THE IMPACT OF THE ECONOMY IN BANKING PERFORMANCE IN ASEAN

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WEEK 2

JUNE 13, 2024

LITERATURE REVIEW

DEA APPROACH

1. Banking Sector Performance in Latin America: Market Power versus Efficiency
2. Do safe banks create safe systems?
3. Measuring the Efficiency in the Lithuanian Banking Sector: The DEA Application
4. Measuring Bank Performance of Nepali Banks: A Data Envelopment Analysis (DEA) Perspective
5. The impact of internet banking on the performance of Romanian banks: DEA and PCA approach
6. An empirical analysis of iran's banking performance
7. Financial performance of rural banks in Indonesia: A two-stage DEA approach
8. Measuring Taiwanese bank performance: A dynamic network DEA approach

OTHER APPROACH

1. The impact of the banking system reform on banks performance
2. The Determinants of Banking Performance in Front of Financial Changes: Case of Trade Banks in Tunisia
3. Banking sector performance and economic growth: evidence from Southeast European countries
4. IMPACT OF BANKING CONSOLIDATION ON THE PERFORMANCE OF THE BANKING SECTOR IN NIGERIA
5. The Impact of Internet Banking on Bank Performance and Risk: The Indian Experience
6. Financial Banking Performance of ASEAN-5 Countries in the Digital Era

LITERATURE REVIEW DEA APPROACH

BANKING SECTOR PERFORMANCE IN LATIN AMERICA: MARKET POWER VERSUS EFFICIENCY

PURPOSE

whether banks in Latin America earn higher profits due to market power or because they are more efficient.

METHOD

1. Data Envelopment Analysis (DEA) to measure bank efficiency
2. panel data regression model

DATA

2500 Banks in 9 Latin American countries over 1997-2005
1. BankScope
2. International Financial Statistics (IFS)

INPUT

1. Personnel Expenses
2. Interest Expenses
3. Non-interest expenses
4. Other operating expenses

OUTPUT

1. Total loans
2. Other earning assets (non-lending activities)

CONCLUSION

1. Banks in Latin America achieve higher profits primarily due to efficiency gains rather than market power.
2. The study also highlights the significance of capital ratios and bank size in explaining profitability, with larger banks and those with higher capital ratios being more profitable..

DO SAFE BANKS CREATE SAFE SYSTEMS?

PURPOSE

The study aims to determine whether relatively stable CEE banks, operating in an unstable global environment, are negatively affected by the new European regulatory framework introduced after the 2008 financial crisis.

METHOD

1. Nonparametric Data Envelopment Analysis (DEA)
- CCR
- BCC
2. Competitive conditions' measures (H-statistics)
3. Z-score index

DATA

Bankscope database, covering the period from 2002 to 2011. The study focuses on banks in five CEE countries: Poland, Hungary, Czech Republic, Slovakia, and Slovenia.

INPUT

1. Personnel Expenses
2. Total Fixed assets
3. Interest Expenses

OUTPUT

1. Total loans net
2. Liquid assets
3. Total deposits

CONCLUSION

The study concludes that the 2008 financial crisis affected CEE banks to a lesser degree than those in more developed countries. CEE banks, having entered the crisis in good shape due to prior restructuring and dynamic growth, emerged relatively unscathed and did not require fundamental restructuring

MEASURING THE EFFICIENCY IN THE LITHUANIAN BANKING SECTOR: THE DEA APPLICATION

PURPOSE

The purpose of this study is to examine the efficiency of banks in Lithuania.

METHOD

DEA technique with variable returns to scale (VRS) and constant returns to scale (CRS) assumptions.

DATA

The data used in this study covers the period from 2012 to 2016. It includes information on various Lithuanian banks, particularly focusing on local banks and those owned by the Nordic parent group and branches.

INPUT

M1 Deposits
M2 Labor Expenses
M3 Deposits Debts ti banks and other credit institutions
M4 Deposits
M5 Deposits

OUTPUT

M1 Operating profit
M2 Loans
M3 Profit before tax
M4 Loans
M5 Net interest income

CONCLUSION

1.Under the VRS assumption, local banks demonstrate better efficiency results.
2. Under the CRS assumption, banks owned by the Nordic parent group and branches show higher pure efficiency and success at working at the right scale. The larger Lithuanian banks (subsidiaries) applied a more appropriate business model compared to smaller (local) banks during the study period.

MEASURING BANK PERFORMANCE OF NEPALI BANKS: A DATA ENVELOPMENT ANALYSIS (DEA) PERSPECTIVE

PURPOSE

Develop a performance model for measuring relative efficiency and potential improvement capabilities of Nepali banks

METHOD

DEA

DATA

The data for this study were obtained from the annual reports of the respective banks. The data covers the period from 2007-08 to 2010-11.

INPUT

M1 Total Deposits
M2 Interest Expenses
M3 Operating non-interest expense

OUTPUT

M1 Total Loans
M2 Interest Income
M3 Operating non-interest income

CONCLUSION

1. The study concludes that the efficiency level of Nepali banks is relatively stable and has increased overall.
2. It finds no significant relationship between the efficiency levels and the ownership structure or asset size of the banks.
3. The study also identifies that nine out of 21 banks analyzed were found to be relatively efficient in the year 2010-11. Additionally, it points out that deeper analysis of DEA results can help pinpoint the causes of inefficiency, which can assist banks in improving their performance.

THE IMPACT OF INTERNET BANKING ON THE PERFORMANCE OF ROMANIAN BANKS: DEA AND PCA APPROACH

PURPOSE

The study seeks to understand whether internet banking affects the overall performance and efficiency of banks in Romania. .

METHOD

DEA and PCA approach

DATA

The data was collected from the annual reports of the banks in the sample, the Bureau Van Dijk Bankscope, and Alexa.com databases for the year 2010. The sample includes 24 banks that account for 95.2% of the total banking assets in Romania.

INPUT

1. Deposits
2. Total operating costs
3. Number of employees
4. Value of owned equipment and software programs

OUTPUT

1. Net total revenues
2. Daily "reach" average rate (percentage of average internet users that have visited the bank's site in a year)

CONCLUSION

The study concludes that internet banking has a significant impact on the efficiency of Romanian banks. The study suggests that encouraging the use of internet banking can lead to greater efficiency and cost savings for banks.

