Sample Proposal # 5

MEASURING EFFICIENCY AND PRODUCTIVITY OF BANKS

A Dissertation Proposal

Submitted to

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01. Background of the Study

Financial institutions around the world experienced substantial changes in the last few years. Technological progress, reduced information costs, severe competition among both bank and non-bank financial intermediaries and ongoing deregulation all led to substantial changes in numerous financial systems (Hoque & Rayhan, 2012). Nepal has been experiencing substantial socio-economic and political changes during the last three decades. During this period, the country experienced a radical changes in political scenarios which has ranged from absolute monarchy to constitutional monarchy and finally to federal republic. Along with the change in socio-political system, the country also adopted vigorous programmes of economic liberalization, privatization and globalization of the economy.

Nepalese financial system saw a rapid growth after the liberalization policies adopted by the nation since 1980. This growth was not only in the number of entities, but also in terms of the varieties of products and services and adoption of the newer technologies (Nepal Rastra Bank, 2017). With economic liberalization, and focus on the private sector development, some foreign banks have established as joint venture banks in Nepal and thus the Nepalese financial system has shown a tremendous growth of banking sector (Nepal Rastra Bank, 2017). By the end of mid January 2018, altogether 147 bank and financial institutions (BFIs) were in operation. Out of them, 28 were commercial banks, 36 development bank, 25 finance companies and 58 microfinance institutions. Also, the total banks branches reached to 5,592 in mid-January 2018 (Nepal Rastra Bank, 2018).

Banks play a central role in the economy. Levin (2005) argues that the efficiency of financial intermediation affects economic growth; while Caprio and Klingebiel (2003) indicate that bank insolvencies can result in systemic crises which have adverse consequences for the economy as a whole. A sound financial system is essential for a healthy and vibrant economy. The banking sector constitutes a predominant component of the financial services industry. The performance of any economy to a large extent is dependent on the performance of the banking sector. The banking sector's performance is seen as the replica of economic activities of the nation as a healthy banking system acts as the foundation of social, economic and industrial growth of a nation.

Efficiency level of bank is measured to assess how well it is doing. Efficiency can be defined as a level of performance that describes a process that uses the lowest amount of inputs to create the greatest amount of outputs (Aikeli, 2008). There are different

approaches to analyzing the efficiency and performance of financial institutions which can be broadly categorized as parametric and non-parametric (Berger & Humphery, 1997). This study will employ DEA-based Malmquist productivity index approach, a non-parametric quantitative model, for measuring the relative efficiencies of Nepalese commercial banks. Data Envelopment Analysis (DEA) is a powerful quantitative and analytical tool for measuring and evaluating performances of set of peer entities called decision making units[1] (DMUs), which convert multiple inputs into multiple outputs. From a set of available data DEA identifies the reference points (relatively efficient DMU's) that define the efficient frontier and evaluate the inefficiency of the other, interior points (relatively inefficient DMU's) that are below the frontier. (Cooper, Seiford, & Zhu, 2004)

DEA has been chosen for this study because it has proved to be a popular technique for performance analysis in general but particularly for the banking sector (Ramanathan, 2003). The banking sector has a series of characteristics that make it particularly suitable for study through DEA: the nature of its multiple inputs and outputs, the non-linearity of its input-output relationships, the non-physical nature of some resources and products, and the impossibility of drawing on market price mechanism for some of them. DEA is particularly suited to working with limited sample size (Evanoff & Israilevich, 1991), and is thus appropriate for use in Nepalese context where there are only 28 commercial banks in operation.

Though DEA is good at estimating *relative* efficiency of a DMU but it does not specifically address absolute efficiency. In other words, it tells how well the DMU is doing compared to the *peers* (set of efficient units), but not compared to a theoretical maximum.

The banking sector in Nepal is one of the most important players in the economy. The country's banks, which are public, joint venture and private, provide capital for industry, construction, tourism and trade. The banks are also the most heavily traded securities on the Nepal Stock Exchange (NEPSE). Therefore, analysis of bank achievements in terms of productivity and efficiency is important from the point of view of depositors, investors, creditors, and regulators. It is also important from the point of view of the bank's management so they can gauge their own performance and compare it against other banks. With the periodic appraisal of performance, the banks can reduce operating risk, develop growth strategy and minimize their expenses to a considerable extent. As the history of Nepalese banking sector development is relatively short and most of the commercial banks

[1] In DEA literature, the organization under study is called a DMU (Decision Making Unit).

in Nepal have established recently, it is very important to give attention towards the present status of performance measures. Therefore, the major focus of this study will be to examine how the commercial banks in Nepal are performing and to appraise their efficiency and productivity level.

