IS THERE A GAP OF BANKING EFFICIENCY BETWEEN ACCESSION AND NON-ACCESSION COUNTRIES IN CENTRAL AND EASTERN EUROPE

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THESIS ABSTRACT

IS THERE A GAP OF BANKING EFFICIENCY BETWEEN ACCESSION AND NON-ACCESSION COUNTRIES IN CENTRAL AND EASTERN EUROPE

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This thesis divides the Central and Eastern European countries into two groups: accession countries which have or will attend Europe Union and non-accession countries which are not willing to attend Europe Union. The accession countries are supposed to have motivation to improve their own cost structure and banking efficiency, which may make them more efficient than non-accession countries. This thesis first utilizes the Seemingly Unrelated Regression technique to obtain the Allen Partial Elasticity, and then adopts Stochastic Frontier Approach to get X-efficiency. This thesis finds that accession countries are more efficient than non-accession countries, and the structure of the banking system has significant effect on efficiency.

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CHAPTER I

INTRODUCTION

In May, 1st, 2004, eight Central Eastern European countries entered into the EU (European Union), two more countries will join the EU in 2007. In order to be the member of EU, many Central and Eastern European countries need made a transition in the banking system during the 1990s. The main goal of those countries, performing the bank reforms, was to decrease the intervention of the government. At the same time, most of the eastern and central European banks adopted the Germany General Bank system in law frame, style of management and technique index, etc. there are more and more commercial banks which has close relationship with small firms entering into the financial market. Many global financial institutions and big banks in EU supply direct guidance and support to eastern and central European countries including reforming scheme, consulting group, and banking export. This process is thought to have positive effect on the performance of eastern and central European countries' banking according to Weill (2000)

There has been much research on comparing the bank efficiency between Eastern and Central European countries and developed Western European countries. Scholtens (2000), Riess et al. (2002) illustrated that compared with the developed Western European countries, there is a backward trend in the Eastern and Central European countries. There are two important points in the bank transition: solving bad loans and

privation. When more and more foreign banks enter into the financial market in Eastern and Central European countries, the banks in those countries have a tendency of merging to relieve the pressure brought by the big Western European banks. The financial market in Eastern and Central European countries are undeveloped and sensitive to the intense competition which is illustrated by Scholtens (2000). Under the pressure of the foreign countries' bank, the banking structure in Eastern and Central European countries have a tendency to become less efficient.

The purpose of this paper is to fill the gap of the literature to compare the bank efficiency between the Eastern and Central European countries which have attended the EU and the ones which do not enter EU. Compared with the developed countries in Western Europe, the banks in Eastern and Central European banks certainly have a very big range of efficiency, but this does not have an important policy implications. Actually, it has more sense to compare the banking efficiency between the new EU member and the countries which did not attend the EU such as Russia. These two groups of banks have the similar basis, and after comparing the banking efficiency, it can get assist in developing policy regards to the financial implications of joining the EU.

An effective method to research on the change of the banking efficiency is to illustrate the cost structure's variation. There is a lot of literature which discusses the cost structure in US banking and can supply a good theory to study European banking. This paper will adopt two forms of translog cost function: the traditional translog function form and transcendental translog functional form. The data set for this paper is 2000-2004, because in 1990s the transition in these countries banks had begun, through 2004 they undertook improving bank efficiency. The author will utilize the translog

function form to calculate the Allen Partial Elasticity first which can reflect the change in cost structure of banks. These Eastern and Central European banks are undeveloped, and the change of the substitution elasticity should lead to an interesting interpertation.

The Allen Partial Elasticity can show the difference of cost structure between the accession countries and non-accession countries, however, AES is not an effective method to compare the banking efficiency for these two groups of countries. We can know the cost structure is different for accession countries and non-accession countries, but we can not judge which structure is better, and can not provide policy recommendations. Therefore, this thesis calculates X-efficiency by utilizing Stochastic Frontier Analysis (SFA). After obtain the X-efficiency, we can compare the banking efficiency for these two groups of countries.

This thesis will proceed as follows: A literature review is illustrated in Chapter 2; the theoretical model and regression method is provided in Chapter 3; definitions of the variables and data analysis are described in Chapter 4; empirical regression results are analyzed in Chapter 5, and the conclusion will be drawn in Chapter 6

CHAPTER II

LITERATURE REVIEW

There is not a lot of literature on the banking efficiency of Central and Eastern European countries. Generally speaking, these countries are in various phases of economic transition, and the literature is primarily focused on the effect of ownership change on banking efficiency. This thesis will not investigate this topic in particular, but this type of literature will provide some economic background and introduce important policies that are vital to understanding the issues discussed in this paper. In this chapter, the literatures on ownership change in Central and Eastern European banking will be illustrated in order to provide the basic framework for the analysis done in this thesis.

In his paper, Drakos (2003) investigates the banking efficiency of eleven Central and Eastern European countries during the 1993-1999 period (8 countries are included in this thesis). He examines the interest margin, and how decrease of the interest margin can express an improvement of banking efficiency. Drakos (2003) concludes that ownership has significant effect on banking efficiency. In addition, he finds that the entry of foreign big banks will increase competition, which can improve banking efficiency in these transition countries. The effect of a decrease of the interest margin is illustrated by empirical result, and Drakos (2003) suggests that transition countries should adopt more effective policies to encourage entry of foreign banks into their respective markets.

Next, Fries and Taci (2002) utilize data for consumer loans in 16 transition

countries during the 1994-99 period. they use the real growth of bank loans as a standard to judge the growth of banks. Their empirical results show that high interest rates and inflation rates in the transition countries have a negative effect on the growth of banks. They found that the pace of the is basically the same as the growth of GDP in the transition countries. Their primary focus is not banking efficiency, but they also arrive at the same conclusion as Drakos (2003). They conclude that the entry of foreign big banks has a significant positive effect on the growth of banks in these transition countries. In addition, they suggest that transition countries should continue to open their financial market in order to encourage large foreign banks enter into their respective markets.

In a companion study Fries et al (2002) investigate the performance of banks in 16 transition countries during the 1994-99 period. They examine whether banks in these countries are taking excessive risk to make profit. In this paper, they find that there are some small private banks taking risk, but this is not true for the whole banking system. Contrary to the two papers mentioned above, Fries, Neven, and Seabright (2002) do not focus on the effect of foreign banks, but instead they illustrate that the reform process of transition countries matters significantly. Second, they estimate a multi-product revenue function and cost function. Finally, they focus on the deregulation and suggest relaxing the regulation policy to increase competition in the financial market of these transition countries.

Next, Hasan and Marton (2003) investigate the cost and profit inefficiency of banks in Hungary during the 1993-98 period. They estimate a multiproduct translog functional form using the stochastic frontier approach (SFA). The distinguishing feature of this paper is that they utilize just one transition country to describe an age of transition

in its banking system. Hasan and Marton conclude that the entry of foreign banks has a positive effect on improving the cost and profit inefficiency of the local banks.

On the contrary, Nikiel and Opiela (2002) use only one transition country, Poland, to investigate this question; however, they find a different result from the previously mentioned studies. The above studies all conclude that foreign banks are more cost and profit efficient, and the entry of foreign big banks has a positive effect on the transition countries' financial markets. Nikiel and Opiela first estimate the cost efficiency. They conclude that the cost efficiency is not determined by the banks type (foreign bank or domestic bank), but instead by the type of consumers. They find that if a bank focuses on supplying service to foreign consumers, the bank is cost efficient. Next, Nikiel and Opiela also examine the profit efficiency question, and find that banks which mainly supply services to foreign customers generally have low profit. Finally, they conclude that cost-efficiency is more important than profit-efficiency, because foreign banks may have profit-inefficiency in the short-run, but they will maximize their profit in the long run by being more cost efficient.

Similarly, there are two case studies for Croatia on similar topic. Kraft and Tirtiroglu (1998) investigate X-inefficiency and scale-inefficiency for new and old banks in Croatia by using the SFA method. The data used in this study is obtained from banks in Croatia during the 1994-95 period. The empirical results show that new private banks are more X-inefficient and more inefficient in scales compared with existing banks in Croatia. Kraft and Tirtiroglu (1998) conclude that this result is caused by simply selling banks to persons, instead of rebuilding the structure of the financial market. They suggest the Croatia government formulate proper policies to make new banks more competitive,

which will improve Crotia's financial market.