AN EMPIRICAL ANALYSIS OF IRAN'S BANKING PERFORMANCE

PURPOSE

The purpose of this paper is to investigate the efficiency and productivity growth of the Iranian banking industry

METHOD

The study uses a new decomposition of the Hicks-Moorsteen total factor productivity (TFP) index developed by O'Donnell to analyze efficiency and productivity changes in a banking context. This approach is preferred over the constant-returns-to-scale Malmquist productivity index because it does not rely on assumptions about firms' optimizing behavior, market structure, or returns to scale. The study assumes that the production technology exhibits variable returns to scale (VRS).

DATA

The data used in the study were obtained from the Central Bank of Iran's (CBI) archives. The dataset includes balanced panel data for 14 banks over six years (2003-2008).

INPUT

M1 labour, measured by the number of full-time equivalent employees on the payroll at the end of each period
M2 physical capital, measured by the book value of premises and fixed assets
M3 purchased funds, including all time and savings deposits and other borrowed funds(not including demand deposits)

OUTPUT

M1 demand deposits
M2 state-owned sector loans
M3 non-state-owned loans

CONCLUSION

The results suggest that government regulations led to large advances in the production possibilities set but also exacerbated scale inefficiencies. The paper recommends that the Iranian government reconsider its regulatory measures to enhance the independence and efficiency of state-owned banks, possibly through privatization and improved management practices.

FINANCIAL PERFORMANCE OF RURAL BANKS IN INDONESIA: A TWO-STAGE DEA APPROACH

PURPOSE

This study aims to analyze the efficiency performance of conventional and Islamic rural banks in Indonesia, specifically, Bank Perkreditan Rakyat (BPR) and Bank Pembiayaan Rakyat Syariah (BPRS)

METHOD

1. DEA
- CCR
- BBC
with variable return to Scale (VRS)
2. Regression model to identify factors affecting the efficiency scores obtained from the DEA

DATA

financial statements of BPR and BPRS for the last five years starting from 2013 TO 2017 which have been available on the pages of the financial services authority

INPUT

Production
1. Interest/margin/profit sharing from third-party fund
2. Expenses for Allowance for Earning Assets
3. Administrative and General Expenses
4. Non-operational expenses
5. Other expenses

Intermediation
1. Capital
2. Savings
3. Time Deposits
4. Bank Loans

OUTPUT

Production
1. Receipt of interest/margin/profit sharing from loans disbursed
2. Other revenue

Intermediation
Loans/financings disbursed

CONCLUSION

The study concludes that both BPRs and BPRS are still inefficient in their intermediary roles, although they are efficient in their production aspects. The capital adequacy ratio (CAR) significantly impacts the technical efficiency in both approaches. The location of the banks also plays a role, with those in cities having higher potential for efficiency. The paper highlights that inefficiencies in intermediation are accompanied by production success, suggesting a trade-off between these functions in microfinance institutions. Recommendations for further research include examining the profiles of fund recipients and addressing the issues not covered by the current model, such as banking crimes and technological innovations

MEASURING TAIWANESE BANK PERFORMANCE: A DYNAMIC NETWORK DEA APPROACH

PURPOSE

The purpose of this paper is to assess the dynamic performance of Taiwanese banks, including both financial holding company (FHC) and non-FHC banks..

METHOD

The method employed in this paper is the 2S-SBM-DNDEA model.

DATA

The data used in this paper comes from the operational records of Taiwanese banks over the period from 2008 to 2016.

INPUT

The inputs in this study are derived from the operational data of the banks, focusing on resources allocated to deposit and lending activities. These include various financial metrics that represent the bank's resources and operational expenses.

OUTPUT

The outputs are the operational performance measures, such as deposit efficiency and lending efficiency, which reflect how well the banks utilize their inputs to generate desired outcomes. The model also considers undesirable outputs like non-performing loans.

CONCLUSION

1. It suggests that improving deposit efficiency is crucial for overall performance improvement.
2. The study also finds that non-FHC banks generally outperform FHC banks in terms of deposit and lending efficiencies.

LITERATURE REVIEW OTHER APPROACH

THE IMPACT OF THE BANKING SYSTEM REFORM ON BANKS PERFORMANCE

PURPOSE

Analyze the impact of the banking system reform on the bank performances at the level of
5 states in Central and Eastern Europe
Banks in Bulgaria, Romania, Poland, Hungary and Slovakia

METHOD

Regression analysis
GMM
Fixed effect

DATA

1. Annual reports of the bank
2. the Fitch IBCA's BankScope database
3. World Bank
4. European Central Bank
5. European Bank for Reconstruction and Development

INDEPENDENT

1. Financial Reform indexes
2. Bank specific variables
3. Banking system specific variables
4. Macroeconomic variables

DEPENDENT

Bank Performance indexes
- cost of intermediation
- operational performance
- bank profitability

CONCLUSION

1. Financial reform has a positive impact on the bank performance indexes (+)
2. Indexes regarding bank reform have a positive impact on the bank performance indexes (+)

THE DETERMINANTS OF BANKING PERFORMANCE IN FRONT OF FINANCIAL CHANGES: CASE OF TRADE BANKS IN TUNISIA

PURPOSE

This paper studies the internal and external determinants of bank performance in Tunisia during the period after financial reform

METHOD

Regression analysis

DATA

1. Tunisian Professional association of Banks and Financial institutions and the central Bank of Tunisia
2. Statistics of the National Institute of Statistics
3. World Bank

INDEPENDENT

1. size of the bank
2. score of effciency
3. The capital average ratio
4. Risk Index
5. Concentration index of the banking sector
6. Binary variable taking the value 1 if the bank is privatized the year t and 0 if not
7. Binary variable taking the value 1 if the bank is quoted the year t and 0 if not
8. Business cycle measured by the variation of GDP
9. Inflation rate

DEPENDENT

Performance of Bank i at year t

CONCLUSION

1. The bank performance is positively related to capitalization, privatization and quotation (+)
2. Bank Size, concentration index and efficiency are negatively related to performance indicators (-)

BANKING SECTOR PERFORMANCE AND ECONOMIC GROWTH: EVIDENCE FROM SOUTHEAST EUROPEAN COUNTRIES

PURPOSE

The study aims to understand how banking efficiency contributes to overall economic growth, taking into account additional factors such as human capital, investment, and trade openness.

