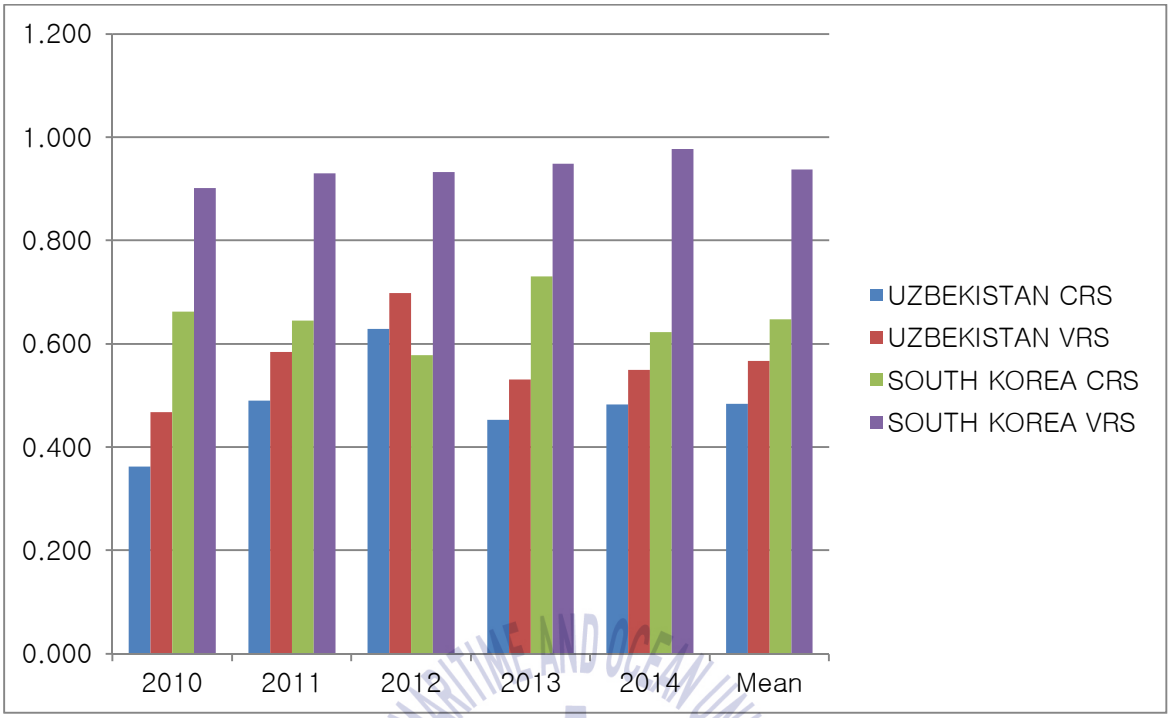



Table 9 and figure 10, 11, 12 shows that the VRS values are higher than CRS value among all DMU's. Uzbekistan banks CRS and VRS value lower than South Korean banks. Table 9 shows that the efficiency of Uzbekistan banks, the average of CRS value of yearly outlook is 0.483 and average VRS level is 0.566. The efficiency of South Korean banks, the average of CRS value of yearly outlook is 0.648 and average VRS level is 0.938.

## 5.2 Scale Efficiency and Return to Scale

Table 10 shows that scale efficiency (SE) and returns to scale (RTS). We compared Uzbekistan banks with South Korean banks, and then results shows the Uzbekistan banks are relatively lower except M-Kredit bank and People's bank. The number of employees, the total assets and total equity in Uzbekistan banks are absolutely lower than South Korean banks.

Table 10 - Scale efficiency of two country's banks

| BANKS | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|
| HANA | 0.924 | 0.552 | 0.800 | 1.000 | 0.567 |
| IBK | 0.938 | 0.659 | 0.745 | 1.000 | 0.788 |
| KEB | 0.857 | 0.957 | 0.847 | 0.891 | 1.000 |
| KB | 0.655 | 0.448 | 0.470 | 0.431 | 0.372 |
| NH | 0.857 | 0.634 | 0.465 | 1.000 | 0.909 |
| SHINHAN | 0.437 | 0.657 | 0.463 | 0.448 | 0.364 |
| WOORI | 0.450 | 0.889 | 0.515 | 0.513 | 0.473 |
| ALOQA | 0.754 | 0.770 | 0.873 | 0.834 | 0.787 |
| PEOPLE'S | 0.613 | 0.748 | 1.000 | 1.000 | 1.000 |
| HAMKOR | 1.000 | 0.999 | 0.826 | 0.757 | 0.698 |
| UZ KDB | 0.787 | 0.795 | 0.932 | 0.926 | 0.897 |
| M-KREDIT | 0.759 | 0.760 | 0.777 | 0.771 | 1.000 |
| RAVNAQ | 0.664 | 0.763 | 0.561 | 0.682 | 0.669 |
| TRUST | 0.788 | 0.872 | 1.000 | 0.871 | 0.827 |