Jemric and Vujcic (2002) utilize a different method, Data Envelopment Analysis (DEA), to estimate the banking efficiency in Croatia using a dataset during the 1995-2000 period. This dataset is slightly after the one adopted by Kraft and Tirtiroglu (1998), and their conclusion is the opposite. Jemric and Vujcic (2002) first conclude that foreign banks are the most efficient, and that new banks are more efficient than old ones. This finding is totally opposite with what Kraft and Tirtiroglu (1998) found. This is probably due to the different environment of these two periods. The political environment in Croatia was not stable during 1994-1995, but became more stable after 1995. One important contribution of Jemric and Vujcic (2002) is that they investigate the factors which can determine the efficiency of Croatian banks. They find that a banks' size does not necessarily determine its banking efficiency; however, number of labor, fixed assets and number of bad loans are all significant factors for banking efficiency.

Next, Grigorian and Manole (2002) try to find some general conclusion for the Central and Eastern European countries. The regression method adopted in this paper is also DEA. They point out that a change of ownership will not improve banking efficiency, but technology brought by advanced foreign banks will make local banks more efficient. Lastly, Grigorian and Manole (2002) also illustrate several disadvantages of the DEA method which may create some bias in the dataset.

Yildirim and Philippatos (2002) adopt SFA (Stochastic Frontier Approach) and DFA (Distribution Free Approach), two methods to estimate banking inefficiency in 12 transition countries in Central and Eastern Europe during the 1993-2000 period. They focus primarily on the degree of inefficiency, and conclude that foreign banks are cost

efficient, but profit inefficient.

The literature above relate to the economic background of banking efficiency in a few transition countries in Central and Eastern Europe. In addition to these works, there is some other technical literature which estimates the AES and X-efficiency for the banking. This kind of literature supplies the technical background for this thesis, and is crucial to understand the development of this thesis.

Humphrey (1981) is the first important literature for the Allen Partial Elasticity (AES). The dataset utilized in this paper is for big US money center banks during 1970-1975 period. He utilizes a full information maximum likelihood estimation (MLE) technique to estimate a translog profit function. Two elasticities are obtained in Humphrey (1981): liability substitution elasticity and own elasticity of demand. This paper was an excellent basis for other literature, which utilized the translog functional form to examine the cost structure in the banking system.

The next important study examining AES is Murray and White (1983). They utilize a dataset for credit unions in British Columbia during 1976-1977 period. The functional form utilized by Murray and White (1983) is a multiproduct translog cost function, which includes three outputs (Mortgage lending, other loans and investment) and four inputs (labor, capital, demand deposits and time deposits). They examine the cost structure by using Seemingly Unrelated Regression (SURE) to estimate a translog function jointly with inputs share equations. In addition Murray and White (1983) compare the translog functional form with other functional forms including CES and Cobb-Douglas.

Similar to Murray and White (1983), Mester (1987) also utilize a translog cost

function to estimate the AES. She focuses on the cost structure of saving and loans. The dataset consist of saving and loans in California in 1982. Mester (1987) also utilizes the SURE technique to estimate the AES. After examining the scale, scope and the Allen elasticity of substitution in saving and loans, she concludes that small saving and loans does not have significant cost disadvantage compared with large saving and loans in the dataset. Different from the two literatures above, Mester (1987) calculates the standard error for the AES, which makes the regression results comparable to other papers.

Noulas et al (1990) investigate US Commercial Banking focusing on the effect of deregulation. Noulas et al (1990) utilize the dataset of US large banks in 1986. They notice that the banks are merging and the average scale of bank increase significantly during this period. Noulas et al (1990) examine how the change of the banking environment influences the cost structure of US commercial banks. This topic is also important in Central and Eastern Europe. Also Noulas et al (1990) adopt a useful classification method, which is also utilized in this thesis. They define a bank with more than 1 billion deposits as a big bank, and a bank with less than 1 billion deposits as a small bank. They also adopt a multiproduct translog cost function with four outputs, four variable input and one fixed input.

Now, we will introduce some literature that focuses on banking efficiency. Hunter and Timme (1993) examine the cost efficiency and AES for US banks by using the Federal Reserve data from 1983-1990. The regression technique adopted in Hunter and Timme (1993) is Full Information Maximum Likelihood (FIML). This paper also has a distinct feature compared with the literature above. Hunter and Timme (1993) estimate two cost functions including a total cost function and a variable cost function. They also

estimate the cost function jointly with share equations. There are six outputs in the total cost function, and four outputs in the variable cost function. Lastly, there are five inputs included in the cost model.

Next, Turati (2002) is an excellent study to discuss scale, scope and AES in European banking. He focuses on the European banking system including France, Germany, Italy, Spain and the UK from 1992-1999. There are three cost functions in Turati (2002). They all include three inputs (Labor, Capital and Deposit) which are the same as are used in this thesis, and two outputs (loans and other assets). His findings show a relatively small difference between cost efficiency of these European countries.

Lastly, Williams and Gardener (2003) examine the issue of X-efficiency for European banks by using Stochastic Frontier Analysis (SFA). They suppose that the regional European banks are most efficient in local area because of the information asymmetry. This is probably because the regional banks master some specific information of the local consumers. The dataset is of large regional banks in Europe during 1990-1998. This paper concludes that the regional banks are efficient, and that the competitiveness of the banking environment has a positive effect on banking efficiency.

CHAPTER III

THEORETICAL MODEL

This chapter will illustrate the translog cost functional form, the formulas for the Allen Partial Elasticity, the SURE technique, and the SFA technique used to calculate the X-efficiency for different groups of banks in Central and Eastern Europe. The cost function form utilized here is a multiproduct translog cost function.

The cost function of a bank is a very useful tool to analyze the structure of a financial market. We can easily obtain an abundance of useful measures such as Economies of Scale and the Elasticity of substitution from the cost function. The general cost function for banks can be written as follows: $C(P, Y)=MIN\{PX: X \in V(Y), P>0\}$ where P is the input price vector, Y is the output vector, and the V(Y) is the requirement set.

The general cost function can be illustrated by microeconomic theory, and it is very important to choose a proper functional form to be utilized in an empirical project. The proper functional form must be flexible and have the fewest restrictions. The functional form should be positive, not decreasing in the cost, homogenous and concave. In addition it should have real values. The translog function form can satisfy all the restrictions above. The functional form of the mutiproduct translog cost function utilized in this thesis will be illustrated as follows:

$$LnTC=\alpha_0+\alpha_1 lnY_1+\alpha_2 lnY_2+\alpha_3 lnY_3+\beta_1 lnPK+\beta_2 lnPL+\beta_3 lnPD+1/2(\delta_{11} lnY_1 lnY_1+\delta_{12} lnY_1 lnY$$

$_2+\delta_{13}\ln Y_1\ln Y_3+\delta_{22}\ln Y_2\ln Y_2+\delta_{23}\ln Y_2\ln Y_3+\delta_{33}\ln Y_3\ln Y_3)+1/2(\gamma_{11}\ln PK\ln PK+\gamma_{12}\ln PK\ln PL+\gamma_{13}\ln PK\ln PD+\gamma_{22}\ln PL\ln PL+\gamma_{23}\ln PL\ln PD+\gamma_{33}\ln PD\ln PD)+\rho_{11}\ln Y_1\ln PK+\rho_{12}\ln Y_1\ln PL+\rho_{13}\ln Y_1\ln PD+\rho_{21}\ln Y_2\ln PK+\rho_{22}\ln Y_2\ln PL+\rho_{23}\ln Y_2\ln PD+\rho_{31}\ln Y_3\ln PK+\rho_{32}\ln Y_3\ln PL+\rho_{33}\ln Y_3\ln PD+\varepsilon$

In this equation, Y_i expresses the ith output (i=1, 2, 3, 4); PK, PL and PD are the input price for the capital, labor and deposit; α, β, δ and ρ are parameters which are to be estimated. The condition of positively linear homogeneity in input prices is illustrated as follows:

$$\sum\beta=1,\ \sum\gamma=0,\text{ and }\sum\rho=0$$

So far, we have discussed the proper cost functional form. Next we can simply find the parameters using OLS for the cost function. However, the coefficients may not be efficient. There is a better method to obtain the efficient estimators, SURE, which consists an entire system of equations including the cost function jointly with share equations. After utilizing Shephard's lemma, we can obtain the cost share equations as follows:

$S_1=\beta_1+\gamma_{11}\ln PK+\gamma_{12}\ln PL+\gamma_{13}\ln PD+\rho_{11}\ln Y_1+\rho_{21}\ln Y_2+\rho_{31}\ln Y_3+e_1$

$S_2=\beta_2+\gamma_{21}\ln PK+\gamma_{22}\ln PL+\gamma_{23}\ln PD+\rho_{12}\ln Y_1+\rho_{22}\ln Y_2+\rho_{32}\ln Y_3+e_2$

$S_2=\beta_3+\gamma_{31}\ln PK+\gamma_{32}\ln PL+\gamma_{33}\ln PD+\rho_{13}\ln Y_1+\rho_{23}\ln Y_2+\rho_{33}\ln Y_3+e_3$

Next we will use the SURE method to estimate the parameters. There is often a correlation among disturbance terms between the cost and cost share equations, and if the correlation is ignored, the OLS will estimate the inefficient estimators. In this thesis, the Seemingly Unrelated Regression (SURE) will be used to obtain efficient and unbiased estimators. Because the sum of the three share equations equals to 1, the cost share

equations are not linearly independent, which yields a singularity problem. In order to solve this problem, one of the share equations should be dropped, and the regression result will be the same. Because dropping any of them gives us the desired result, it does not matter if we drop input price of labor, capital or deposit.