METHOD

Dynamic panel generalized method of moments (GMM)

DATA

1.Banking Performance Data: Financial Development and Structure Dataset (updated in September 2015) and World Bank.
2.Economic Growth Data: World Development Indicators (WDI) of the World Bank.
3.Human Capital, Trade Openness, Investment, and Government Expenditure Data: World Development Indicators (WDI) of the World Bank.
4.Institutional Quality Data: World Governance Indicators (WGI)

INDEPENDENT

1. Banking performance indicators (ROE,ROA)
2. Human Capital
3. Infrasture Quality
4. Investment
5. Trade Openness
6. Inflation
7. Government Expenditure

DEPENDENT

Economic Growth (GDP Growth Rate)

CONCLUSION

- The study concludes that banking sector performance has a positive and significant impact on economic growth in the thirteen Southeast European countries examined. The results indicate that an effective and efficient banking system is a major determinant of economic growth in these countries. Additionally, the study finds that human capital, investment, and trade openness also have positive and significant effects on economic growth. The findings suggest that policymakers should focus on fostering a robust banking system and enhancing human capital and trade openness to promote economic growth in Southeast European countries.

IMPACT OF BANKING CONSOLIDATION ON THE PERFORMANCE OF THE BANKING SECTOR IN NIGERIA

PURPOSE

The purpose of this paper is to examine the performance of the Nigerian banking sector before and after the banking consolidation exercise that took place in 2005.

METHOD

The study employs a quantitative research technique based on an ex-post facto design. Secondary data on key performance indicators were collected for the period 1996-2014. Analytical techniques used include descriptive statistics and independent sample t-tests to determine significant differences in banking sector performance between the pre- and post-consolidation periods.

DATA

The data for this study were sourced from the annual reports of the Nigeria Deposit Insurance Corporation (NDIC) and the Central Bank of Nigeria (CBN).

INDEPENDENT

the independent variable in this study is the period of banking sector performance, categorized into two groups
- Pre-consolidation period (1996-2004)
- Post-consolidation period (2006-2014)

DEPENDENT

Performance indicators
1. non-performing loans ratio (asset quality)
2. return on assets (profitability)
3. capital adequacy ratio (long-term liquidity)
4. liquidity ratio (short-term liquidity
5. loans and advances ratio (credit delivery)
6. banking sector assets ratio (bank size).

CONCLUSION

The study concludes that banking consolidation significantly impacted the performance of the Nigerian banking sector. The findings are as follows:
- There was a significant improvement in asset quality, as indicated by a reduction in non-performing loans.
- Capital adequacy ratio and loans and advances to economic agents showed significant increases, supporting the notion that higher equity capital enhances lending capacity
- There was no significant difference in return on assets, liquidity ratio, and banking sector assets ratio between the pre and post consolidation periods

THE IMPACT OF INTERNET BANKING ON BANK PERFORMANCE AND RISK: THE INDIAN EXPERIENCE

PURPOSE

It aims to examine the impact of Internet banking on banks' performance and risk by analyzing financial data from Indian banks.

METHOD

Multiple Regression

DATA

1. The data for this study was obtained from the financial statements and income-expense reports of banks submitted to regulators and banking associations
2. Survey from bank website

INDEPENDENT

1.Adoption of Internet banking (dummy variable indicating whether the bank has adopted Internet banking)
2.Size (total assets)
3. Equity
4. Loans
5. operational costs
6. non-interest income
7. demand and saving deposits
8. spread (net interest margin).

DEPENDENT

1.Bank performance measures
- Return on Assets
- Return on Equity

2.Risk measure
- Net Non-Performing Assets

CONCLUSION

the adoption of Internet banking has a negative and significant impact on the profitability of private sector banks, particularly new private sector banks. On the other hand, Internet banking has helped reduce the risk profile of banks, as evidenced by lower Net Non-Performing Assets ratios. (-)

FINANCIAL BANKING PERFORMANCE OF ASEAN-5 COUNTRIES IN THE DIGITAL ERA

PURPOSE

compare the banking financial performance in Indonesia, Singapore, Malaysia, Thailand, and the Philippines during the period 2012-2017

METHOD

1.one-way ANOVA
2.panel regression analysis

DATA

Websites of each bank (21 banks)

INDEPENDENT

1. Information completeness in digital banking
2. Digital banking index
3. Number of internet banking users
4. Amount of credit channelled by the bank
5. Funding from third parties

DEPENDENT

Net Interest Margin (NIM)

CONCLUSION

The study suggests that the impact of digital banking on bank performance can increase with further development and refinement of digital banking systems in the ASEAN region.

WHAT I WANT TO STUDY

THE IMPACT OF THE ECONOMY IN BANKING PERFORMANCE IN ASEAN COUNTRIES DEA APPROACH (OR SELECT ONLY 5 COUNTRIES WITH THE HIGHEST GDP)

ASEAN stands for the Association of Southeast Asian Nations. It's a group of ten countries in Southeast Asia that work together on various issues.

1. Brunai
2. Cambodia
3. Indonesia
4. Laos
5. Malaysia
6. Myanmar
7. Philippines
8. Singapore
9. Thailand
10. Vietnam

WHY

Understanding Economic Influence: This project will help understanding how economic factors like GDP growth, inflation, and unemployment rates affect banking performance. This knowledge is crucial for predicting banking trends and making informed financial decisions.

Regional Significance: ASEAN countries are a significant part of the global economy. Analyzing these countries provides insights into emerging markets, which are often seen as high-potential areas for investment and growth

NEXT STEPS

1. Study more about ASEAN Economics
2. Study about the approach DEA

WEEK 3

JUNE 20, 2024

ASEAN ECONOMY

The Association of Southeast Asian Nations (ASEAN) is a regional intergovernmental organization comprising ten Southeast Asian countries. Established on August 8, 1967, ASEAN aims to promote political and economic cooperation and regional stability among its members.