Table 11 - Return to scale of two country's banks

| BANKS | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|
| HANA | CRS | DRS | IRS | IRS | DRS |
| IBK | IRS | DRS | IRS | IRS | DRS |
| KEB | IRS | IRS | DRS | CRS | IRS |
| KB | IRS | DRS | IRS | DRS | DRS |
| NH | IRS | DRS | DRS | IRS | DRS |
| SHINHAN | CRS | IRS | DRS | DRS | DRS |
| WOORI | DRS | IRS | DRS | DRS | DRS |
| ALOQA | IRS | IRS | IRS | CRS | DRS |
| PEOPLE'S | CRS | CRS | IRS | IRS | IRS |
| HAMKOR | IRS | CRS | DRS | DRS | DRS |
| UZ KDB | CRS | IRS | CRS | CRS | DRS |
| M-KREDIT | DRS | IRS | IRS | DRS | IRS |
| RAVNAQ | CRS | IRS | DRS | IRS | DRS |
| TRUST | CRS | DRS | IRS | CRS | CRS |

Figure -13. Scale Efficiency level two country's banks[68]

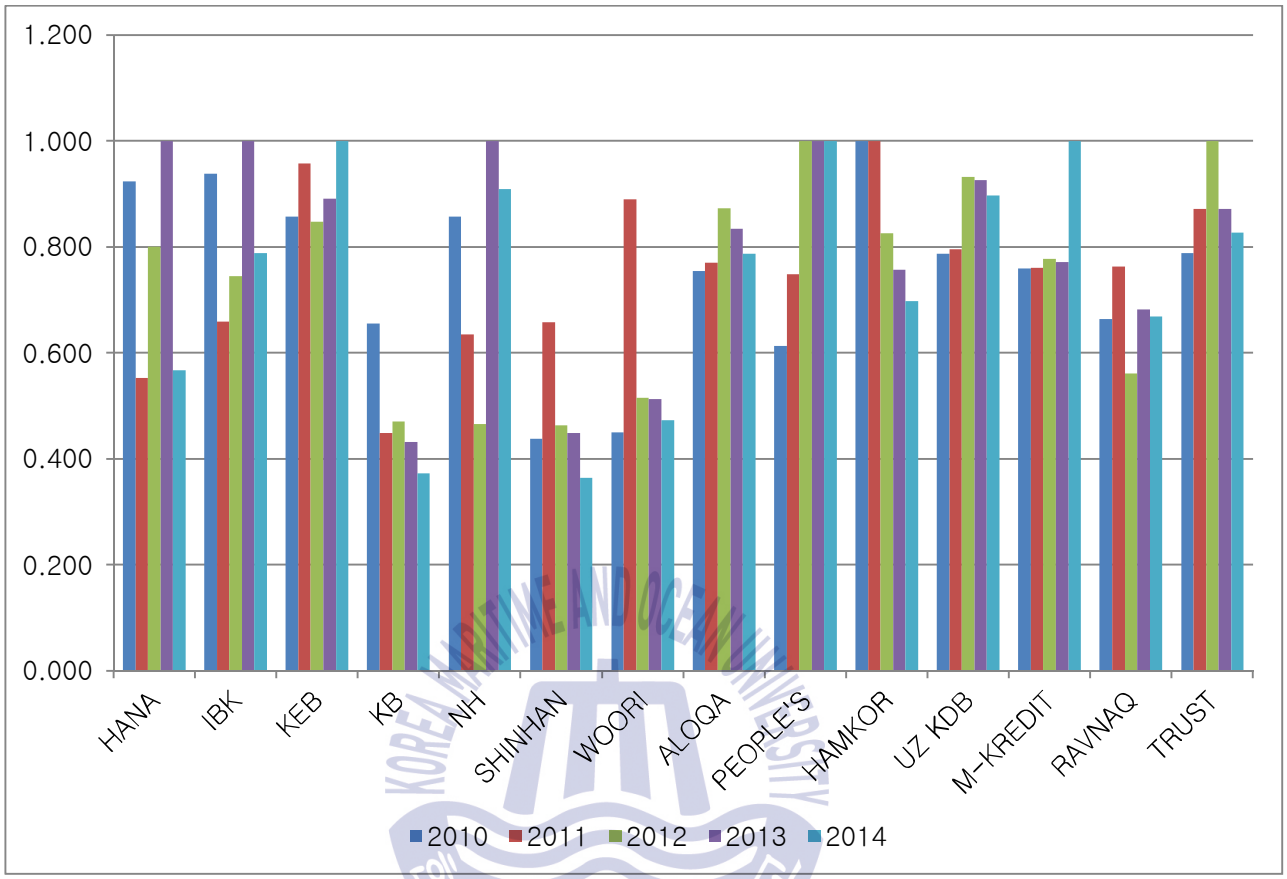



Table 16 and figure 12 shows the measure of returns to scale derived from DEA model. Roughly, Uzbekistan banks have showed DRS and CRS trends. But, the most South Korean banks have showed CRS and DRS trends in few years. It means output increases is less than the input increases.

[68] Calculated in DEAP 2. 1 software

### 5.3 Empirical results of SFA model

We estimated parameters using Frontier 4.1 which is considering half-normal and truncated-normal distribution about $u_i$'s. we use half normal distribution. Our model has five coefficients of Cobb-Douglas distance function. We use the equation to express our model:

$$ln\left(\frac{D_0}{y_m}\right) = \alpha_0 + \Sigma\alpha_i \ \ lny_i^* + \Sigma\beta_j \quad lnx_j + v_i$$

Where $y_i^* = {}^{y_i}/_{y_m}$

In this equation, the $lnD_0$ is moved to left hand, then right hand term become $-lny_m$, because$D_0 = 1$.

One coefficient $(y_2 = operating\ \ revenue)$ is removed from coefficient restriction of homogeneity of distance function. Then the equation changed to the following form:

$$ln\left(\frac{D_0}{oper\ \ rev}\right) = \alpha_0 + \Sigma\alpha_1 ln\frac{loan}{oper\ \ rev} + \Sigma\ \ \beta_1 lnasset + \Sigma\beta_2 lnequity + \Sigma\beta_3 lnemployee + v_i$$

Where $D_0 = 1$ (11)

So, the equation (11) can be expressed as following:

$$\ln oper\ \ rev = \alpha_0 + \Sigma\alpha_1 ln\frac{loan}{oper\ \ rev} + \Sigma\beta_1 lnasset + \Sigma\beta_2 lnequity + \Sigma\beta_3 lnemployee + v_i$$