02. Problem Statement

The global banking crisis of 2008 brought to the fore the importance of performance measurement of banking institutions and according to Olweny and Shipho (2011) the crisis demonstrated the importance of bank performance to both national and international economies and the need to keep it under surveillance at all the times. Apart from the regulators, bank performance is of utmost importance to other stakeholders like depositors, bank managers, and investors. Hamid and Azmi (2011) state that in a competitive financial market, bank performance will provide signal to depositors and investors alike, on whether to invest or withdraw funds from a bank. Similarly regulators around the world will use analysis of bank performance for its regulation purposes and to monitor developments or any pertinent issues to preserve the banking system stability and the financial system as a whole. At this backdrop this study will deal with the following issues:

- What is the relative efficiency level of Nepalese commercial banks?
- How much do the commercial banks differ among each other with respect to their productivity scores?
- Whether the cross sectional variables influence on the productivity and efficiency of banks?
- Do the ownership structures and size of banks affect their efficiency?

03. Objectives of the Study

The general objective of this study is to analyze the efficiencies and inefficiencies of the Nepalese commercial banks and establishing a benchmark among these companies.

The specific objectives of the study are as follows:

- To examine the relative efficiency level of Nepalese commercial banks
- To compare the productivity scores of Nepalese commercial banks
- To analyze the influence of cross sectional variables on bank efficiency and productivity
- To investigate whether the ownership structure and size of a bank affect its efficiency

04. Hypothesis

The study will test following null hypotheses to reach to the conclusion on the issues raised in research questions:

Hypothesis 1

H_0: There is no significant difference in efficiency scores among different banks based on the DEA approach.

Hypothesis 2

H_0: Ownership structure and size of a bank have no significant relationship with efficiency of banks.

Hypothesis 3

H_0: Cross-sectional variables have no significant influence on bank efficiency.

05. Rationale of the Study

By using the DEA-based Malmquist productivity index approach, this study will ascertain the change in the efficiency level of Nepalese commercial banks. In the international scenario, DEA is not a new technique to measure efficiency of any entity but it is still new in the context of Nepal and limited in research work only. So, this study will introduce new approach to measure the efficiency of banks in Nepal. The study will demonstrate how to identify relatively efficient banks among the peer banks and thus help to establish an appropriate benchmarking. The study of benchmarks and their importance will help inefficient banks move on to higher level of efficiency. The study will also identify that among different cross-sectional variables, which variables have significant influence on the efficiency of commercial banks. Similarly, it will explicitly reveal whether the joint venture banks in Nepal are more efficient than domestic private banks and public banks. More specifically, it will help to identify whether the cross-sectional variables like debt to equity ratio, deposits, paid up capital and net profit will have significant impact on the efficiency of commercial banks, and non-performing loan or not.

06. Review of the Literature

This section presents the review of various books, research studies, dissertations and journal articles. The section is divided into three sub-sections. The first sub-section deals with conceptual review, the second sub-section presents review of related studies and finally, research gap is presented at the third sub-section.

6.1 Theoretical Review

Various books, research papers, articles, dealing with theoretical aspects of bank efficiency and productivity are reviewed in this sub-section dividing into different headings.

6.1.1 Financial Institutions in Nepal

Formal banking in Nepal started with the establishment of Nepal Bank Limited in 1937 AD (Maskay & Subedi, 2009). Nepal Rastra Bank, the central bank of Nepal, was established after 29 years in the year 1956 AD. Till early 1980, Agricultural Development Bank Nepal (ADBL), Nepal Bank Limited (NBL) and Rastra Banijya Bank (RBB) were the main pillars of formal banking system in Nepal. Nabil Bank, established in 1984 AD, is the first fully private sector owned commercial bank and also the first foreign joint venture bank of Nepal.

By the end of mid July 2018, there were 28 "A" class commercial banks, 33 "B" class development banks, 25 "C" class finance companies, and 63 "D" class micro-finance development banks. The average non-performing loan (NPL) ratio of the BFIs stood at 1.66 percent in mid-April 2018 . The number of branches of BFIs stood at 6,418 in mid - June 2018. These include 2,919 branches of commercial banks, 951 of development banks, 183 of finance companies and 2,365 of microfinance institutions. On an average, population served by per branch of BFIs stood at 4,490 in mid-June 2018 compared to 5,809 a year ago. Of the total 753 local levels formed in the process of implementing federalism, commercial banks have shown their presence in 556 as of 8 July 2018. As of mid- May 2018, the number of deposit accounts stood at 22.5 million and loan accounts 1.29 million. The number of ATMs reached 2,624. Likewise, the number of mobile banking users reached 4 million and the internet banking users 784 thousand. The number of issued debit card stood at 5.24 million and credit cards 97 thousand (Nepal Rastra Bank, 2018).

6.1.2 Functions of Banks

Banks are identified by the functions they perform in the economy. They are involved in transferring funds from savers to borrowers (financial intermediation) and in paying for goods and services (Rose & Hudgins, 2008). Historically, banks have been recognized for the great range of financial services they offer - from checking accounts and savings plans to loans for businesses, consumers, and governments. However, bank service menus are expanding rapidly today to include investment banking, insurance protection, financial

planning, advice for merging companies, the sale of risk-management services to businesses and consumers, and numerous other innovative services including fintech. Banks no longer limit their service offerings to traditional services but have increasingly become general financial-service providers. Nepalese commercial banks are also offering a wide range of services to their clients by taking the advantage of recent innovations in banking sector in the international arena. They are adopting the new technology and innovations collaborating with the foreign banks through joint venture and strategic partnership.