Objectives of ASEAN

1. **Economic Growth**: Accelerate economic growth, social progress, and cultural development in the region.
2. **Peace and Stability**: Promote regional peace and stability through adherence to principles of the United Nations Charter.
3. **Collaboration and Assistance**: Enhance cooperation in economic, social, cultural, technical, educational, and other fields.
4. **Regional Cooperation**: Maintain close and beneficial cooperation with existing international organizations.

Economic Significance

1. **Population**: Over 650 million people, making it one of the most populous regions in the world.
2. **Economy**: Combined GDP of approximately $3 trillion, making ASEAN one of the largest economic regions globally.
3. **Diversity**: Comprises diverse economies, from highly developed Singapore to developing nations like Cambodia and Laos.

Challenges and Opportunities

1. **Financial Inclusion**: Varying levels of access to banking services across countries
2. **Technological Adoption**: Differences in the adoption of banking technologies and digital banking services.
3. **Regulatory Differences**: Understanding how different regulatory frameworks impact banking performance and efficiency.

ASEAN (10 COUNTRIES)

DATA

1. Brunai
2. Cambodia
3. Indonesia
4. Laos
5. Malaysia
6. Myanmar
7. Philippines
8. Singapore
9. Thailand
10. Vietnam

3 Banks from each country

Total = 30 Banks

Might be hard to find data (political problem and reporting standard)

Easier to access data because of better reporting standards

RATIONALE FOR USING DEA IN ASEAN BANKING PERFORMANCE ANALYSIS

1. Efficiency Measurement
DEA allows for the measurement of relative efficiency among banks, considering multiple inputs and outputs. This is particularly useful for comparing banks across countries with different economic and regulatory environments.

2. Benchmarking
Identifies best-performing banks and provides benchmarks for other banks to improve their operations.

3. Resource Utilization
Helps understand how well banks utilize their resources and what factors contribute to their efficiency or inefficiency.

4. Policy Implications
Provides insights for policymakers to design regulations that enhance banking sector performance and financial stability.

TO MEASURE BANK EFFICIENCY

USE 2 STAGE DEA APPROACH

1. USE DEA TO CALCULATE EFFICIENCY SCORES (CCR MODEL AND BCC MODEL)

1.1 The CCR model is used when assuming constant returns to scale, making it appropriate for situations where size and scale do not impact efficiency.

1.2 The BCC model allows for variable returns to scale, making it suitable for situations where the scale of operations significantly impacts efficiency.
1.3 Slack based measure
Applying 2 approaches
- **Intermediation** assumes that the company's activities transform money borrowed from surplus funds to the deficit
- **Production** assumes that the company as a producer generates savings and loan accounts

2. USE TOBIT REGRESSION TO ADJUST THESE SCORES FOR ENVIRONMENTAL FACTORS

CCR AND BCC

Input-Oriented CCR Model	Input-Oriented BCC Model
$\text{Max } \theta_0 = \sum_{j=1}^{m} u_j y_{j0}$	$\text{Max } \theta_0 = \sum_{j=1}^{m} u_j y_{j0} + u_0$
subject to $\sum_{i=1}^{s} v_i x_{i0} = 1$	subject to $\sum_{i=1}^{s} v_i x_{i0} = 1$
$\sum_{j=1}^{m} u_j y_{jk} - \sum_{i=1}^{s} v_i x_{ik} \leq 0$	$\sum_{j=1}^{m} u_j y_{jk} - \sum_{i=1}^{s} v_i x_{ik} + u_0 \leq 0$
$v_i \geq 0,\ u_j \geq 0,\ u_0$ free in sign	$v_i \geq 0,\ u_j \geq 0,\ u_0$ free in sign

$x_{ik} = the\ observed\ amount\ of\ input\ of\ the\ i\ type\ of\ the\ k\ DMU$

$y_{jk} = the\ observed\ amount\ of\ output\ of\ the\ j\ type\ of\ the\ k\ DMU$

$u = weight\ of\ output$

$v = weight\ of\ input$

WEIGHT = Decision variables for the DEA model so we put weight restrictions as constraints in the model

INPUT AND OUTPUT

INPUT Definition: Inputs in DEA are the resources consumed by a Decision-Making Unit (DMU) to produce outputs. These are quantifiable factors that are utilized in the production process and are considered necessary for generating outputs.

OUTPUT Definition: Outputs in DEA are the goods or services produced by a Decision-Making Unit (DMU) as a result of utilizing inputs. These are the quantifiable results of the production process, representing the achievements or accomplishments of the DMU

INPUT AND OUTPUT

Approach	Input	Output
Production	1. Interest 2. Expenses for Allowance 3. Administrative and General Expenses 4. Non-operational expenses 5. Other expenses	1. Receipt of interest/margin/profit sharing from loans disbursed 2. Other revenue
Intermediation	1. Capital 2. Savings 3. Time Deposit 4. Bank Loans	Loans/Financings disbursed Use more than 1 output

TOBIT REGRESSION

TOBIT REGRESSION IS OFTEN USED IN THE SECOND STAGE OF DEA FOR THE FOLLOWING REASONS:

1. Adjusting for External Influences
DEA efficiency scores reflect how well a decision-making unit (DMU) converts inputs into outputs. However, these scores can be influenced by external environmental factors that are beyond the control of the DMUs, such as economic conditions, regulatory environments, and market competition. Tobit regression helps to account for these external factors, allowing for a more accurate comparison of DMU performance.

2. Handling Censored Data
DEA efficiency scores are inherently censored between 0 and 1. This means that traditional regression methods like Ordinary Least Squares (OLS) may not be appropriate, as they can predict values outside this range. Tobit regression is specifically designed to handle such censored data, providing more reliable and meaningful results.