All coefficients are significant at the 1% significant level of t distribution. The output cost function is well behaved. It can be noted that output parameters show the expected positive signs and input parameters have negative sing, which is consistent with microeconomic theory. This indicated that the cost from the frontier increase when output grows and shows that input increase at a given output level reduce the distance. The value of LR is 0.254, which is larger than the critical value distribution at the 1% one-side hypothesis test, which means that $H_0$: $\lambda = 0$ is rejected. Therefore, there exists technical inefficiency effect. From the result, we could measure the efficiency of cost function model in SFA. Table 12 shows Maximum Likelihood Estimation (MLE) results from SFA methods of Uzbekistan banks.

| Table 12 - MLE estimates for SFA cost function of Uzbekistan banks | |
|---|---|
| Independent Variables | Cobb-Douglas (CFS) Dependent variables -log (PRO) |
| Constant | 0.157 |
| Log (AS) | 0.266 |
| Log (EQ) | -0.371 |
| Log (EMP) | 0.101 |
| $\lambda^2$ | 0.321 |
| $\gamma$ | 0.940 |
| Log Likelihood | 0.558 |
| LR | 0.254 |

All coefficients are significant at the 1% significant level of t distribution. The output cost function is well behaved. It can be noted that output parameters show the expected positive signs and input parameters have negative sing, which is consistent with microeconomic theory. This indicated that the cost from the frontier increase when output grows and shows that input increase at a given output level reduce the distance. The value of LR is 0.808, which is larger than the critical value distribution at the 1% one-side hypothesis test, which means that $H_0$: $\lambda = 0$ is rejected. Therefore, there exists technical inefficiency effect. From the result, we could measure the efficiency of cost function model in SFA. Table 13 shows Maximum Likelihood Estimation (MLE) results from SFA methods of South Korean banks.

| Table 13 - MLE estimates for SFA cost function of South Korean banks | |
|---|---|
| Independent Variables | Cobb-Douglas (CFS) Dependent variables -log (PRO) |
| Constant | 0.252 |
| Log (AS) | 0.387 |
| Log (EQ) | 0.684 |
| Log (EMP) | 0.110 |
| $\lambda^2$ | 0.296 |
| $\gamma$ | 0.999 |
| Log Likelihood | 0.556 |
| LR | 0.808 |

Among Uzbekistan banks, the average of banks' efficiency is increasing year by year. Similar to the Uzbekistan banks, the average of South Korean bank' efficiency is increasing year by year. We may see the slightly differences of the distribution of efficiency. In attempting to explore technical efficiency discriminations between these two frontier methods, the further study should take into consideration factors of the operating environments.