6.1.3 Banks' Business Models

Banks' business models evolve over time in response to changes in the economic and financial environment as well as to new rules and regulations. "Just as any other firm, a bank seeks a competitive edge by exploiting its comparative advantages in terms of access to specialized resources, available market opportunities and managerial skill. The result of this effort is a business model that emphasizes some activities as opposed to others, and that is reflected, inter alia, in the bank's balance sheet composition" (Roengpitya, Tarashev, Tsatsaronis, & Villegas, 2017, p. 2). The business models that are applied in bank management are various, and by continuous innovation in this field banks strive to secure a significant competitive advantage in the market (Jatic & Ilic, 2018). Recent years have seen the strong competition in the global market and continuous seeking for the business models that could secure long-term business success to the banks. Innovations have been implemented in every segment of the banking business, and development of business models and strategies is the priority at every level of management in today's banks.

Roengpitya et al. (2017) classify banks into four business models. Two models are alternative versions of a commercial banking model, one that relies mainly on retail sources of funding and one that puts more emphasis on wholesale sources. These two models are quite stable, in the sense that the balance sheet characteristics of the typical constituent bank change little when experiment with different sets of input variables. A third model is the trading model, where banks hold larger securities portfolios funded in the interbank and wholesale markets. The fourth one is the universal model, which blends characteristics of the other three business models. Farne and Vouldis (2017) also indicate the co-existence of four distinct business models: traditional commercial, complex commercial, wholesale funded and securities holding banks. Nepalese banks are found performing wholesale and

retail banking. They do not hold significant size of securities portfolios. They invest basically in government securities with the primary motive of maintaining liquidity.

6.1.4 Concept of Productivity and Efficiency

Productivity is the ratio between an output and the factors that made it possible. Lovell (1993) defines the productivity of a production unit as the ratio of its output to its input. This ratio is easy to compute if the unit uses a single input to produce a single output. On the contrary, if the production unit uses several inputs to produce several outputs, then the inputs and outputs have to be aggregated so that productivity remains the ratio of two scalars.

Similar, but not equal, is the concept of efficiency. In the efficiency literature many authors do not make any difference between productivity and efficiency. For instance, Sengupta (1995) and Cooper, Seiford and Tone (2000) define both productivity and efficiency as the ratio between output and input.

Efficiency and productivity, anyway, are two cooperating concepts. The measures of efficiency are more accurate than those of productivity in the sense that they involve a comparison with the most efficient frontier, and for that they can complete those of productivity, based on the ratio of outputs on inputs. Providing a definition of technical efficiency, Koopmans (1951) stated that an input-output vector is technically efficient if, and only if, increasing any output or decreasing any input is possible only by decreasing some other output or increasing some other input.

6.1.5 Commonly Used Models for the Evaluation Banks Performance

6.1.5.1 Return on Equity (ROE) Model

The Return on Equity (ROE) model could be employed to analyze the bank’s profitability and to identify specific measures of credit risk, liquidity risk, operational risk and capital risk. In this model the ratios analysis is used to assess the profitability level and risk factors attached with this profitability.

6.1.5.2 CAMELS Ratings Model

CAMELS is, basically, a ratio-based model for evaluating the performance of banks. It is a model for ranking/rating of the banks. The CAMELS framework can trace its roots to 1979, when the Uniform Financial Institutions Rating System (UFIRS) was implemented in US banking institutions, and later globally, following a recommendation by the US Federal

Reserve (Bauer, Berger, Ferrier, & Humphrey, 1998). In 1996, in an effort to make the rating system more risk-focused, a sixth component relating to sensitivity to market risk was added to the CAMEL rating, making it CAMELS. This system became internationally known with the abbreviation CAMELS, reflecting six assessment areas: capital adequacy, asset quality, management efficiency, earnings performance, liquidity and sensitivity to market risk. The CAMELS system focuses on the evaluation of the banking system by examining its balance sheet, as well as, profit and loss statement, thus observing the institution's dynamic aspect (DeYoung, Flannery, Lang, & Sorescu, 2001). CAMELS employs financial ratios to assess the various elements within the CAMELS framework and based on pre-determined industry benchmarks to determine the financial soundness of financial institutions.

6.1.5.3 Capital Adequacy Measurements (Basel 1, Basel 2 and Basel 3) Model

Capital adequacy has emerged as one of the major indicators of the financial health of a banking entity. Capital adequacy and availability ultimately determine the robustness of financial institutions to shocks to their balance sheets (Evans, Leone, Gill, & Hilbers, 2000). It is important for a bank to maintain depositors' confidence and preventing the bank from going bankrupt. Thus, it is useful to track capital adequacy ratios that take into account the most important financial risks—foreign exchange, credit, and interest rate risks—including risks involved in off-balance sheet operations, such as derivative positions.