After obtaining parameters for the translog cost function by using SURE, the Allen Partial Elasticity (AES) can be calculated. AES can express the elasticity of an input ratio with respect to another input ratio. It can illustrate the relationship between the different inputs, and can supply the information for analyzing structure of the financial markets. Because three inputs are included in this thesis, there are six useful AES. The formulas for the AES are illustrated as follows;

$\theta_{11}= (\gamma_{11}+S_1 (S_1-1))/S_1$

$\theta_{12}= (\gamma_{12}+S_1S_2)/ (S_1S_2)$

$\theta_{13}= (\gamma_{13}+S_1S_3)/ (S_1S_3)$

$\theta_{22}= (\gamma_{22}+S_2 (S_2-1))/S_2$

$\theta_{23}= (\gamma_{23}+S_2S_3)/S_2S_3$

$\theta_{33}= (\gamma_{33}+S_3 (S_3-1))/S_3$

Where $\theta_{11,}$ θ_{22} and θ_{33} are own AES, and $\theta_{12,}$ θ_{13} and θ_{23} are cross AES. S_1 is the cost share for Capital, S_2 is the cost share for Labor, and S_3 is the cost share for Total Deposit. Therefore, the AES is calculated by using the parameters obtained in the SURE estimation and the input cost shares. An important topic here is what can be used as the variable of cost share. There are three values for cost share: actual value for the cost share, mean value of the actual cost share, and the fitted cost share. It should be noted that, in this thesis, the mean value of the actual cost share will be utilized.

The AES can be only utilized to obtain the information of the cost structure for the whole financial market in the Central and Eastern European countries. The main purpose of this thesis is to investigate the different cost structure and banking efficiency between the countries which have or will attend the Europe Union (accession countries) and the countries that have not and will not attend EU. Therefore a Chow test will be utilized in this thesis to test this difference. Many foreign big banks enter into financial markets in accession countries, and the accession countries probably adopt some new advanced technology. Therefore, the cost structures in these two groups of countries may be different. A Chow test is used to test the hypothesis that the regression coefficients are different in these two groups of countries. However, this thesis will still utilize the SURE method to estimate the parameters for these two groups of data.

We can know whether the two groups of countries have different cost structure by using a Chow test. However we do not know which cost structure is better. Even if we know the structures are different, we cannot supply valid policy suggestions. Therefore we need to do a new regression to obtain further information.

To do this, this thesis will utilize the Stochastic Cost Approach (SFA) to estimate the cost efficiency for each bank. It will divide the countries into two groups: the accession countries which will attend EU, and the non-accession countries which will not attend the EU. Next it will calculate the X-efficiency for every bank using SFA in the same group, and then get the average X-efficiency for each group.

In SFA analysis, the error term for the cost function is not $\sigma \in (0, \sigma^2)$, but it is a composite expression: e=V+U. Because the cost function utilized in this thesis is translog function, the formula is e=lnV-lnU, where V is the cost inefficiency. We can choose two

types of distribution for the cost inefficiency: Half Normal and Truncated Normal. Stevenson (1980) shows that truncated normal distribution is more flexible than the Half Normal distribution. Therefore, this thesis will adopt the Truncated Normal distribution for lnV. On the contrary, lnU is random error and follows the symmetric normal distribution. In order to get the X-efficiency, we have two steps: first we use SFA technique to obtain the expected value of inefficiency conditional on the estimated value of residual e: E (V/e); second, we can obtain the X-efficiency by comparing each bank with the most efficient bank in that group. We can utilize $e^{(\ln V)}$ to get the cost inefficiency V, where the smallest V illustrates the most efficient bank. Then we can get the X-efficiency for every bank by this formula: $X_i=V_{best}/V_i$ where X_i is the X-efficiency for the bank i, V_{best} is the smallest value for the cost inefficiency in the group, which shows the most efficient bank, and V_i is the cost inefficiency for the bank i. lastly, X_i is between 0 and 1, and the X_i is bigger when a bank is more efficient.

CHAPTER IV

DATA AND METHODOLOGY

The primary use of this chapter is to describe the data used in this thesis, and also describe how the variables are defined. All the data utilized in this thesis is from bankscope. It contains a lot of useful information for both public and private banks. As a global dataset, the bankscope covers 25000 banks around the world until August 2004. This database contains detailed information on the consolidated or unconsolidated balance sheet and income statement. The report also includes information in varying degrees of standards which you can use to search and analyze banks across borders. The database is huge, and contains 200 types of data and 36 kinds of ratios for every bank. The bankscope database has three main advantages: first, the data provided in this database is all given in standardize format, which can be easily utilized and compared; second, it supplies the detailed enough information for researchers to investigate individual banks; third, it supplies the locations of the banks which makes for easy comparison between banks in different countries. The disadvantage of this dataset is that the data is not a random sample. It is supplied on a volunteer basis by commercial banks, and at the same time there is some missing data which makes having comparison study of different years somewhat difficult.

The dataset in this thesis covers the 2000-2004 period. The data contains public as well as commercial banks; however, commercial banks are the main part of the dataset.

The main purpose of this thesis is to illustrate the difference in banking efficiency in diverse countries, and because of this, public and commercial banks do not need to be differentiated. The translog cost function in this thesis includes four outputs and three input price, which are independent variables. The dependent variable is total cost, and all variables are all utilized in the translog form.

TOTAL COST is the dependent variable and is an important standard used to estimate banking efficiency. The method utilized in this paper is the intermediation method which uses the actual dollar value as the variable. The total cost is a sum of all the input cost. In this paper, the total cost is calculated by adding up the cost in capital, labor, and commission. By calculating the total cost, we can also get a very important variable for this thesis, share of the input. The variable of share will be utilized to construct the share equation which will be used to calculate AES. Every variable of share illustrates an input share of the total cost. For example, capital's share equals the total payment to capital divided by total cost.

There are three variables of output, loans, investment, commission revenue, and the detailed definitions of the outputs will be given as follows.

First, LOANS (Y1) is the net loans. The net loans are calculated by total loans subtracting loan reserves. Total loans contain the sum of commercial loans, credit cards, real estate loans, and installment loans. Loans reserve is the amount of reserve for commercial banks to give to the central banks. The loans reserve cannot be utilized by the banks, so it is most reasonable to utilize net loans as one of the output.

Second, IVESTMENT (Y2) is taken directly from the reports of bankscope. Investment is an important source of output in banks, and it can express the ability of

banks to earn money. It contains Securities, Tax-Exempt Securities, stocks and bonds, and other forms of investment.

Third, COMMISSION REVENUE (Y3) is the income from the fee which is charged by banks for the service of facilitating transactions, such as buying or selling securities or real estate. It is not a big part of the output, but this variable may have a relationship with the number of employee, and so on, so this paper includes this as an output for banks.

Next, there are three kinds of input, capital (X1), labor(X2) and deposit(X3). There are three input price: price of capital (PK), price of labor (PL) and price of deposit (PD).

PRICE OF CAPITAL (PK) has two parts. The first is the physical capital cost and the second is the financial capital cost. The physical capital cost contains the occupancy cost on the building and equipment, and the reserve for physical capital. The financial capital cost includes dividends paid on stock, and interest payment on securities and so on. The price of capital is calculated by totaling the payment for capital divided by the amount of capital.

Next, PRICE OF LABOR (PL) is easy to understand. It is calculated by dividing the sum of wages by the number of employees. The data for this variable is based on the full time employee and is equal to the average annual wage for all employees.