Table 14 – Efficiency levels of SFA (TE) model of two countries

| | Year | DMU1 | DMU2 | DMU3 | DMU4 | DMU5 | DMU6 | DMU7 |
|---|---|---|---|---|---|---|---|---|
| | | Aloqa Bank | People's Bank | Hamkor Bank | UZKDB Bank | M-Kredit Bank | Ravnaq Bank | Trust Bank |
| Uzbekistan | 2010 | 0.330 | 0.710 | 0.197 | 0.080 | 0.662 | 0.052 | 0.136 |
| | 2011 | 0.474 | 0.614 | 0.185 | 0.074 | 0.668 | 0.035 | 0.179 |
| | 2012 | 0.466 | 0.664 | 0.375 | 0.073 | 0.722 | 0.017 | 0.164 |
| | 2013 | 0.516 | 0.637 | 0.455 | 0.044 | 0.817 | 0.124 | 0.281 |
| | 2014 | 0.576 | 0.626 | 0.488 | 0.051 | 0.822 | 0.135 | 0.361 |

| | Year | DMU8 | DMU9 | DMU10 | DMU11 | DMU12 | DMU13 | DMU14 |
|---|---|---|---|---|---|---|---|---|
| | | Hana Bank | IBK Bank | KEB Bank | KB Bank | NH Bank | Shinhan Bank | Woori Bank |
| South Korea | 2010 | 0.490 | 0.560 | 0.269 | 0.791 | 0.543 | 0.676 | 0.651 |
| | 2011 | 0.546 | 0.604 | 0.290 | 0.797 | 0.584 | 0.812 | 0.785 |
| | 2012 | 0.855 | 0.625 | 0.294 | 0.802 | 0.574 | 0.779 | 0.766 |
| | 2013 | 0.946 | 0.700 | 0.321 | 0.852 | 0.692 | 0.819 | 0.859 |
| | 2014 | 1.000 | 0.766 | 0.344 | 0.946 | 0.767 | 0.906 | 0.919 |

Table-14 shows the technical efficiency levels of SFA model which are measured by using output-oriented SFA method. The average efficiency of DMU2 and DMU5 is highest (equal to 1) during 5 years; DMU4 and DMU6 is the lowest during 5 years too. About South Korean banks, the average efficiency of DMU8, DMU12 and DMU14 is

the highest (equal to 1) in TE. DMU10 is relatively low in this model among South Korean banks. The efficiency values showed that the Uzbekistan banks are still low, but the efficiency of these banks has been increasing during 5 years. South Korean banks have showed high level, but Uzbekistan banks also increasing slightly during following years.

**Table 15 – The Comparison of DEA and SFA in efficiency measurement**

| Year | Nation | CRSTE | VRSTE | SE | SFA |
|---|---|---|---|---|---|
| 2010 | Uzbekistan | 0.362 | 0.467 | 0.766 | 0.309 |
| | Korea | 0.662 | 0.902 | 0.731 | 0.569 |
| 2011 | Uzbekistan | 0.489 | 0.584 | 0.815 | 0.319 |
| | Korea | 0.645 | 0.93 | 0.685 | 0.631 |
| 2012 | Uzbekistan | 0.629 | 0.699 | 0.853 | 0.354 |
| | Korea | 0.577 | 0.932 | 0.615 | 0.670 |
| 2013 | Uzbekistan | 0.453 | 0.531 | 0.834 | 0.411 |
| | Korea | 0.731 | 0.948 | 0.755 | 0.741 |
| 2014 | Uzbekistan | 0.483 | 0.549 | 0.84 | 0.437 |
| | Korea | 0.623 | 0.977 | 0.639 | 0.807 |

Table 15 and figures 14-15 shows the efficiency measurement of SFA and DEA model of two country's banks. Similar to the DEA model, the SFA TE results showed that the banks of South Korea have relatively constant than Uzbekistan banks, and scale efficiency (SE) of South Korean banks is an enough higher than that of Uzbekistan banks'. Uzbekistan banks TE result showed relatively higher than others.