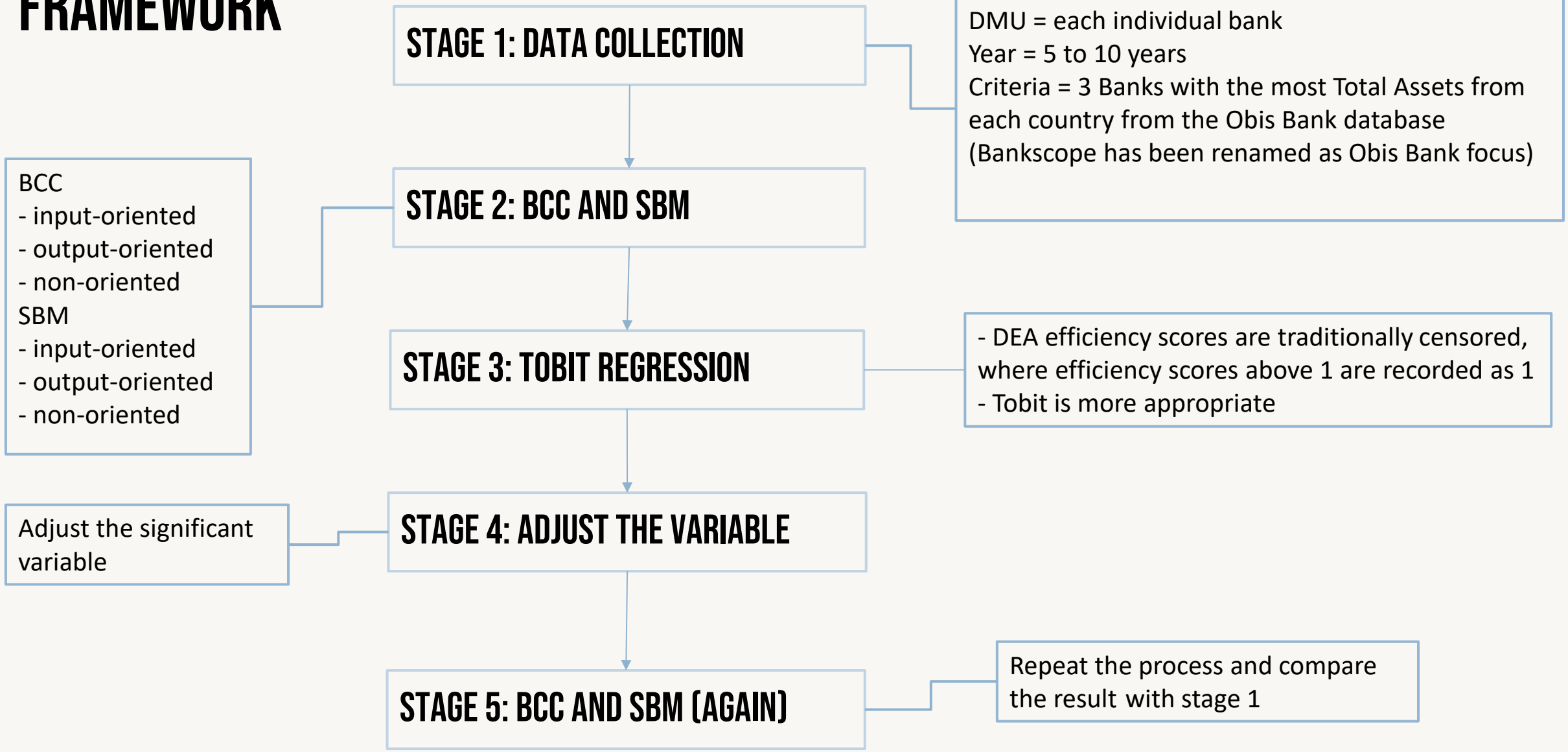
NEXT STEPS

1. Explore Data
2. Study about the method more

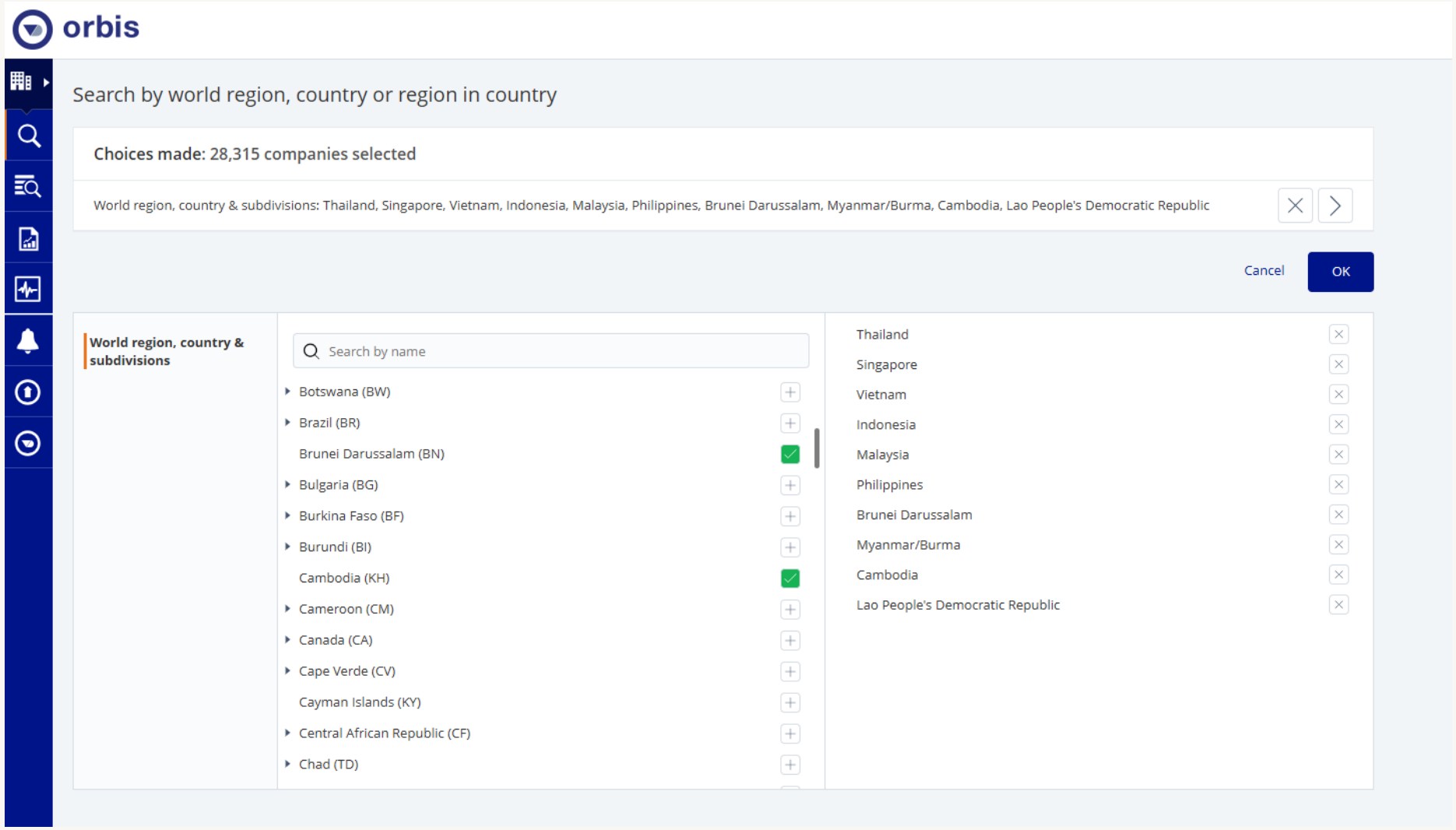
WEEK 4

JUNE 27, 2024

FRAMEWORK


STAGE 1: DATA COLLECTION
DMU = each individual bank
Year = 5 to 10 years
Criteria = 3 Banks with the most Total Assets from each country from the Obis Bank database (Bankscope has been renamed as Obis Bank focus)
STAGE 2: BCC AND SBM
BCC
- input-oriented
- output-oriented
- non-oriented
SBM
- input-oriented
- output-oriented
- non-oriented
STAGE 3: TOBIT REGRESSION
- DEA efficiency scores are traditionally censored, where efficiency scores above 1 are recorded as 1
- Tobit is more appropriate
STAGE 4: ADJUST THE VARIABLE
Adjust the significant variable
STAGE 5: BCC AND SBM (AGAIN)
Repeat the process and compare the result with stage 1

DATA COLLECTION



BCC WITH VARIABLE RETURNS TO SCALE (VRS)

Input-Oriented BCC Model

The input-oriented BCC model focuses on minimizing inputs while maintaining the current level of outputs.

Maximize θ

Subject to:

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io}, \quad i = 1, \ldots, m$$
$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro}, \quad r = 1, \ldots, s$$
$$\sum_{j=1}^{n} \lambda_j = 1$$
$$\lambda_j \geq 0, \quad j = 1, \ldots, n$$

Output-Oriented BCC Model

The output-oriented BCC model focuses on maximizing outputs while keeping the inputs at their current levels.

Minimize ϕ

Subject to:

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_{io}, \quad i = 1, \ldots, m$$
$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq \phi y_{ro}, \quad r = 1, \ldots, s$$
$$\sum_{j=1}^{n} \lambda_j = 1$$
$$\lambda_j \geq 0, \quad j = 1, \ldots, n$$

Non-Oriented BCC Model