Lastly, PRICE OF DEPOSIT (PD) is calculated by dividing the interest payment for the total deposit by the total dollar value of deposit. The deposit includes all types of accounts such as demand deposit, time deposit and other deposits.

These are the definitions of the input prices. It should be noted that the input

prices cannot be gotten directly from the report, but must be calculated, and the calculation method will be illustrated next. There are two main types of expense for banks. The first is interest expense and the second is the non-interest expense. It is easy to understand that the interest expense is the payment for a deposit. Therefore, the interest payment divided by the total deposit is equal to the price of deposit. The non-interest expense can be divided into two parts: the expenses for the employees and the other expenses. The expenses for the employees are calculated by dividing by the number of employee and getting the price for labor. The non-interest payment excluding the personal payment is the expense for the capital, and we can use this divided by the asset expense to get the price for the capital.

General data analysis: the median and mean values for all the four output in accession countries are bigger than the data in non-accession countries in the whole 5 years' dataset. However, the non-accession countries own the bigger maximum value. This situation illustrates that in average the banking scale is larger in accession countries. There are many small banks in non-accession countries, such as the bank with the total deposit just 1 million dollars. And the minimum data for total deposit in accession countries is 7 million. There is a very huge deviation between median and average value in non-accession countries, because there is a very big bank in Russia, SBERBANK-Savings Bank of the Russian Federation, which has more than ten billion dollars in loans, and it increased the average value. The same situation happens in all the three output.

After examining the dataset, we can find that this bank does not have high input price. The price of capital and labor in SBERBANK-Savings Bank of the Russian

Federation are all lower than the average across countries. The price of deposit can expressed as a weighted interest rate, and the SBERBANK-Savings Bank of the Russian Federation has a high interest rate in comparison to the average. The biggest banks do not have the highest input price, but have the very large total cost. It is interesting to examine the cost efficiency of the Russian banks which contain most of big banks in the Central and Eastern European banks.

Data analysis for cost share: in 2000, the average cost share of the capital, labor and deposit for accession countries are 25%, 16% and 59%. This illustrates that the largest part of the cost is the interest cost, and the cost of the capital is larger. In order to enter Europe Union, accession countries in Central and Eastern Europe adopt more advanced technique which makes the cost of capital a larger fraction of the overal costs. Compared with accession countries, the non-accession countries do not have the dominant cost share. The share for capital, labor and deposit is 37%, 25%, 38%. The non-accession countries have similar share with these three inputs.

In 2001, the accession countries have nearly the same cost structure as 2000. The average cost share is 23%, 17% and 60% for capital, labor and deposit. This illustrates that the process of entry of foreign big banks continues and the accession still try to improve the techniques for banking. The non-accession countries' cost structure also stays the same, which is 33%, 27% and 40% for capital, labor and total deposit. In rest of three years, the non-accession countries do not have any significant change in cost structure, because they do not have any motivation to improve the banking efficiency. The cost share for accession countries in 2002 is 25%, 23% and 52%. The share of capital and labor becomes similar, which illustrates that the banking technique in accession

countries is more mature. In The 2003 and 2004, the cost structure for accession countries stays the same. The accession countries owns nearly same cost share for capital and labor, but have a higher share for deposit.

In the Data analysis for the individual country, the total deposit is the most important resource for banks, and most of the cost and profit for banks is made by utilizing deposits. The investment and loan is the primary method to use deposits, and the expense of the interest is the biggest part of the cost for Central and Eastern European banks and it has a very big relationship with total deposits. At the same time, the total deposits, which is an important standard for bank's scale, is often used to divide the banks into different groups. Therefore, it follows that this thesis will utilize the data of the total deposits in the different countries to analyze the structure difference in the Central and Eastern European banks. There are several small countries which only have a few banks in the dataset, and some years contain no data for these banks. For these small countries, if they have all the data for all five years, they will have a statistical table; and if they miss any year of data, they will be treated as random data, but are not given a table to describe the structure of that country. The tables will include the number of banks, minimum, maximum, median, mean, the number of big banks, and the size change. One billion dollars in total deposits is the standard to judge the scale of the banks. It is a big bank if its total deposit is over one billion. The size change variable means the difference between the mean values of the deposit compared with the 2000 mean value. There are nine Central and Eastern European countries on the statistical tables in this thesis. We can divide the nine countries into four groups which each have different market structures.

The First group of countries includes Armenia, Belarus and Georgia. This group

of countries owns very few banks in the dataset. They all have less than six banks for each year. They have nearly no big banks, except Belarus which has one big bank. The bank scale is small among these three countries. In 2000, all the countries had total deposit less than 15 million dollars, and Armenia only had 4656.45 thousand dollars. They all have a big increasing trend during the dataset. In 2004, the mean scale of banks in Armenia is 1289.93% compared with 2000. Belarus increased the most, in 2003, when it increase more than 36 times its data in 2000; Georgia increased the least, with its biggest scale being in 2003 which was 790.75% versus the data in 2000. however, this is still a big increase compared with countries in other group.

The Second group is the accession countries. There are seven countries in this dataset which have or will attend the Europe Union. They are: Bulgaria, Poland, Romania, Czech, Hungary, Slovenia, and Slovakia. All the seven countries are included in the tables, and they all have similar situations. They do not have a lot of banks, but all have big banks which own more than one billion in total deposits. This is especially true for Poland which does not have more than 5 banks in the dataset, but every year has 1 big bank, and in 2004 all three banks in Poland are big banks. Romania and Czech has more banks than Poland, and nearly always has one big bank. Poland has a big commercial bank, Bank Pekao SA which is the biggest commercial bank in Poland. Romania and Czech also has two big banks: Romanian Commercial Bank SA and Ceskoslovenska Obchodni Banka. Compared with Romania, Poland's banks expand more rapidly, Increase an average of 703.77% during the five years. Romania and Czech increase 174.97% and 135.69% respectively compared with the data in 2000. Slovenia and Slovakia are very similar. They all have less than 9 banks, but often have 3 large banks.

These two countries' banking scale did not increase significantly, until 2004 when they arrive at the biggest scale.

The third group includes Kazakstan and Ukraine. They do not have big banks in the 2000 and 2001, but have big banks in the rest of the 3 years. The increased speed of scale is not big in this group: only 315.13% and 224.83% respectively. These two countries do not have one dominant super big bank, but have 2 or three big banks which have similar scale and can compete with each other. Kazakstan has 3 big banks: Bank Turan Alem, Kazkommertsbank and OJSC Halyk Savings Bank of Kazakhstan; Ukraine has 2 big public banks, and 1 bank named Privat bank. This group of countries is notable because it has competition in the banking system.

The last group includes just one country, Russia. It is the biggest country in Central and Eastern Europe and has a lot of banks. Russia owns the biggest bank scale in this dataset. Every year it has mean total deposits of more than 1 billion dollars. At the same time, it has mostly big banks. In particular, there is one super big bank in Russia, SBERBANK which is the central bank of Russia. This bank is always the biggest bank in the dataset, and it brings up the mean scale of Russian banks significantly. In contrast with the other groups, Russia has a decreasing trend of the bank's scale, which is quit odd when compared to the significant, positive growth seen in the other groups.

Table 4.1 Accession countries and non-accession countries in this thesis

Accession countries	Non-accession countries
Bulgaria(07)(BG)	Albania(AL)
Poland(PL)	Armenia(AM)
Romania(07)(RO)	Belarus(BY)
Czech(CS)	Croatia(HR)
Hungary(HU)	Georgia(GE)
Slovenia(SI)	Kazakstan(KZ)
Slovakia(SK)	Moldova(MD)
	Russian(RU)
	Ukraine(UA)
	Kyrgyzstan(KG)

Table 4.2 Data statistics of variables (2000)-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	6690.82	20700.00	111.07	0.10	7.37	0.01
Maximum	3959220.37	8667151.51	144561.51	218.91	46.50	3.42
Median	253284.94	207442.14	6654.57	0.72	18.03	0.07
Mean	416845.99	684845.38	18168.20	8.37	19.18	0.17
share				0.25	0.16	0.59

All values are in thousand dollars except the input price

Table 4.3 Data statistics of variables (2000)-non-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	1822.78	1721.52	101.27	0.08	1.07	0.004
Maximum	10171388.53	10002429.19	431271.31	26.75	59.31	0.24
Median	50707.08	47349.68	3276.38	0.79	8.81	0.05
Mean	294577.49	361710.34	14938.24	1.74	11.02	0.06
share				0.37	0.25	0.38