Figure 14 – DEA and SFA models in efficiency of Uzbekistan banks

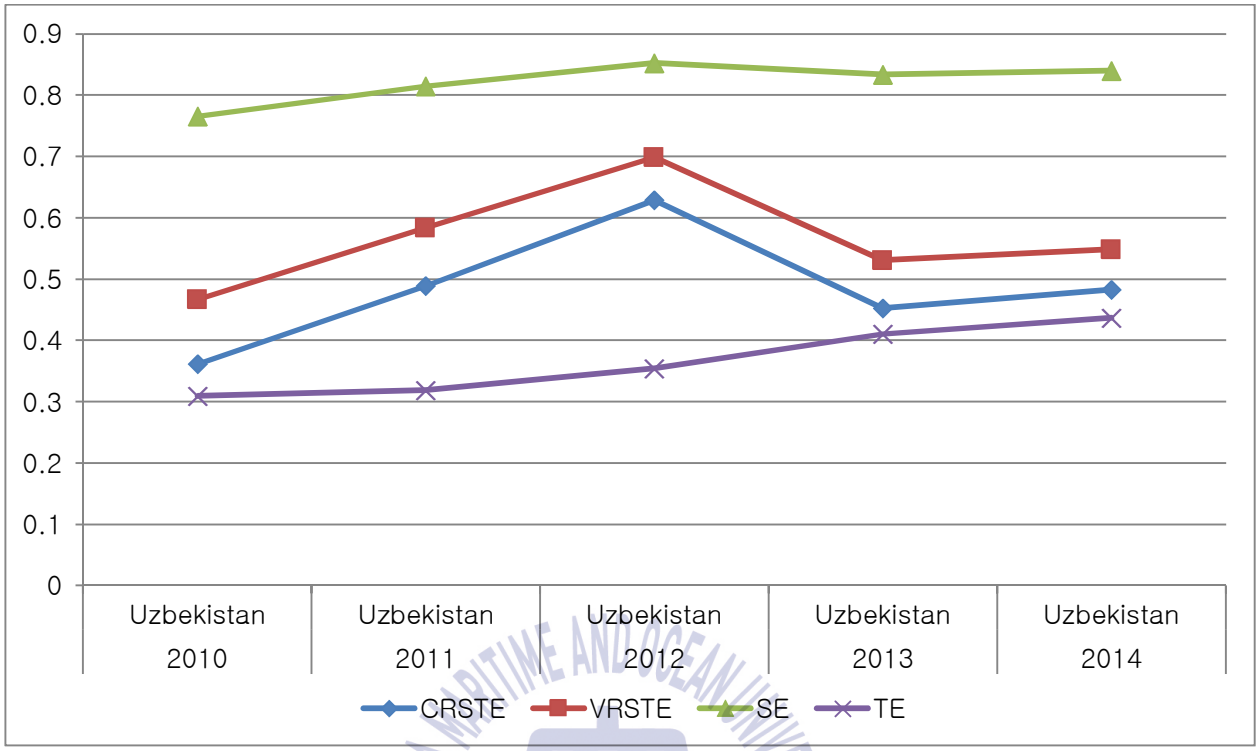



Figure 15 – DEA and SFA in efficiency of South Korean banks

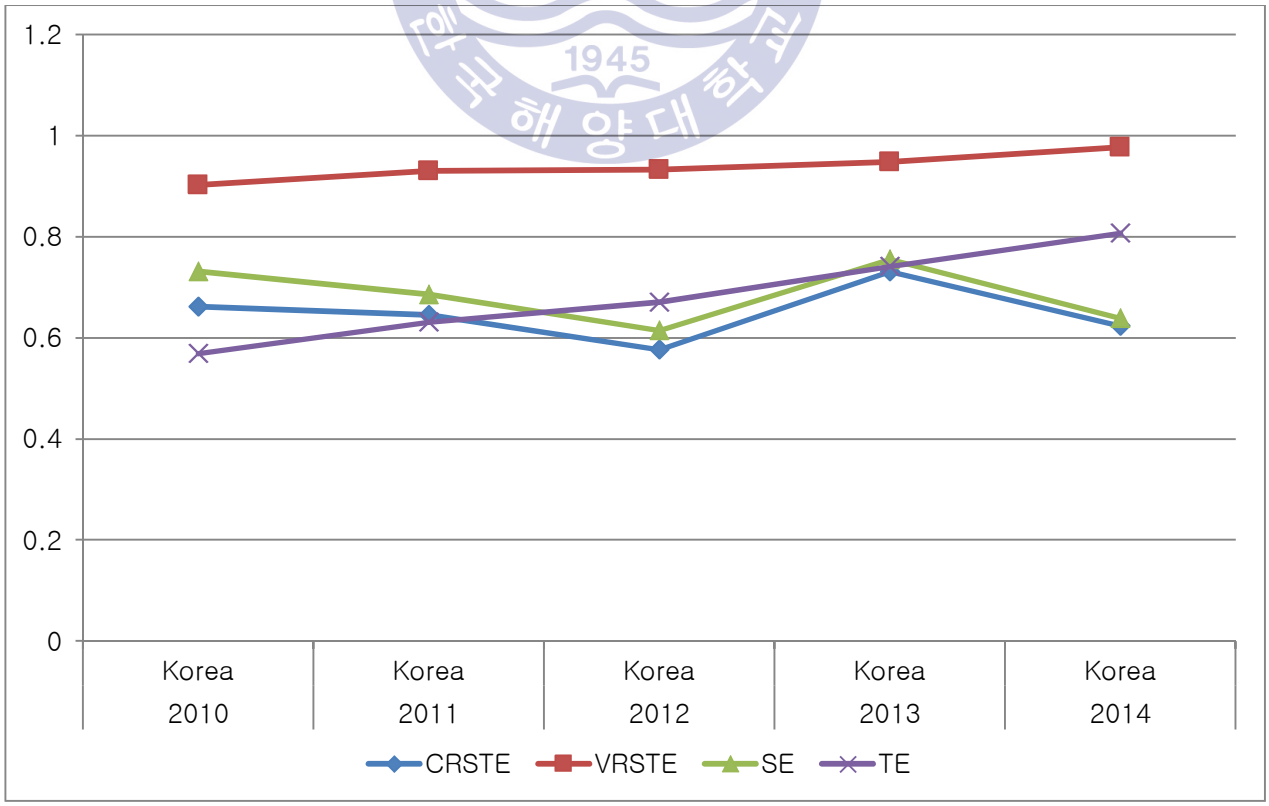


Table 16 - Return to scale from SFA model of two countries

| | Year | DMU1 | DMU2 | DMU3 | DMU4 | DMU5 | DMU6 | DMU7 |
|---|---|---|---|---|---|---|---|---|
| Uzbekistan | | Aloqa Bank | People's Bank | Hamkor Bank | UZKDB Bank | M-Kredit Bank | Ravnaq Bank | Trust Bank |
| | 2010 | CRS | CRS | IRS | CRS | IRS | CRS | IRS |
| | 2011 | IRS | DRS | DRS | DRS | CRS | DRS | IRS |
| | 2012 | IRS | CRS | IRS | DRS | IRS | DRS | DRS |
| | 2013 | CRS | DRS | IRS | DRS | IRS | IRS | IRS |
| | 2014 | DRS | DRS | IRS | CRS | IRS | IRS | IRS |

| | Year | DMU8 | DMU9 | DMU10 | DMU11 | DMU12 | DMU13 | DMU14 |
|---|---|---|---|---|---|---|---|---|
| South Korea | | Hana Bank | IBK Bank | KEB Bank | KB Bank | NH Bank | Shinhan Bank | Woori Bank |