Basel 1 and Basel 2 were mainly concerned with the capital adequacy component and the minimum capital to total assets ratio. The soundness of a bank can be defined as the likelihood of a bank becoming insolvent (Greenspan, 1998). The lower this likelihood the higher is the soundness of a bank. Bank capital essentially provides a cushion against failure.

6.1.5.4 Technical Efficiency Model

Also there is another tool for measuring the efficiency, especially technical efficiency. This tool employed either the Data Envelopment Analysis (DEA) or Stochastic Frontier Analysis (SFA) to measure the relative efficiency for the institutions being evaluated.

Stochastic Frontier Analysis (SFA): It is a parametric approach which is derived from parametric linear regression and it is used to measure the relative efficiency of DMUs[2]. The

[2] In DEA literature, the organization under study is called a DMU (Decision Making Unit).

original model was proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977), and it requires an a priori assumption about the shape of the efficiency frontier.

Data Envelopment Analysis (DEA): Data envelopment analysis (DEA) is an approach to measuring the relative efficiency of a set of DMUs with multiple inputs and multiple outputs using mathematical programming. DEA is a non-parametric quantitative model which is employed for measuring the relative efficiencies of decision making units (DMUs).The first DEA model was proposed by Charnes, Cooper and Rhodes (1978) and was later named the CCR model from their acronyms (Charnes–Cooper–Rhodes). Since then, a number of DEA models have been developed and a significantly large number of applications have been reported in the DEA literature.

Malmquist Productivity Index Approach

A very useful approach for productivity measurement in DEA is the Malmquist productivity index (MPI), which was named after Professor Sten Malmquist, on whose ideas the MPI is based, and was introduced by Caves, Christensen and Diewert (1982). The MPI calculates the relative performance of a DMU at different periods of time using the technology of a base period. Fare, Grosskopf, Lindgren and Roos (1992) combined the efficiency measurement of Farrell (1957) with the productivity measurement of Caves, Christensen and Diewert (1982) to construct a DEA-based MPI and decomposed it into two broad components, one of which measures *efficiency changes* and the other measures *technical changes*. Each of these two components is further decomposed to measure the changes in efficiency of DMUs.

6.2 Review of Past Studies

This sub-section presents review of research studies carried out iin the past in the area of efficiency and productivity of banks.

Drake (2001) conducted a study on efficiency and productivity changes in the main UK banks over the period 1984 to 1995 and concluded that bank scale inefficiencies were a more severe problem than X-efficiencies[3]. Drake's Malmquist productivity indices suggested that, on the whole, UK banks exhibited positive productivity growth over the

[3] X-efficiency describes a company's ability to get the maximum output for its inputs due to competitive pressure. The concepts of X-inefficiency were introduced by Harvey Leibenstein in 1966. For more details see, Leibenstein, H. (1966). Allocative efficiency vs. X-efficiency. *American Economic Review* ***56***(3), 392–415.

period. Sathye (2002) also used Malmquist index to analyze productivity changes from 1995-1999 in a panel of 17 Australian banks to assess the effects of deregulation and the reforms introduced by the Wallis Report of 1997. Sathye found a decline of 3.1 percent in technical efficiency over the period and of 3.5 percent in the total factor productivity index, although annual productivity grew by 1.3 percent.

Using data envelopment analysis and Mamlquist total factor productivity index, Sinha and Chatterjee (2008) made comparison of fund based operating performance and total factor productivity growth of selected Indian commercial banks for the five year period 2000-01 to 2004-05. Their findings revealed that the mean technical efficiency of the private and foreign banks is somewhat higher than the public sector banks. However, public sector commercial banks exhibited higher Malmquist index than the private sector banks.

In Nepalese context, Malmquist index has been applied in very few sectors like energy (Jha, Yorino, & Zoka, 2007), and agriculture (Suhariyanto & Thirtle, 2001). In banking sector, Thagunna and Poudel (2013) used data envelopment analysis to measure and analyze efficiency levels of banks in Nepal for the period of four years from fiscal year from 2007-08 to 2010-11. The result showed that efficiency level is relatively stable and has increased in overall. Their findings did not show significant effect of the ownership type and the asset size of a bank on its efficiency. Neupane (2013) analyzed the effects of various indicators on the efficiency of the twenty two commercial banks in Nepal. He attempted to identify the change in efficiency and productivity of banking industry during the period of 2007/08 to 2011/12 using Malmquist Index as to measure the efficiency and productivity. He concluded that the productivity change of commercial banks in Nepal has improved over the sample period and that the increase in productivity change in Nepalese commercial banks is due to the technical progress rather than efficiency components. Using DEA, Pathak (2017) analyzed the post-merger operating performance of Nepalese financial institutions. His sample includes 23 merger cases of 50 banks and financial institutions, in which seven were commercial banks and the rest were development banks and finance companies. He found very small changes (statistically insignificant) in the post merger efficiencies of financial institutions.