All values are in thousand dollars except the input price

Table 4.4 Data statistics of variables (2001)-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	5188.00	15334.12	300.00	0.12	3.63	0.01
Maximum	7875389.50	7390708.44	367453.54	637.53	51.54	3.18
Median	278427.93	337192.37	10597.69	0.63	16.48	0.05
Mean	634748.50	991195.38	31903.07	15.74	18.55	0.14
share				0.23	0.17	0.60

All values are in thousand dollars except the input price

Table 4.5 Data statistics of variables (2001)-non-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	1321.13	742.42	56.62	0.04	1.44	0.01
Maximum	13155962.54	9676489.91	475096.22	13.89	46.13	0.85
Median	58969.20	44046.83	3456.39	0.74	7.54	0.05
Mean	338242.84	333706.77	14540.08	1.20	11.14	0.06
share				0.33	0.27	0.40

All values are in thousand dollars except the input price

Table 4.6 Data statistics of variables (2002)-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	1817.00	2516.78	86.26	0.11	0.10	0.01
Maximum	6850137.69	11397266.18	362593.23	12.28	50.99	1.09
Median	247461.11	344704.77	9408.01	0.71	18.03	0.05
Mean	670501.38	1044194.42	30776.93	1.21	19.16	0.07
share				0.25	0.23	0.52

All values are in thousand dollars except the input price

Table 4.7 Data statistics of variables (2002)-non-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	86.78	817.54	37.51	0.08	0.36	0.01
Maximum	14623598.05	12630328.27	532638.65	14.21	69.04	1.34
Median	69628.50	50967.43	3019.28	0.81	7.64	0.05
Mean	362614.84	337960.33	14604.97	1.49	12.22	0.07
share				0.33	0.27	0.40

All values are in thousand dollars except the input price

Table 4.8 Data statistics of variables (2003)-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	4817.96	1894.42	136.43	0.14	6.62	0.01
Maximum	9226774.72	12554182.58	420845.81	12.02	686.13	2.25
Median	337158.53	220005.05	8244.33	0.75	18.81	0.04
Mean	957493.26	984659.78	42350.96	1.17	29.69	0.08
share				0.31	0.27	0.42

All values are in thousand dollars except the input price

Table 4.9 Data statistics of variables (2003)-non-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	262.50	906.36	22.69	0.04	0.72	0.00
Maximum	24641519.12	16177372.08	627995.76	9.19	104.55	3.04
Median	125238.54	81907.69	4248.36	0.77	9.04	0.05
Mean	595369.08	437716.35	19632.65	1.28	14.79	0.08
share				0.32	0.27	0.41

All values are in thousand dollars except the input price

Table 4.10 Data statistics of variables (2004)-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	20567.72	18733.90	278.57	0.08	7.03	0.01
Maximum	13464307.50	7205979.26	508209.00	4.45	67.74	0.24
Median	541996.78	297429.49	12756.65	0.62	18.65	0.04
Mean	1477176.29	1106965.90	53590.97	0.88	21.12	0.05
share				0.29	0.28	0.44

All values are in thousand dollars except the input price

Table 4.11 Data statistics of variables (2004)-non-accession countries

standard	Y1	Y2	Y3	PK	PL	PD
Minimum	17400.00	10523.02	438.46	0.18	2.31	0.02
Maximum	5193298.42	4841685.47	155582.52	11.24	97.44	0.34
Median	380489.25	166166.34	10303.19	0.70	10.72	0.05
Mean	882590.56	545232.67	29685.85	1.11	15.60	0.06
share				0.27	0.26	0.46

All values are in thousand dollars except the input price

Table 4.12 The statistics of banks in Armenia (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	1	1	6	6	2
Minimum	4656.45	4292.02	7087.32	9722.08	53707.19
Maximum	4656.45	4292.02	31564.23	38080.21	66422.90
Median	4656.45	4292.02	23016.04	23291.52	60065.04
Mean	4656.45	4292.02	20098.02	23513.34	60065.04
Big bank	0	0	0	0	0
Size change	100%	92.17%	431.62%	504.96%	1289.93%

All values are in thousand dollars except the input price

Table 4.13 The statistics of banks in Belarus (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	1	3	4	4	1
Minimum	13595.32	8800.00	18900.00	34800.00	73629.14
Maximum	13595.32	1253086.23	1399600.00	1499769.48	73629.14
Median	13595.32	40716.09	155265.05	218529.55	73629.14
Mean	13595.32	434200.78	432257.53	492907.14	73629.14
Big bank	0	1	1	1	0
Size change	100%	3193.75%	3179.46%	3625.56%	541.58%

All values are in thousand dollars except the input price

Table 4.14 The statistics of banks in Georgia (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	4	4	6	6	2
Minimum	1164.56	1699.03	3492.82	5638.55	55068.49
Maximum	30329.11	33980.58	61722.49	83759.04	177753.42
Median	13696.20	15533.98	21339.71	28626.51	116410.96
Mean	14721.52	16686.89	24864.43	34096.39	116410.96
Big bank	0	0	0	0	0
Size change	100%	113.35%	168.90%	231.61%	790.75%

All values are in thousand dollars except the input price

Table 4.15 The statistics of banks in Croatia (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	18	22	23	23	7
Minimum	19668.19	18046.91	21565.30	27406.44	111834.92
Maximum	2275943.25	4536022.02	5804017.50	7278150.02	8308674.30
Median	131282.72	140713.26	131560.90	197973.53	1136195.91
Mean	326602.20	566485.16	706608.89	1037471.08	2923909.81
Big bank	1	3	4	6	4
Size change	100%	173.45%	216.35%	317.66%	895.25%

All values are in thousand dollars except the input price

Table 4.16 The statistics of banks in Kazakstan (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	7	12	14	16	14
Minimum	18346.02	26195.07	82.15	76.97	55066.92
Maximum	566492.75	820193.08	1093304.70	1807148.80	2869292.31
Median	99833.91	67671.44	133975.74	253443.70	486845.76
Mean	145991.40	196810.98	262566.62	475961.64	904912.42
Big bank	0	0	2	3	3
Size change	100%	134.81%	179.85%	326.02%	619.84%

All values are in thousand dollars except the input price

Table 4.17 The statistics of banks in Poland (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	5	4	5	5	3
Minimum	91687.84	375489.70	108172.95	734334.90	1479902.35
Maximum	908408.95	15225464.84	14071062.95	13779057.69	7348615.90
Median	623109.50	770303.87	787383.30	1041194.40	1538690.48
Mean	548786.45	4285390.57	3198388.25	4509153.12	3455736.24
Big bank	0	1	1	1	3
Size change	100%	780.88%	582.81%	821.66%	629.71%

All values are in thousand dollars except the input price

Table 4.18 The statistics of banks in Romania (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	9	10	14	16	5
Minimum	26100.00	22400.00	13400.00	16500.00	95693.09
Maximum	3447553.85	3479466.50	4275516.81	4853132.66	7252571.09
Median	71143.87	89084.27	114170.85	169805.92	226594.76
Mean	472073.46	483244.01	515975.29	610799.77	1693866.37
Big bank	1	1	1	2	1
Size change	100%	102.37%	109.30%	129.39%	358.81%

All values are in thousand dollars except the input price

Table 4.19 The statistics of banks in Russia (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	23	36	48	56	29
Minimum	22613.64	4861.06	13003.23	30979.99	36938.67
Maximum	22657024.61	24746476.87	28309905.96	41692491.81	6328900.00
Median	260553.98	137582.95	153441.63	251318.13	598590.20
Mean	1559572.34	1222797.86	1169213.22	1508776.92	1304015.78
Big bank	6	6	8	11	11
Size change	100%	78.41%	74.97%	96.74%	83.61%

All values are in thousand dollars except the input price

Table 4.20 The statistics of banks in Ukraine (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	11	13	18	18	10
Minimum	17600.00	1113.52	4500.79	7052.42	49000.00
Maximum	557291.38	872000.00	1007276.27	1667600.00	1962800.00
Median	63961.73	112445.22	128549.34	188089.66	441500.00
Mean	185431.92	248387.19	265820.96	435776.59	717619.56
Big bank	0	0	1	3	3
Size change	100%	133.95%	143.35%	235.01%	387.00%

All values are in thousand dollars except the input price

Table 4.21 The statistics of banks in Czech (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	10	11	16	21	1
Minimum	7917.912	9178.411	2202.181	4672.897	1712336.150
Maximum	10221405	9761328	15998673	19480861	1712336.150
Median	592248.7	1236703	936004.1	181445.4	1712336.150
Mean	1549347	1783356	2605543	2308043	1712336.150
Big bank	4	6	8	6	1
Size change	100%	115.10%	168.17%	148.97%	110.52%