| | 2010 | IRS | CRS | CRS | CRS | CRS | CRS | DRS |
| | 2011 | IRS | CRS | CRS | CRS | CRS | IRS | IRS |
| | 2012 | IRS | CRS | CRS | IRS | DRS | DRS | DRS |
| | 2013 | IRS | IRS | CRS | CRS | IRS | CRS | IRS |
| | 2014 | IRS | IRS | IRS | IRS | IRS | IRS | IRS |

Table 16 shows the measure of returns to scale derived from SFA model. Roughly, Uzbekistan banks have shown CRS and DRS trends. But, the most South Korean banks show CRS and IRS trends in few years. It means output increases is less than the input increases.

## 5.4 Distributions of efficiency measures

Table 17 – Descriptive Statistics of South Korean banks: DEA-CRS, DEA-VRS, SE and SFA

| Variable | Average | Min | Max |
|---|---|---|---|
| DEA-CRS (IO) | 0.648 | 0.520 | 0.852 |
| DEA-VRS (IO) | 0.938 | 0.864 | 1.000 |
| DEA-CRS (OO) | 0.648 | 0.520 | 0.852 |
| DEA-VRS (OO) | 0.998 | 0.995 | 1.000 |
| SE | 0.685 | 0.530 | 0.886 |
| SFA | 0.684 | 0.569 | 0.807 |