Sharif, Hasan, Kurniasari, Hermawan, and Gunardi (2019) evaluated the technical efficiency, productivity change of financial companies listed in the Malaysian stock exchange (Bursa Malaysia) and examined the effects of productivity change on efficiency over the period 2007–2016. Data Envelopment Analysis (DEA) was utilized on a

Malmquist Productivity Index in order to calculate the financial companies' efficiency scores. The results of the study show that some firms were fully efficient. The results implied that these companies were in optimal control of their inputs or resources to generate the maximum outputs.

Erina and Erins, (2020) conducted a study with the aim to empirically evaluate cost-benefit efficiency of the banks of seven CEE states (the Czech Republic, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia) in the periods before and during the crisis, and in the period of economic recovery using Data Envelopment Analysis (DEA) method. Their findings showed that banking systems most effectively operate in Lithuania and Slovenia, while the Latvian banking system is most inefficient.

6.3. Research Gap

Though there are several studies already dealing with the efficiency of banks, recent status in this field is still to be explored. In the context of Nepal very few studies have been conducted in this field. Literature on productivity and efficiency level of banks in Nepalese context are still not adequate. This study, therefore, aims at filling this gap.

07. Research Methodology

7.1 Research Design

The study will use descriptive and causal-comparative research designs. Descriptive research design will be adopted for fact-finding and searching the adequate information about efficiency levels of commercial banks and the determinant factors of bank efficiency. It will use causal comparative research design in explaining the relationship of ownership structure and size of a bank with the efficiency of a bank. For this, the study will employ cross-sectional regression analysis by using panel data. Causal comparative research design will also be used to measure the influence of cross-sectional variable on bank efficiency.

7.2 Population and Sample, and Sampling Design

Twenty-seven commercial banks are operating in Nepal as on February 2020 (Nepal Rastra Bank, 2020). These 27 commercial banks are defined as the population of this study. By using simple random sampling method, this study will select 20 banks for the study. Lottery method will be used to select the sample. For this, first of all, the names of 27 banks will be written on separate pieces of paper of same size, shape and colour. Thus, there will be 27 names each written on a piece of paper. All of those pieces of paper will be

folded and mixed up into a bowl. Then, a blindfold selection will be made by picking a piece of paper from the bowl, recording the information to include that bank in the sample. Following the same process, 20 banks will be selected for the study.

7.3 Nature and Source of Data, and the Instrument of Data Collection

The study will be based on secondary data. The required data will be collected by visiting the head office of each sampled banks and browsing the websites of respective commercial banks and Nepal Rastra Bank (NRB). The financial data will be extracted from the income statements, balance sheets and annexes of the annual reports of each bank. The study will cover the period of ten years, that is, from the fiscal years 2009/2010 to 2018/2019.

7.4 Methods of Analysis

Descriptive as well as inferential analyses will be carried out in the process of analyzing data. Trend lines, tables, mean and standard deviation will be used for descriptive analysis. DEA analysis, correlation coefficient and regression analysis will be used for inferential analysis. Statistical package for the social sciences (SPSS), version 20 and Excel Program in computer will be used for data processing. Data will be coded and entered in the SPSS and necessary commands will be given to get the outputs. The outputs obtained in the SPSS will be copied on the excel worksheet where the tables obtained from the SPSS will be refined and then use to interpret the results. Also, necessary tables and charts will be drawn using the Microsoft Excel in order to make analysis easy. Then the tables and charts will be presented in this report along with analyses so that conclusion can be drawn. After running regression model, the t-test will be used to test the significance of null hypotheses and coefficient of independent variables in the models. Assumptions of least square estimator will be tested before running the regression models.

This study will use DEA-based Malmquist productivity index approach to examine relative efficiency of banks. There are different approaches to measure the bank efficiency by using the DEA model. This study will use input oriented model based on intermediation approach by taking the assumption of both constant return to scale (CRS) and variable return to scale (VRS). Total deposits, staff expenses, interest expenses, and operating non-interest expenses will be used as input variables and total loans and advances, interest income and operating non-interest income as output variables for the study. The study will use DEAP

version 2.1, a computer program developed by Coelli (1996) to conduct DEA. Appendix A presents the specification of DEA model.

Econometric Model

Regression will be run to find the effect of cross-sectional variables (influencing factors) on bank efficiency. The efficiency score based on CRS as well as VRS will be used as dependent variables where as leverage ratio (D/E ratio), log of net profit, loans/assets, ratio of non-performing loans, risk weighted assets, and age will be used as independent variables. Data of fiscal year 2018/2019 will be used for the regression model. The following regression model will be used:

$$Y_i = \alpha + \beta_1 LEV_i + \beta_2 LNP_i + \beta_3 LOA_i + \beta_4 NPL_i + \beta_5 RWA_i + \beta_6 AGE_i + \varepsilon_{jt.} \quad \ldots\ldots\ldots (1)$$

$$\varepsilon_{jt} = V_k + u_k$$

In the above equation Y_i is the latent variable which is efficiency based on CRS and VRS, β is the coefficient, LEV_i is the leverage ratio, LNP_i is the log of the net profit, LOA_i is the percentage of loan to total assets, NPL_i is the percentage of non-performing loans, RWA_i is the percentage of capital fund to risk weighted assets and AGE_i is the number of years bank is in operation. ε_{jt} is the disturbance term, V_k with capturing the unobserved bank specific effects and u_k is the idiosyncratic error and is independently identically distributed (i.i.d), $e_k \sim N(0,\sigma^2)$.