All values are in thousand dollars except the input price

Table 4.22 The statistics of banks in Hungary (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	3	3	2	4	2
Minimum	184572.4	175706.9	513168.4	656613.1	4275107
Maximum	6145861	6911314	558083.1	13544801	17506878
Median	337098.3	916306.5	535625.8	1783869	10890992
Mean	2222511	2667776	535625.8	4442288	10890992
Big bank	1	1	0	2	1
Size change	100%	120.03%	24.10%	199.88%	490.03%

All values are in thousand dollars except the input price

Table 4.23 The statistics of banks in Slovenia (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	7	7	9	9	4
Minimum	90143.2	111952.2	162540.1	240675	336713
Maximum	1103164	1158912	1920139	2412685	8572743
Median	634901.5	694595.7	992005.3	1347036	2156909
Mean	541293.8	644392.6	924634.3	1252286	3305819
Big bank	1	2	4	6	3
Size change	100%	119.05%	170.82%	231.35%	610.73%

All values are in thousand dollars except the input price

Table 4.24 The statistics of banks in Slovakia (Total Deposit)

Variable	2000	2001	2002	2003	2004
NO. bank	5	7	9	9	3
Minimum	107930.1	112391.9	112266.5	87763.46	1016886.26
Maximum	3440765	3791425	4632756	4861683	6466701.291
Median	359080.3	665007.1	765253.7	704694.5	1523722.058
Mean	944027.8	1520910	1611901	1438707	3002436.536
Big bank	1	3	3	3	3
Size change	100%	161.11%	170.75%	152.40%	318.05%

All values are in thousand dollars except the input price

CHAPTER V

EMPIRICAL RESULT

This thesis adopts two regression techniques: SURE (Seemingly Unrelated Regression) and SFA (Stochastic Frontier Analysis). SURE is utilized to estimate the parameters which will be used to obtain the AES (Allen Partial Elasticity), and SURE is also used to run the Chow test to test for a significant difference between the parameter estimates of the two models. SFA is used to obtain the X-efficiency in order to examine the efficiency difference between the two different groups of countries.

In order to utilize SURE, this thesis adopts a system of equations which includes the cost function and the cost share equation. The dataset contains banks in Central and Eastern European countries during 2000-2004 period. There are three outputs and three input price in the cost function. The outputs are LOANS, INVESTMENT, and COMMISSION REVENUE. The input prices are price of capital, price of labor and price of total deposit. The real values for the parameters in the cost function and share equations (β, γ and ρ) are the same. This will increase the efficiency of the estimators, because there are no new parameters that needed to be estimated other than the ones in the cost functions. Since all variables are in the form of logarithms, every parameter can be interpreted as the elasticity of the independent variable with respect to the change of total cost. In theory, all the variables need be strictly positive and can be satisfied by the log form. In addition, the total cost will increase when the output and the input price

increase, and this condition needs all the parameters estimated for output and input price to be positive. Therefore, the seven parameters for the three outputs and three input price (α_1, $\alpha 2$, α_3, $\alpha 4$, $\beta 1$, $\beta 2 and \beta 3$) must be positive. In actuality the regression result shows that all these seven parameters have the positive signs.

From the regression result table of SURE; we know that all the parameters for the output and input price are positive for every year. This means that the cost function satisfies the restriction in every year. All the weighted R^2 is above 0.95 which is a common result for the SURE method. However, not all the parameters are significant in all the year.

The input of labor and capital are strong substitutes for each other in the dataset for accession countries, with the exception 2001. The relationship of substitution can be illustrated by its positive sign. The highest AES for these two variables is 4.573 in 2004, and lowest AES is 0.547 in 2001. In the whole dataset, the change of AES for labor and capital is very significant. The relationship between these two variables is strong complement in 2000, which is very strange. Combining the SURE result with AES, we can find a big structural change during the 2000-2001. In 2000 and 2001, the t-value for the parameters of price of labor are 5.768 and 1.042 respectively, which means that the price of labor has a very significant effect on the total cost in 2000, but is not significant in 2001. During this period, many foreign big banks entered into the financial market in several accession countries, and this process brings more advanced banking techniques. The new techniques and machines need banks to hire more employees and some exports, which makes labor has a significant effect. During this period, both capital and labor increase significantly, and these two variables are strong complements. After 2001, the

cost structure begins to be stable and the capital and labor becomes to be substitutes again.

The relationship of labor and total deposit is substitutes for each other during 2000-2004. Total deposits is the basis for banks to produce INVESTMENT and LOANS. And labor can express the ability for the Central and Eastern European banks to earn money. Actually, the prospect of a bad loan is a big problem there, and with more financial officers these banks may have a better chance to calculate the probability of bad loans, and at the same time improve the efficiency to utilize the total deposit. They can utilize less total deposit to obtain more loans; therefore the labor and deposit are substitutes. Biggest AES is 8.786 in 2000, and the smallest AES is 1.192 in 2003.

The relationship of capital and deposit is also substitutes for each other in 2000-2003. This relationship is similar with the relationship between labor and deposits. Capital includes the physical capital and financial capital. They all have a positive influence on LOANS and INVESTMENT. Actually this variable can illustrate a technical level which can improve the efficiency of banks, and its increase will decrease the amount of input of total deposits.

The AES for the non-accession countries illustrates that all the inputs are substitutes for each other. The AES structure does not have any big change during 2000-2004. All the AES are close to 1, and have only small difference during the dataset. We can ascertain that the non-accession countries do not have incentive to improve the cost structure of their banking systems, which may make them have low banking efficiency.

Next, the countries in the dataset can be divided into two groups: the accession

countries (including the ones will attend EU in 2007) and the non-accession countries. For the accession countries, there are more foreign big banks entering into their financial market, which will bring advanced techniques. This process will improve the banking efficiency and cost structures in these countries. At the same time, in order to attend EU, the government in accession countries will adopt a series of policies which will change the environment for banks. This process may make these two groups of countries have different cost structures. Because of this, a Chow test is used to check the difference of cost structure in these two groups.

After dividing the data into two groups, the observations for the accession countries are not enough for 2004. Therefore, this paper only contains the chow test for 2000-2003. The result shows that in 2000, it accepts the hypothesis that there is no difference of cost structure in these two groups. However, in 2001, 2002 and 2003, there is a significant difference in the cost structures between the two groups of countries. The F-value in these three years are all significant at the 5% level. Although there is a difference, we cannot judge which group has better cost structure. In order to answer this question, we need a more powerful technique to supply more information.

This paper divided the countries into the accession countries and non-accession countries. The banks in the accession countries are more efficient than the non-accession ones for every year. Because there is not enough data to attain large degree of freedom in 2004, the X-efficiency will be calculated in the combined data from the four years. In 2000, the average X-efficiency for accession countries is 93.01%. The most efficient country is Czech, which owns the average X-efficiency as 99.86%. The most inefficient country, which has X-efficiency of 86.20%, is Slovenia. In 2001, the average

X-efficiency is 92.01%. The most efficient country is still Czech, but the most inefficient country changes into Poland. The X-efficiency for accession countries continues a trend of decreasing. It falls 89.92% in 2002, and has a little increase in 2003. Actually, the most efficient country in the whole dataset is always Czech, and different year has individual inefficiency country, and in average, Slovenia is most inefficient with the number of 86.13%.

The X-efficiency for non-accession countries in 2001 is pretty low, which is only 70.65%. Russia has an X-efficiency of 76.20%, which is the lowest efficiency in this year. Croatia has the largest X-efficiency in this year: 89.41%. The banking efficiency in non-accession countries is higher in 2002, the X-efficiency was 74.16%. Croatia had average banking efficiency (69.97% is still better than Russia (68.77%). The countries which do not have many big banks have high banking efficiency. In this dataset in 2002, Armenia is most efficient; whose X-efficiency is 80.58%. In 2003, the average X-efficiency for non-accession countries is 75.82%. Banking system in Croatia and Kazakstan are realitively efficient, and they obtain the X-efficiency: 79.25% and 82.30% respectively. Similarly, Russia obtains the lowest efficiency 71.51%. From the X-efficiency, we can know that the biggest country, Russia, always has the low efficiency. The three countries with medium financial market, Croatia, Kazakstan and Ukraine have higher efficiency, but still pretty low compared with the accession countries. These three countries have similar structure with accession countries, but have low efficiency, and this situation suggests these three countries to try to attend EU.