Table 18 – Descriptive Statistics of Uzbekistan banks: DEA-CRS, DEA-VRS, SE and SFA

| Variable | Average | Min | Max |
|---|---|---|---|
| DEA-CRS (IO) | 0.483 | 0.265 | 0.857 |
| DEA-VRS (IO) | 0.566 | 0.368 | 0.910 |
| DEA-CRS (OO) | 0.483 | 0.265 | 0.857 |
| DEA-VRS (OO) | 0.821 | 0.770 | 0.940 |
| SE | 0.822 | 0.709 | 0.938 |
| SFA | 0.366 | 0.309 | 0.437 |

**Table 19 – Pearson correlation for efficiency levels**

| *South Korea* | *DEA-CRS* | *DEA-VRS* | *SE* | *SFA* |
|---|---|---|---|---|
| DEA-CRS | 1.000 | | | |
| DEA-VRS | (0.032) | 1.000 | | |
| SE | 0.940 | (0.358) | 1.000 | |
| SFA | 0.057 | 0.980 | (0.271) | 1.000 |

| *Uzbekistan* | *DEA-CRS* | *DEA-VRS* | *SE* | *SFA* |
|---|---|---|---|---|
| DEA-CRS | 1.000 | | | |
| DEA-VRS | 0.990 | 1.000 | | |
| SE | 0.836 | 0.758 | 1.000 | |
| SFA | 0.162 | 0.022 | 0.650 | 1.000 |

Tables 17-18-19 have showed the liner correlations among efficiency values of 4 methods. All correlation coefficients are also significant at 1% significance level except the correlation between DEA-VRS and SFA model has very weak correlation with other values. But DEA-CRS and SE model has strong correlation values in both countries' banks.

# Chapter Six: Conclusions

## 6.1 Research findings

The first chapter presented the research background, the aim, contributions and structures of the study.

Chapter 2 reviews the literature review on the efficiency of banks. Because banks play an important role as the financial intermediaries in the financial market, so bank performance has increased attention of researchers over the past 20 years. Most of studies measure bank's efficiency in western developed countries. The study of bank efficiency of Uzbekistan and South Korea began later but the research showed the commercial bank`s efficiency in both countries was rapidly increasing. This study briefly introduced the Uzbekistan and South Korean banking system. The Uzbekistan banking system was dominated by the national bank of Uzbekistan (NBU), and most policy was made by central bank of Uzbekistan (CBU). Similar situations happened in the South Korean banking system, that is, KOB as the central bank focused on the fiscal policies. After the Asian financial crisis in 2007~2008, the South Korean government proposed an ambitious plan to develop South Korea as a financial center in the Northeast Asia. At the same time, the South Korean banks performance induced significant improvement of the Korean banking system. We can expect that South Korean banks' efficiencies and performances have been increasing rapidly and were operating properly compared with those of Uzbekistan. Similarly to Asian banks, Uzbekistan banks also have been developing year by year. We tried to find Uzbekistan banks' efficiency indicators in our

results. We tried to compare some main banks in Uzbekistan and South Korea.

We have explained efficiency measurement concepts and functions of DEA and SFA model in chapter 3 and 4. Also we tried to describe the pure technical efficiency and scale efficiency, and compared DEA and SFA model results of two countries. We have explored the efficiency of the banks in Uzbekistan and South Korea based on DEA and SFA model in chapter 5. Our research data were obtained from financial and banking sources and each bank`s annual reports for the period 2010 through 2014. The input variables used in this study are employees, total assets and total equity. The output variables include total loans and total profit.

There are two main results in this study. First result is the measurement of the TE and SE of the Uzbekistan and Korean banks over the period 2010 to 2014, using the DEA CRS-VRS models and SFA function models.

Second result is some comparisons: First, VRS efficiency values are higher than CRS efficiency values. Only few banks reached the most efficiency during the period, because of some financial difficulty after the global financial crisis after 2008. Second, among the banks of Uzbekistan, the efficiency of People's Bank and Aloqa Bank are slightly higher indicators than others. As a whole, the efficiency of South Korean banks is higher than Uzbekistan bank's efficiency. We have analyzed the scale efficiency and technical efficiency.

1. The SE and TE results showed that South Korean banks are also higher than that of Uzbekistan banks. Three and four

banks reached the most efficient level in the input-oriented or the output-oriented of DEA and SFA model.

2. The tendency of CRS and DRS is strong in Uzbekistan banks during that period. Opposite to the Uzbekistan banks, among South Korean banks, most banks showed CRS and IRS trend. But the whole efficiency of Uzbekistan banks trend is lower than that of South Korean banks trend. As we said in introduction of this paper, Uzbekistan has followed the South Korean model and has been developing step by step.

### 6.2 Implications

DEA and SFA is very useful tool to measure the relative efficiency. In this paper, we apply DEA method to analyze Uzbekistan and South Korean banks and compare the results. Important implications are presented in the following.