The non-oriented BCC model considers both input and output orientations simultaneously.

Maximize $\sum_{r=1}^{s} \mu_r y_{ro}$

Subject to:

$$\sum_{i=1}^{m} \nu_i x_{io} = 1$$
$$\sum_{i=1}^{m} \nu_i x_{ij} - \sum_{r=1}^{s} \mu_r y_{rj} \geq 0, \quad j = 1, \ldots, n$$
$$\sum_{j=1}^{n} \lambda_j = 1$$
$$\mu_r \geq 0, \quad r = 1, \ldots, s$$
$$\nu_i \geq 0, \quad i = 1, \ldots, m$$

SLACK-BASED MEASURE (SBM) OF EFFICIENCY

Input-Oriented SBM Model with VRS

Objective:

$$\rho_I^* = \min_{\lambda, s^-} \left(1 - \frac{1}{m} \sum_{i=1}^{m} \frac{s_i^-}{x_{io}}\right)$$

Subject to:

$$x_o = X\lambda + s^-$$
$$y_o \leq Y\lambda$$
$$\sum_{j=1}^{n} \lambda_j = 1$$
$$\lambda_j \geq 0, \quad s^- \geq 0$$

Output-Oriented SBM Model with VRS

Objective:

$$\rho_O^* = \min_{\lambda, s^+} \left(\frac{1}{1 + \frac{1}{s} \sum_{r=1}^{s} \frac{s_r^+}{y_{ro}}}\right)$$

Subject to:

$$x_o \geq X\lambda$$
$$y_o = Y\lambda - s^+$$
$$\sum_{j=1}^{n} \lambda_j = 1$$
$$\lambda_j \geq 0, \quad s^+ \geq 0$$

Non-Oriented SBM Model with VRS

Objective:

$$\rho^* = \min_{\lambda, s^-, s^+} \left(1 - \frac{1}{m} \sum_{i=1}^{m} \frac{s_i^-}{x_{io}}\right) / \left(1 + \frac{1}{s} \sum_{r=1}^{s} \frac{s_r^+}{y_{ro}}\right)$$

Subject to:

$$x_o = X\lambda + s^-$$
$$y_o = Y\lambda - s^+$$
$$\sum_{j=1}^{n} \lambda_j = 1$$
$$\lambda_j \geq 0, \quad s^- \geq 0, \quad s^+ \geq 0$$

BCC (ADJUSTED)

Input-Oriented Adjustment:

$$x_{i,j,t}^{\text{adjusted}} = x_{i,j,t} + \left(\max_{j=1,\ldots,n} \left\{ \hat{S}_{i,j,t}^{-} \right\} - \hat{S}_{i,j,t}^{-} \right)$$

Output-Oriented Adjustment:

$$y_{r,j,t}^{\text{adjusted}} = y_{r,j,t} + \left(\hat{S}_{r,j,t}^{+} - \min_{j=1,\ldots,n} \left\{ \hat{S}_{r,j,t}^{+} \right\} \right)$$