The LEV ratio (defined as debt to equity ratio) will be used as to measure the leverage of commercial banks. The variable is expected to take a positive sign and associated with higher efficiency as banks with appropriate leverage ratio can earn better from the debt portion. Deposits will be taken as proxy for debt and paid up capital (with reserves and retained earnings) will be used as proxy for equity. Log of net profit (LNP) will be used as to measure the relationship between the efficiency and profitability. It is expected to have positive relation with the efficiency. LOA will be used as a proxy for liquidity risk; hence, one would expect to have positive relationship between liquidity and performance (Bourke, 1989). Non-performing loan as a percentage of total loans (NPL) will be used as a proxy of credit risk. The coefficient of non-performing loans is expected to be negative as bad loans have regressive impact on bank's profitability. Capital fund to risk weighted assets (RWA) will be used as a proxy of bank's exposure to potential losses. The coefficient of RWA is

also expected to be positive as bank with higher capital fund to RWA are able to absorb higher potential losses but it may also yield negative coefficient since greater capital fund to RWA decreases financial leverage which may yield to lower interest margins and return on equity. Finally, AGE will be used as a proxy for management expertise as greater year of operation means better understanding of competition, market condition and higher goodwill. It is generally expected that commercial banks become more efficient with higher years of operation.

Likewise, regression model will also be run to examine the association of ownership structure and size of banks with their efficiency. The efficiency score based on CRS as well as VRS will be used as dependent variables where as structure of the bank (joint venture or not), and size will be used as independent variables. The values will be taken for the fiscal year 2018/19. The following regression model will be used:

$$Y_i = \alpha + \beta_1 STRUC_i + \beta_2 SIZE_i + \varepsilon_{jt.} \quad (2)$$

In the above equation Y_i is the latent variable which is efficiency based on CRS and VRS, β is the coefficient, $STRUC_i$ is the dummy variable which takes the value 0 if the bank is foreign joint venture and 1 if not, and $SIZE_i$ (used as control variable) is the log of assets for each bank i. ε_{jt} is the disturbance term. Commercial banks with foreign joint venture are expected to be more efficient than other commercial banks; hence, the coefficient of STRUC is expected to be negative. The coefficient of SIZE may be positive if banks are able to achieve economies of scale, however, the coefficient of SIZE may also be negative if the banks has higher risks due to higher diversification of assets.

7.5 Research Framework and Definition of Variables

7.5.1 Conceptual Framework

Figure 1 shows the conceptual framework of the study. It focuses on understanding the relationship between independent variables and dependent variables. The study will be built around two constructs: cross sectional variables (independent variable) and bank's efficiency (dependent variable). Bank efficiency will be measured in terms of DEA efficiency. The key cross sectional variables are Leverage ratio (LEV), Net profit (LNP), Loan/asset ratio (LOA), Non performing loan ratio (NPL), Capital adequacy ratio (WRA), and Age of the bank (AGE). The key moderating variables are – ownership structure and size of the banks. Different cross sectional variables influence bank efficiency.

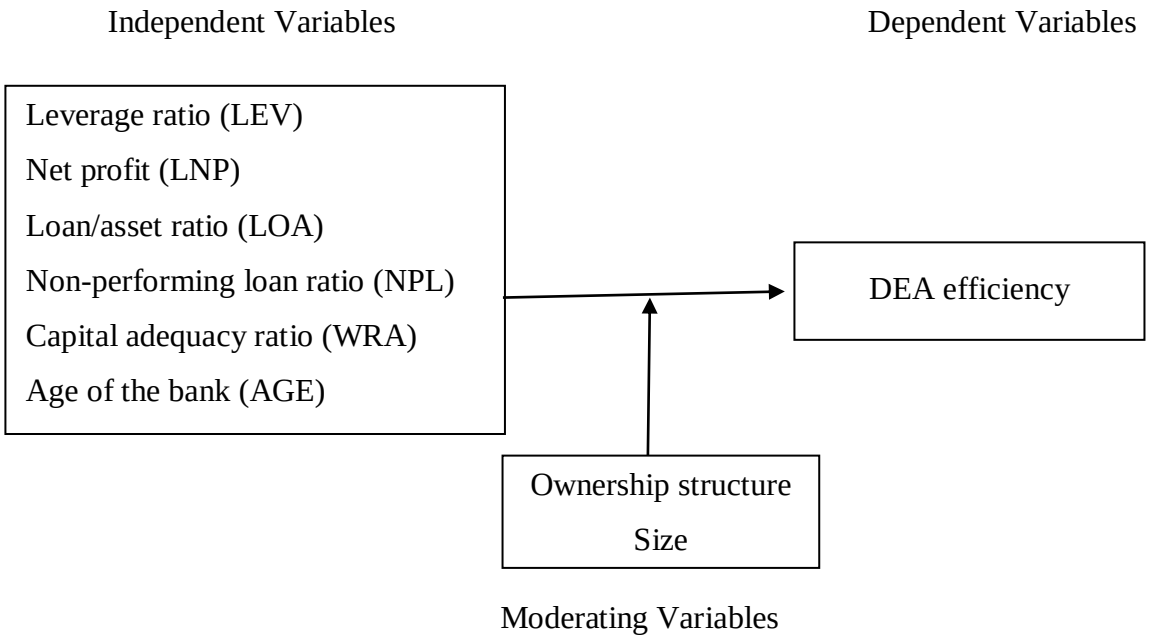

Figure 1. Schematic diagram of the relationship between cross sectional variables efficiency of banks.