First, HB and AB showed relatively lower efficiency in DEA model. This result can be related to the efficiency of state-owned banks. Uzbekistan state-owned banks` inputs such as the number of employees and total assets are over-employed compared with other commercial banks, and South Korean banks. The reasonable policy for the Uzbekistan banks is to shut down some branches which have no profit prospects, to reduce operating and managing cost, to reform human resources recruitment system and salary system.

Second, in Korea, efficiency values of SHBs are relatively lower in both model, but is still low compared with the Uzbekistan PB's. But the efficiency of most banks is higher than that of the Uzbekistan

banks in both CRS and VRS models. Therefore, the Uzbekistan government should pay more attention to developing the middle and small-sized commercial banks and reforming the state-owned banks, but South Korean government should have focused on improving the efficiency of LCBs.

Third, in terms of Scale Efficiency, the changes of changes of scale efficiency for the banks are similar to their technical efficiency changers. The tendency of DRS is strong in Uzbekistan HBs during that period which implies these banks should reduce their operation due to the decreasing return the scale. Uzbekistan AB's has showed the tendency of CRS and IRS which means these banks should enlarge their scale size or keep it. They are developing well at the situation of the constant returns to scale. Different with the Uzbekistan banks, South Korean banks have showed the CRS and IRS trend and the tendency of DRS in LCBs. Uzbekistan PBs and HBs appear steadily and comparatively efficient. Uzbekistan banks and a few South Korean banks need to reform for improving their efficiency.

Forth, the average of efficiency of South Korean banks is higher than that of Uzbekistan. This phenomenon is disadvantageous for Uzbekistan banks. As Uzbekistan is located in Central Asia and South Korea is located at East Asia, two countries have a strong sense of competition at some aspects, especially in finance sector. Some South Korean banks are starting to establish branches in Uzbekistan, such as Korean Exchange Bank. So, Uzbekistan banks should improve their efficiency so that they can be competitive with South Korean banks, and even foreign banks. It is the same for South Korean banks. Though they are better than Uzbekistan banks, there are many

aspects to improve.

Last, the efficiency values of Uzbekistan banks have been increasing year by year. The result implies that Uzbekistan banking system reform has significant influence on the technical efficiency of the JSCBs, but little influence for SOCBs. So the government needs to pay more attention to their reform of SOCBs.

### 6.2 Recommendations

First, a high level of transparency in the formulation and execution of its policies should be ensured, and the Bank must maintain close communication with the markets. Particularly in Uzbekistan, banking sector is still highly regulated in many aspects. All banks are required to implement the Law of Accounting in Uzbekistan, which set out the basic reporting principles. This situation should change especially after the Uzbekistan joined the WTO, and SCOBs successfully made operations with foreign banks. The Uzbekistan government also should not apply more pressure to supply "policy loan" on the SOCBs which cause a number of low efficiencies. And it should also develop new statistics, to better reflect changes in economic conditions, while continuing to improve its existing ones.

Second, for Uzbekistan and South Korean banks, the function of macro prudential policy should be strengthened. Furthermore, banks must continue their efforts to ensure the efficiency and stability of the payment and settlement system. They should work to ensure efficient and secure payment and settlement systems operation.

Third, there should be more serious outreach to escalate

international cooperation. Recent global financial crisis, banks should maintain closer cooperative ties with international financial organizations and other central banks. Banks also needs to reinforce its cooperative relations with regional central banks, especially between Uzbekistan and South Korea.

Fourth, strong and sound cooperative relations with the government must be maintained. The bank should work to coordinate its monetary policy with the government`s economic policy because monetary policy is inseparable from foreign exchange policy. Cooperation with the government and supervisory authorities is a great essential to ensure financial stability since the global financial crisis. Meanwhile, the banks should have been given much more operational freedom in terms of business competition and interest rate setting. Reducing political interference in the banking system and withdrawing intervention policies are fundamental to enhance the efficiency of the two countries banking systems.

Last but not the least; bank`s managerial efficiency should be improved. Organization and personnel management is significant for the banks. The organization needs a rapid decision-making system to respond to the expected changes in the domestic and global economy in a proactive and timely fashion. Human resources also are very important. Employees should undergo continued training and education to develop their expertise and capabilities. Similarly, academic exchange and joint research with external organizations such as foreign central banks should be stepped up. These are the important factor that can affect the efficiency.

Measuring, understanding and improving banking efficiency is a major matter of concern not only for banks` mangers, but also government. Greater efforts are required to promote further competition in Uzbekistan and South Korean banking sector.

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