Non-Oriented Adjustment:

For non-oriented models, adjust both inputs and outputs as follows:

$$x_{i,j,t}^{\text{adjusted}} = x_{i,j,t} + \left(\max_{j=1,\ldots,n} \left\{ \hat{S}_{i,j,t}^{-} \right\} - \hat{S}_{i,j,t}^{-} \right)$$

$$y_{r,j,t}^{\text{adjusted}} = y_{r,j,t} + \left(\hat{S}_{r,j,t}^{+} - \min_{j=1,\ldots,n} \left\{ \hat{S}_{r,j,t}^{+} \right\} \right)$$

SBM (ADJUSTED)

Input-Oriented Adjustment:

$$x_{i,j,t}^{\text{adjusted}} = x_{i,j,t} + \left(\max_{j=1,\ldots,n}\left\{\hat{S}_{i,j,t}^{-}\right\} - \hat{S}_{i,j,t}^{-}\right)$$

Output-Oriented Adjustment:

$$y_{r,j,t}^{\text{adjusted}} = y_{r,j,t} + \left(\hat{S}_{r,j,t}^{+} - \min_{j=1,\ldots,n}\left\{\hat{S}_{r,j,t}^{+}\right\}\right)$$

Non-Oriented Adjustment:

For the non-oriented SBM model, adjustments are made to both inputs and outputs similarly to the BCC model:

$$x_{i,j,t}^{\text{adjusted}} = x_{i,j,t} + \left(\max_{j=1,\ldots,n}\left\{\hat{S}_{i,j,t}^{-}\right\} - \hat{S}_{i,j,t}^{-}\right)$$

$$y_{r,j,t}^{\text{adjusted}} = y_{r,j,t} + \left(\hat{S}_{r,j,t}^{+} - \min_{j=1,\ldots,n}\left\{\hat{S}_{r,j,t}^{+}\right\}\right)$$

TOBIT REGRESSION

$$y_i^* = x_i'\beta + \varepsilon_i$$

$$y_i = \begin{cases} 0 & \text{if } y_i^* \leq 0 \\ y_i^* & \text{if } y_i^* > 0 \end{cases}$$

- y_i^* is the unobserved ("latent") variable
- y_i is the observed variable
- x_i are explanatory variables
- *β are the unknown parameters*
- ε_i *is normally distributed* drawn from N(0, σ^2)

SOFTWARE

Any recommendation?

- STATA
- DEA Solver (Not free)
- DEAP

- R fot Tobit Regression

WEEK 5

JULY 4, 2024

REPORT

Chapter 1 has been drafted

FRAMEWORK

DATA COLLECTION

DMU = each individual bank
Year = 5 to 10 years
Criteria = 3 Banks with the most Total Assets from each country from the Obis Bank database (Bankscope has been renamed as Obis Bank focus)

STAGE 1: BCC AND SBM

BCC non-oriented
SBM non-oriented

STAGE 2: TOBIT REGRESSION AND ADJUST THE VARIABLE

- Perform Tobit regression to adjust the inputs or outputs based on environmental variables, aiming to homogenize the data.
- Regress the input slacks on a set of explanatory environmental variables
- Adjust the significant variable

STAGE 3: BCC AND SBM (AGAIN)

Repeat the process and compare the result with stage 1

STAGE 0: TOBIT REGRESSION

Perform Tobit regression to adjust the inputs or outputs based on environmental variables, aiming to homogenize the data.

REPEAT STAGE 1 2 AND 3

DATA COLLECTION

- Extract data from 2010 to 2023.
- Select 10 years of data (if there is too much missing data, then use only 5 years).

QUESTION ON HOW TO MAKE IT HOMOGENEITY

For example

My input variable is Interest and Capital

$$\text{InterestRate}_i^* = \alpha + \beta_1 \text{GDPGrowth}_i + \beta_2 \text{Inflation}_i + \beta_3 \text{PolicyRate}_i + \epsilon_i$$

$$\text{Capital}_i^* = \alpha + \beta_1 \text{GDPGrowth}_i + \beta_2 \text{Inflation}_i + \beta_3 \text{MarketCap}_i + \epsilon_i$$

DO WE USE THE SAME VARIABLE HERE, OR IS IT DIFFERENT FOR EACH INPUT VARIABLE?

WEEK 6

JULY 11, 2024

FRAMEWORK

DATA COLLECTION

DMU = each individual bank
Year = 5 to 10 years
Criteria = 3 Banks with the most Total Assets from each country from the Obis Bank database (Bankscope has been renamed as Obis Bank focus)

STAGE 1: BCC AND SBM

BCC non-oriented
SBM non-oriented

STAGE 2: TOBIT REGRESSION AND ADJUST THE VARIABLE

- ~~Perform Tobit regression to adjust the inputs or outputs based on environmental variables, aiming to homogenize the data.~~
- Regress the input and output slacks on a set of explanatory environmental variables
- Adjust the significant variable

STAGE 3: BCC AND SBM (AGAIN)

Repeat the process and compare the result with stage 1

WEEK 7-9

CODING AND RESULTS

- Working on R

WEEK 10 - 12

WORKING ON THE REPORT

- Writing the report
- Aim to finish 80% on Week 10

FRAMEWORK

3 stages

DATA COLLECTION

DMU = each individual bank 30 Banks
Year = 10 years
Criteria = Average total assets