7.5.2 Operational Definition of Variables

The operational definitions of the variables under study are given below:

Inputs Variables used in DEA

Total deposits: Total deposits includes all types of deposits - interest bearing deposits (saving deposits, fixed deposits, call deposits and certificate of deposits) and non-interest bearing deposits (current deposits, margin deposits and other non-interest bearing deposits). *Staff expenses*: Salary, allowances, contribution to provident fund, training expenses, uniform, medical, insurance, pension/gratuity and leave provision and other expenses made on staff comprises the staff expenses.

Interest expenses: Sum of interest paid on all interest bearing liabilities, including transactions accounts, time and savings deposits, and other borrowings, and long-term debt.

Operating non-interest expenses: Noninterest income includes all other income received by the bank as a result of its on- and off-balance-sheet activities. This is composed of personnel expense, which includes salaries and fringe benefits paid to bank employees; occupancy expense from rent and depreciation on equipment and premises; and other operating expenses, including technology expenditures, utilities, and deposit insurance premiums.

Outputs Variables used in DEA

Total loans and advances: This is the amount of total loan and advances net of loan loss provision. This amount is derived by deducting loan loss provision from gross loan and advances. This amount is taken from the assets side of the balance sheet.

Interest income: Sum of interest earned on all of a bank's assets, including loans, investment, deposits held at other institutions and money at call on short notice.

Operating non-interest income: Income from products and services offered by a commercial bank that is not earnings from lending activities. This item includes commission and discount, other operating income and exchange fluctuation income.

Cross Sectional Variables used in Regression Model

Efficiency score: This is the value derived from data envelopment analysis (DEA).

Leverage ratio (D/E ratio): The LEV ratio (defined as debt to equity ratio) is used as to measure the *leverage* of commercial banks. It is calculated dividing debt by equity. The summation of debentures and bonds, borrowings, deposits and bills payable will be taken as proxy for *debt,* and summation of paid-up capital and reserves and funds will be used as proxy for *equity*.

Net profit: Net profit is the amount of money that is left after subtracting the total expenses from the total revenue. Income before taxes and extraordinary items minus income taxes plus (or minus) extraordinary items results in the net profit for the bank

Loans and advances to total assets ratio: The loan and advances to total assets ratio will be derived dividing loan and advances by total assets. Total assets is the total of the assets side of the balance sheet of a bank. Assets include cash balance; balance with NRB; balance with banks and financial institutions; money at call on short notice; investments; loans, advances and bills purchased; fixed assets; non-banking assets and other assets.

Ratio of non-performing loans: It measures the credit risk. It will be derived dividing non-performing loan by total loans

Capital fund to risk weighted assets ratio: Capital fund to risk weighted assets (RWA) has been used as a proxy of bank's *exposure to potential losses.* This will be derived dividing capital fund by risk weighted assets.

*Ag*e: Age has been used as a proxy for *management expertise* as greater year of operation means better understanding of competition, market condition and higher goodwill. It is

generally expected that commercial banks become more efficient with higher years of operation. Age will be counted in terms of he number of years a bank is in operation.

Ownership structure: The ownership structure of the banks will be divided into public bank, joint venture bank, and private bank.

Size of banks: Total asset of the banks in their balance sheet will be considered as size of the bank. Natural logarithm value of the total assets (SIZE) will be used in the regression to minimize the non-linear relationship between the independent and dependent variables.

08. Limitations and Delimitations of the Study

This study will have following limitations:

- The authenticity of the data that will be taken from secondary source (websites) will depend on the accuracy of information provided by the websites hosts.
- Since DEA is an extreme point technique, noise (even symmetrical noise with zero mean) such as measurement error can cause significant problems.
- DEA is good at estimating *relative* efficiency of a DMU but it does not specifically address *absolute* efficiency.
- This study will use data envelopment analysis (DEA) to assess the efficiency and productivity of commercial banks. Other techniques like traditional ratios, CAMELS rating systems and balanced scorecard will not be used.
- Only internal factors affecting the performance and efficiency of the commercial banks will be considered. Emphasis or consideration will not be given to the external factors affecting the performance and efficiency of the commercial banks.
- It will analyze only efficiency and productivity aspects of the performance. Other aspects such as profitability, liquidity and capital adequacy will not be analyzed.
- It will cover only commercial banks. Other financial institutions like development banks and finance companies will not be considered for the study.