The average X-efficiency in this 4 years period for the accession countries is 90.34%, and the average X-efficiency in this 4 years period for the non-accession ones is

75.82%. Therefore, the Banks in the accession countries are more efficient than banks in the non-accession countries. However, the efficiency of banks in accession countries is lowered during this 4 year period.

Table 5.1 Seemingly unrelated regression (SUR) result-2000

	Accession		Non-accession					Accession	Non-accession
Para-meter	Esti-mate	t-value	Esti-mate	t-value	Para-meter	Esti-mate	t-value	Esti-mate	t-value
α_0	1.906	7.010	0.322	4.305	γ_{12}	-0.258	-3.197	0.039	0.892
α_1	0.220	0.903	0.024	0.209	γ_{13}	-0.039	-0.479	0.085	1.213
α_2	0.911	5.986	0.544	7.696	γ_{22}	0.154	0.980	0.002	0.070
α_3	0.516	2.235	0.427	3.473	γ_{23}	0.730	4.674	-0.108	-1.502
β_1	0.639	5.768	0.132	2.320	γ_{33}	-0.068	-2.570	0.387	4.835
β_2	0.136	0.667	0.041	0.428	ρ_{11}	-0.213	-3.859	-0.141	-2.502
β_3	0.768	3.251	0.774	6.130	ρ_{12}	-0.171	-1.089	-0.168	-1.952
δ_{11}	-0.239	-3.372	0.136	3.292	ρ_{13}	0.128	1.095	-0.335	-3.144
δ_{12}	0.259	3.404	-0.195	-3.946	ρ_{21}	0.096	2.251	0.032	0.905
δ_{13}	0.087	1.153	-0.126	-2.043	ρ_{22}	0.179	1.114	0.114	1.986
δ_{22}	0.060	1.615	0.098	3.877	ρ_{23}	0.140	2.957	0.374	4.375
δ_{23}	-0.248	-3.692	-0.031	-0.618	ρ_{31}	0.154	2.544	0.106	2.044
δ_{33}	0.054	1.448	0.131	4.348	ρ_{32}	-0.078	-0.928	0.025	0.551

Table 5.2 Allen Partial Elasticity of Substitution in 2000(accession countries)

Input	capital	Labor	deposit
Capital	-0.349	-5.571	0.734
Labor		0.130	8.786
deposit			-0.520

Table 5.3 Allen Partial Elasticity of Substitution in 2000(non-accession countries)

Input	capital	Labor	deposit
Capital	-0.559	1.453	1.605
Labor		-0.743	0.074
deposit			-0.337

Table 5.4 Seemingly unrelated regression (SUR) result-2001

Accession			Non-accession		Accession			Non-accession	
Accession			Non-accession						
Para-meter	Esti-mate	t-value	Esti-mate	t-value	Para-meter	Esti-mate	t-value	Esti-mate	t-value
α_0	0.863	2.243	0.148	3.127	γ_{12}	-0.018	-0.311	-0.031	-0.995
α_1	0.008	0.042	0.260	4.963	γ_{13}	-0.026	-0.398	0.043	1.065
α_2	0.559	2.080	0.512	9.568	γ_{22}	-0.108	-1.136	-0.039	-1.207
α_3	0.386	1.655	0.266	4.632	γ_{23}	0.478	3.952	0.058	0.935
β_1	0.143	1.042	0.035	0.963	γ_{33}	-0.381	-6.201	0.138	3.536
β_2	0.067	0.258	0.013	0.219	ρ_{11}	-0.075	-1.524	-0.006	-0.164
β_3	0.194	0.570	0.993	11.489	ρ_{12}	0.064	0.882	0.014	0.293
δ_{11}	0.101	1.576	0.078	2.516	ρ_{13}	0.060	0.576	-0.006	-0.109
δ_{12}	-0.239	-3.179	-0.248	-5.348	ρ_{21}	0.107	2.483	0.022	0.596
δ_{13}	-0.045	-0.509	0.003	0.052	ρ_{22}	0.153	1.916	0.140	4.251
δ_{22}	0.069	2.033	0.098	5.696	ρ_{23}	-0.248	-2.461	0.097	2.504
δ_{23}	0.100	1.212	0.078	1.980	ρ_{31}	-0.040	-1.057	-0.009	-0.302
δ_{33}	-0.002	-0.055	-0.011	-0.339	ρ_{32}	-0.208	-2.294	-0.135	-3.543
γ_{11}	0.008	0.551	-0.023	-1.712	ρ_{33}	0.210	1.739	-0.011	-0.227

Table 5.5 Allen Partial Elasticity of Substitution in 2001(accession countries)

Input	capital	Labor	deposit
Capital	-0.737	0.547	0.808
Labor		-1.447	5.607
deposit			-1.044

Table 5.6 Allen Partial Elasticity of Substitution in 2001(non-accession countries)

Input	capital	Labor	deposit
Capital	-0.737	0.649	1.323
Labor		-0.878	1.538
deposit			-0.255

Table 5.7 Seemingly unrelated regression (SUR) result-2002

Accession			Non-accession					Accession	Non-accession
Para-meter	Esti-mate	t-value	Esti-mate	t-value	Para-meter	Esti-mate	t-value	Esti-mate	t-value
α_0	0.219	3.575	0.226	4.183	γ_{12}	0.101	1.580	0.016	0.594
α_1	0.343	4.692	0.302	6.584	γ_{13}	-0.344	-8.925	-0.138	-3.359
α_2	0.179	3.819	0.396	7.858	γ_{22}	0.069	4.026	-0.004	-0.222
α_3	0.334	5.196	0.296	5.969	γ_{23}	0.105	1.383	-0.097	-2.793
β_1	0.096	1.506	0.005	0.126	γ_{33}	-0.468	-10.753	-0.271	-10.599
β_2	0.128	1.441	0.039	0.767	ρ_{11}	-0.013	-0.253	0.027	1.266
β_3	0.030	0.422	0.393	5.585	ρ_{12}	0.061	1.086	0.030	0.990
δ_{11}	0.065	2.902	0.096	6.956	ρ_{13}	0.370	6.594	0.101	2.811
δ_{12}	-0.043	-1.614	-0.312	-10.552	ρ_{21}	-0.083	-2.873	-0.017	-0.685
δ_{13}	-0.110	-2.404	0.088	2.684	ρ_{22}	0.177	3.133	0.007	0.189
δ_{22}	0.007	0.461	0.119	7.269	ρ_{23}	-0.205	-5.068	-0.023	-0.662
δ_{23}	-0.024	-0.858	0.057	2.074	ρ_{31}	0.065	1.762	0.031	1.085
δ_{33}	0.089	3.446	-0.041	-1.967	ρ_{32}	-0.289	-5.075	-0.044	-1.133
γ_{11}	0.023	0.905	-0.019	-1.386	ρ_{33}	-0.218	-4.647	-0.070	-1.772

Table 5.8 Allen Partial Elasticity of Substitution in 2002(accession countries)

Input	capital	Labor	deposit
Capital	-0.654	2.853	1.552
Labor		-0.465	1.922
deposit			-1.350

Table 5.9 Allen Partial Elasticity of Substitution in 2002(non-accession countries)

Input	capital	Labor	deposit
Capital	-0.734	1.179	0.051
Labor		-0.745	0.112
deposit			-1.269

Table 5.10 Seemingly unrelated regression (SUR) result-2003

	Accession							Non-accession	
Accession			Non-accession						
Para-meter	Esti-mate	t-value	Esti-mate	t-value	Para-meter	Esti-mate	t-value	Esti-mate	t-value
α_0	0.107	1.663	0.098	1.771	γ_{12}	0.106	1.539	0.010	0.303
α_1	0.372	4.216	0.618	9.940	γ_{13}	-0.125	-1.687	-0.024	-0.627
α_2	0.472	6.766	0.185	3.408	γ_{22}	0.072	2.349	-0.040	-1.592
α_3	0.050	0.597	0.159	2.827	γ_{23}	0.212	1.738	-0.111	-2.678
β_1	0.133	1.682	0.022	0.454	γ_{33}	-0.245	-4.106	-0.102	-3.946
β_2	0.031	0.319	0.115	1.868	ρ_{11}	0.008	0.151	0.100	2.415
β_3	0.575	4.876	0.415	6.136	ρ_{12}	0.076	0.722	0.023	0.568
δ_{11}	0.197	3.835	0.137	7.196	ρ_{13}	0.172	1.925	0.047	1.374
δ_{12}	-0.180	-3.009	-0.242	-6.282	ρ_{21}	-0.009	-0.211	-0.106	-2.497
δ_{13}	-0.157	-2.288	0.023	0.657	ρ_{22}	0.232	3.078	0.042	0.911
δ_{22}	0.058	1.665	0.080	3.260	ρ_{23}	-0.085	-1.190	0.006	0.176
δ_{23}	0.058	0.970	0.042	0.918	ρ_{31}	-0.102	-2.768	-0.016	-0.446
δ_{33}	0.017	0.430	-0.034	-1.675	ρ_{32}	-0.271	-3.287	-0.072	-1.657
γ_{11}	-0.083	-2.350	-0.003	-0.144	ρ_{33}	-0.026	-0.424	-0.005	-0.184