STAGE 1: SBM

SBM VRS non-oriented

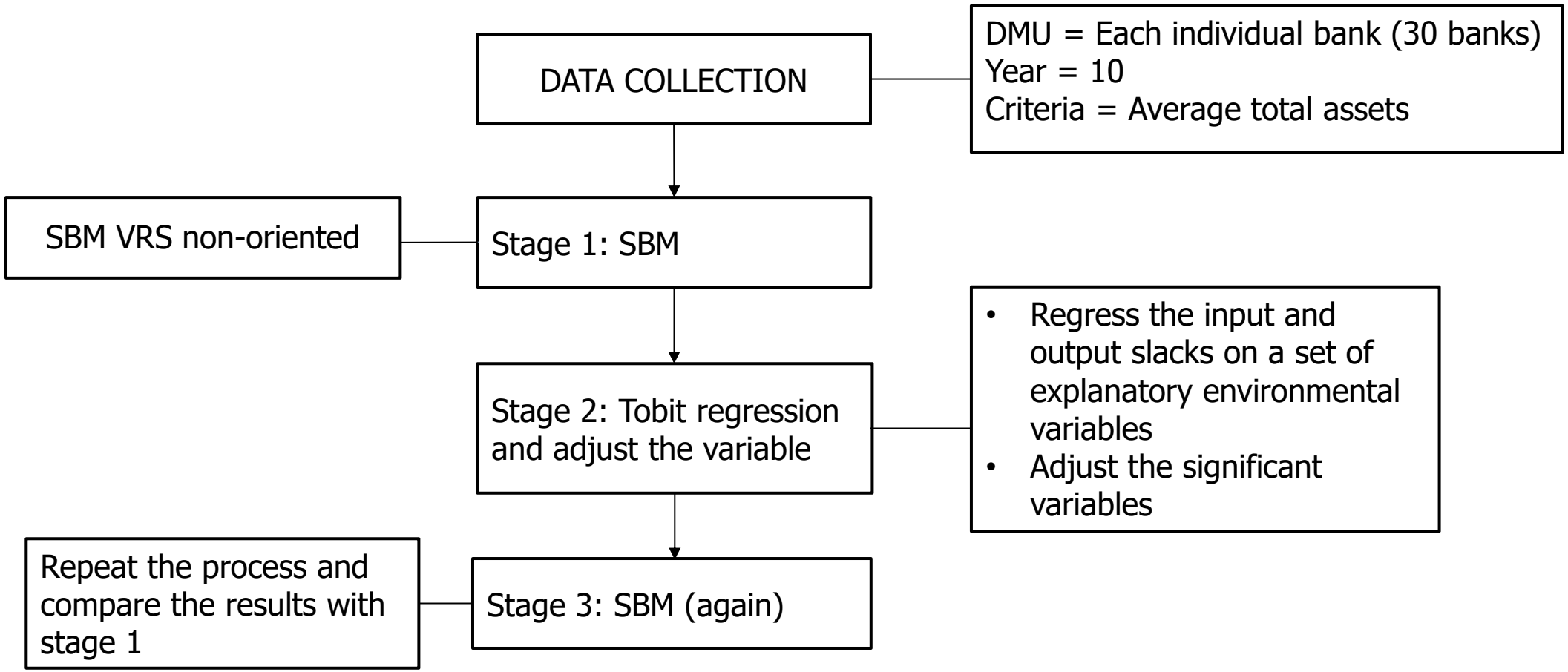
STAGE 2: TOBIT REGRESSION AND ADJUST THE VARIABLE

- Regress the input and output slacks on a set of explanatory environmental variables
- Adjust the significant variable

STAGE 3: SBM (AGAIN)

Repeat the process and compare the result with stage 1

Three-Stage Analytical Method



Equation 2: Tobit Regression for Inputs

$$\text{Slack}_{ij}^* = \beta_0 + \beta_1 \text{GDP}_i + \beta_2 \text{Inflation}_i + \beta_3 \text{Unemployment}_i + \epsilon_i$$

where:

- Slack_{ij}^* is the latent variable representing the slack for the j-th input of the i-th DMU,
- $\beta_0, \beta_1, \beta_2, \beta_3$ are the regression coefficients,
- ϵ_i is the error term.

Equation 3: Tobit Regression for Outputs

$$\text{Slack}_{ir}^* = \beta_0 + \beta_1 \text{GDP}_i + \beta_2 \text{Inflation}_i + \beta_3 \text{Unemployment}_i + \epsilon_i$$

where:

- Slack_{ir}^* is the latent variable representing the slack for the r-th output of the i-th DMU,
- $\beta_0, \beta_1, \beta_2, \beta_3$ are the regression coefficients,
- ϵ_i is the error term.

Non-Oriented Adjustment:

For the non-oriented SBM model, adjustments are made to both inputs and outputs similarly to the BCC model:

$$x_{i,j,t}^{\text{adjusted}} = x_{i,j,t} + \left(\max_{j=1,\ldots,n} \left\{ \hat{S}_{i,j,t}^{-} \right\} - \hat{S}_{i,j,t}^{-} \right)$$

$$y_{r,j,t}^{\text{adjusted}} = y_{r,j,t} + \left(\hat{S}_{r,j,t}^{+} - \min_{j=1,\ldots,n} \left\{ \hat{S}_{r,j,t}^{+} \right\} \right)$$

1. **Initial DEA Efficiency Score:**

$$\text{Efficiency}_i = \frac{\sum_{r=1}^{s} u_r y_{ri}}{\sum_{j=1}^{m} v_j x_{ji}}$$

2. **Tobit Regression for Inputs:**

$$\text{Slack}_{ij}^* = \beta_0 + \beta_1 \text{GDP}_i + \beta_2 \text{Inflation}_i + \beta_3 \text{Unemployment}_i + \epsilon_i$$

3. **Tobit Regression for Outputs:**

$$\text{Slack}_{ir}^* = \beta_0 + \beta_1 \text{GDP}_i + \beta_2 \text{Inflation}_i + \beta_3 \text{Unemployment}_i + \epsilon_i$$

4. **Adjusted Inputs:**

$$\text{Adjusted\_Input}_{ij} = \text{Input}_{ij} + (\max(\text{Predicted\_Slack}_{ij}) - \text{Predicted\_Slack}_{ij})$$

5. **Adjusted Outputs:**

$$\text{Adjusted\_Output}_{ir} = \text{Output}_{ir} + (\text{Predicted\_Slack}_{ir} - \min(\text{Predicted\_Slack}_{ir}))$$

6. **Adjusted DEA Efficiency Score:**

$$\text{Adjusted\_Efficiency}_i = \frac{\sum_{r=1}^{s} u_r \text{Adjusted\_Output}_{ir}}{\sum_{j=1}^{m} v_j \text{Adjusted\_Input}_{ij}}$$