9. Organization of the Study

This study will be organized into five chapters. The first chapter will deal with the general introduction of the study including general background, problem statement, objectives of the study, hypothesis, rational of the study, limitations of the study and organization of the study. The second chapter will include theoretical review, review of literature of studies conducted in global context as well as the in Nepalese context. This chapter will be closed with research gap. The third chapter will focus on the research methodology including research design, population and sampling procedure, nature and

sources of data, research framework and operational definition of variables, and methods of analysis. Chapters four will focus on the presentation and analysis of data. This chapter will be divided into two sections, namely, results and discussion. Finally, chapter five will provide a summary, conclusion and implications. The summary section will provide an overview on all works carried out in chapter one through four including major findings derived from the study. The second section of this chapter will present the conclusion drawn from the findings of the study. This chapter will also include a separate section describing implication of the study as well as the scope for future research based on major findings of the study

09. Work Plan

The major activities plan for the proposed study is given in Table 1:

Table 1

Tentative Work Plan for the Study

Activities	Time in months					
	1	2	3	4	5	6
Literature review and refining research design						
Data collection						
Processing, classification and tabulation data						
Analysis of the data						
Report writing						
Typing, binding and submission						

10. Budgeting

The estimated expenditure for the research project is given in Table 2.

Table 3

Estimated Expenditure for the Research Project

S. No.	Activities	Cost (in rupees)
1.	Stationary	1,000
2.	Books and journals purchase and photocopy of reading materials	3,300
3.	Field visits for data collection (travelling, accommodation and food)	5,300
4.	Report printing, photocopying, and binding	2,300
5.	Miscellaneous	1,000
	Total Budget	**12,900**

In words, rupees twelve thousand nine hundred only.

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Appendix A: Specification of DEA Model

The characteristics of DEA can be described through the original model developed by Charnes, Cooper and Rhodes (1978). Consider *N* units (each is called a DMU) that convert *I* inputs into *J* outputs, where *I* can be larger, equal or smaller than *J*. To measure efficiency of this converting process for a DMU, Charnes et al. (1978) propose the use of the maximum of a ratio of weighted outputs to weighted inputs for that unit, subject to the condition that the similar ratios for all other DMUs be less than or equal to one. That is,

$$\text{Max } e^0 = \frac{\sum_{j=1}^{J} u_j^0 y_j^0}{\sum_{i=1}^{I} v_i^0 x_i^0} \qquad \text{(A1)}$$

Subject to

$$\frac{\sum_{j=1}^{J} u_j^0 y_j^n}{\sum_{i=1}^{I} v_i^0 x_i^n} \le 1;\ n = 1,\ldots,N;\ v_i^0, u_j^0 \ge 0;\quad i = 1,\ldots,I;\ j = 1,\ldots,J. \qquad \text{(A2)}$$

where y_j^n, x_j^n are positive known outputs and inputs of the *n*th DMU and v_i^0, u_j^0 are the variable weights to be determined by solving Model 1. The DMU being measured is indicated by the index 0, which is referred to as the base DMU. The maximum of the objective function e^0 given by Model 1 is the DEA efficiency score assigned to DMU^0. Since every DMU can be DMU^0, this optimization problem is well defined for every DMU. If the efficiency score $e^0 = 1$, DMU^0 satisfies the necessary condition to be DEA efficient; otherwise it is DEA inefficient.

It is difficult to solve Model 1 as stated, because the objective function is non-linear and fractional. Charnes et al. (1978), however, transformed the above non-linear programming problem into a linear one as follows:

$$\text{Max } h^0 = \sum_{j=1}^{J} u_j^0 y_j^0 \qquad \text{(A3)}$$

Subject to

$$\sum_{i=1}^{I} v_i^0 x_i^0 = 1, \quad \sum_{j=1}^{J} u_j^0 y_j^n - \sum_{i=1}^{I} v_i^0 x_i^n \le 0; \qquad \text{(A4)}$$

$$n = 1,\ldots,N;\ v_i^0 \ge \varepsilon;\ u_j^0 \ge \varepsilon;\ i = 1,\ldots,I;\ j = 1,\ldots J.$$

The variables defined in Model 2 are the same as those defined in Model 1. An arbitrarily small positive number, ε is introduced in Model 2 to ensure that all of the known inputs and outputs have positive weight values and that the optimal objective function of the dual problem to Model 2 is not affected by the values assigned to the dual slack variables in computing the DEA efficiency score for each DMU. The condition $h^0 = 1$ ensures that the base DMU^0 is DEA efficient; otherwise it is DEA inefficient, with respect to all other DMUs in the test. A complete DEA model involves the solution of *N* such problems, each for a base DMU, yielding *N* different (v_i^n, u_j^n) weight sets. In each program, the constraints are held constant while the ratio to be maximized is changed. Finally, these DEA problems are solved in the paper using the computer software. There are a number of software options for running DEA. This study will use DEAP software version 2.1 developed by Coelli (1996) to measure the relative efficiency of DMUs.