Table 5.11 Allen Partial Elasticity of Substitution in 2003(accession countries)

Input	Capital	Labor	deposit
Capital	-0.911	2.118	0.027
Labor		-0.462	2.966
deposit			-1.260

Table 5.12 Allen Partial Elasticity of Substitution in 2003(non-accession countries)

Input	Capital	Labor	deposit
Capital	-0.688	1.111	0.815
Labor		-0.882	0.009
deposit			-0.835

Table 5.13 Seemingly unrelated regression (SUR) result-2004

Accession			Non-accession		Accession			Non-accession	
Accession			Non-accession						
Para-meter	Esti-mate	t-value	Esti-mate	t-value	Para-meter	Esti-mate	t-value	Esti-mate	t-value
α_0	-0.415	-8.201	0.312	7.290	γ_{12}	0.066	0.732	0.024	4.027
α_1	0.131	0.571	0.005	0.114	γ_{13}	-0.053	-0.815	-0.022	-2.147
α_2	0.253	0.907	0.051	1.234	γ_{22}	-0.582	-8.546	0.044	2.849
α_3	0.733	3.117	0.077	2.168	γ_{23}	-0.271	-3.908	-0.033	-3.721
β_1	0.282	1.982	0.106	3.633	γ_{33}	-0.304	-6.463	-0.033	-1.572
β_2	0.071	0.300	0.057	1.615	ρ_{11}	0.041	0.656	0.098	5.146
β_3	0.190	1.066	0.851	17.042	ρ_{12}	0.792	7.613	-0.106	-5.230
δ_{11}	0.049	0.540	0.058	4.165	ρ_{13}	0.614	9.804	-0.032	-1.173
δ_{12}	-0.180	-1.340	0.102	3.562	ρ_{21}	-0.481	-4.718	-0.036	-2.003
δ_{13}	-0.008	-0.150	-0.075	-5.305	ρ_{22}	0.644	3.819	0.004	0.201
δ_{22}	-0.834	-9.883	-0.126	-2.677	ρ_{23}	-0.550	-4.660	0.054	2.266
δ_{23}	1.734	10.272	-0.014	-1.120	ρ_{31}	0.488	6.894	-0.053	-2.114
δ_{33}	-0.798	-11.335	-0.009	-0.464	ρ_{32}	-1.263	-13.262	0.058	3.633
γ_{11}	-0.058	-1.851	-0.066	-1.610	ρ_{33}	0.266	4.444	-0.033	-1.975

Table 5.14 Allen Partial Elasticity of Substitution in 2004(accession countries)

Input	Capital	Labor	deposit
Capital	-0.970	4.573	0.546
Labor		-2.758	1.192
Deposit			-1.519

Table 5.15 Allen Partial Elasticity of Substitution in 2004(non-accession countries)

Input	capital	Labor	deposit
Capital	-0.571	1.079	1.352
Labor		-0.387	1.065
deposit			-0.980

CHAPTER VI

CONCLUSION

In 2004, eight Central and Eastern European transition countries entered into the Europe Union, and Bulgaria and Romania will be admitted to the EU in 2007. These countries are defined as accession countries in this thesis. In order to attend EU, the accession countries have motivation to improve banking efficiency during 2000-2004 period which is the dataset utilized in this thesis. The governments in accession countries have made a series of policies to encourage the entry of foreign big banks, which will bring a lot of technology to the financial market in accession courtiers. The adoption of the new technology is supposed to improve the cost efficiency and change the cost structure of accession countries. This thesis examined the different cost structure between these two groups of countries.

After analyzing the data, we can find the different banking structure in the accession countries and non-accession countries. Accession countries have higher average scale of banks, but non-accession countries have a lot of small banks. In this thesis, the bank scale is measured by total deposit: the bank with more than 1 billion dollars' total deposit is defined as big bank, and the bank with total deposit less than 1 billion dollars is called small bank. Many non-accession countries do not have any large bank at all. Nearly every accession country has more than 1 large bank in each year. Russia is a special country in the dataset, because it owns the most of the large

banks. This thesis will compare the cost structure and banking efficiency in these two groups of countries.

In order to obtain the information for the cost structure, it is necessary to calculate Allen Partial Elasticity (AES). This thesis adopts multiproduct translog cost function, which is jointly estimated with cost share equations. The translog functional form can satisfy all the restriction for the cost function. There are 4 outputs (loans, investment, commission revenue and total deposit), and 3 input price (price of capital, price of labor and price of total deposit) including in this cost model. All the values for the outputs are real dollar values, and dataset utilized in this thesis is obtained from the bankscope for 2000-2004 period.

There are two main regression method utilized in this thesis: Seemingly Unrelated Regression (SURE) and Stochastic Frontier Approach (SFA). SURE is adopted to estimate the parameters, which is used to calculate the AES; SFA is utilized to obtain the X-efficiency to judge the banking efficiency. Chow test is also estimate to examine whether there is difference of cost structure in these two groups of countries.

All the parameters for the 3 outputs and 3 input price are positive, after running SURE test. This satisfies the homogeneity and non decreasing cost condition. The parameter for the price of deposit is always most significant in the non-accession countries, which shows that the total cost is sensitive for the interest cost in these countries. The weighted R^2 in this thesis is compatible with other studies.

The AES illustrates that all the inputs are substitute with exception for capital and labor in the accession countries, which are complements in 2001. Capital is a very strong substitute for labor in 2000, and this may be because there are many foreign big banks

entering into the accession countries at the same time. The non-accession countries have all input as substitute and the AES stay stable around 1. The accession countries only have strong substitution relation among all the three input in 2000, and after that period, the cost structure also stay the same for the accession countries. In order to test whether there is significant difference between these two groups, this thesis adopts Chow test. The empirical result shows that except 2000, the cost structures of these two groups are significantly different in 5% level.

Finally, this thesis adopts the X-efficiency to measure the banking efficiency for the accession countries and non-accession countries. The accession countries always have higher X-efficiency than non-accession countries, but both of these two groups have a trend of decreasing in the banking efficiency. After examining the banking efficiency for the individual country, we can find that the most efficient country often has a medium-size financial market, such as Czech in accession countries. The most inefficient country is often the country with the very huge financial market, which is Russia with the lowest efficiency. For the different country in the non-accession group, the author finds that Russia often has low efficiency, but the countries with middle financial market such as Croatia, Ukraine and Kazakstan have higher efficiency. These three countries have similar structure of financial market compared with accession countries, but have pretty slow efficiency. This situation illustrates the process of attending EU has a significant positive effect on the accession countries' financial market, which suggests Croatia, Ukraine and Kazakstan also attend EU to improve their financial market.

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APPENDIX

Table 6.1 Structure Test for Null Hypotheses that accession and the Non-accession countries have the same cost structure

Year	2000	2001	2002	2003
F Value	2.844	3.133	3.105	6.274

Table 6.2 X-efficiency for the accession countries and the non-accession countries

Year	accession	Non-accession
2000	93.01%	83.52%
2001	92.01%	70.65%
2002	89.92%	74.16%
2003	90.34%	75.82%

Table 6.3 X-efficiency for individual countries

Country	2000	2001	2002	2003	average
Czech	99.86%	97.44%	97.91%	94.18%	97.35%
Poland	87.40%	80.44%	96.61%	87.30%	87.94%
Romania	88.15%	93.58%	88.12%	87.66%	89.38%
Slovenia	86.20%	89.39%	82.50%	86.43%	86.13%
Slovakia	99.06%	91.05%	79.94%	91.09%	90.29%
Russia	76.20%	68.77%	71.83%	71.51%	72.08%
Ukraine	82.75%	74.06%	74.66%	79.08%	77.64%
Kazakstan	85.72%	69.16%	79.78%	82.30%	79.24%
Croatia	89.41%	69.97%	76.37%	79.25%	78.75%
Hungary	99.84%	88.02%	99.97%		95.94%
Georgia	88.88%	76.79%	66.12%		80.92%