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Is Microfinance the Best Tool for Empowerment? Analysis of Efficiency of Developing Economies's Microfinance Institutions in Empowering Women Using Data Envelopment Analysis Meta Frontier Technology

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IS MICROFINANCE THE BEST TOOL FOR EMPOWERMENT?

ANALYSIS OF EFFICIENCY OF DEVELOPING ECONOMIES'S MICROFINANCE INSTITUTIONS IN EMPOWERING WOMEN USING DATA ENVELOPMENT ANALYSIS META FRONTIER TECHNOLOGY

by

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ABSTRACT

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Poverty is still prevalent in developing economies, although the proportion of people living below the international poverty line ($1.90 a day) decreased by 24.6% between 1990 and 2013 according to World Bank. Women are more likely than men to live in poverty due to minimal access to resources. Microfinance institutions (MFIs) lend small funds to women thereby empowering them, encouraging entrepreneurship and creating creditworthiness.

This thesis examines the effect of MFIs on gender inequality via women empowerment by calculating output-oriented Data Envelopment Analysis using the meta frontier technology, and relating the efficiency results to the Gender Inequality Index (GII) obtained from the United Nations Human Development database. The sample is from Mix Market database between 2002-2016, including MFIs in 17 countries across 5 regions. This thesis tests the null hypothesis that efficiency scores of MFIs and GII are not linearly related, against the alternative, efficiency scores and GII are inversely related. Rejecting the null indicates that MFIs play a critical role in empowering women, thus reducing inequality.

This thesis did not find enough evidence to reject the null hypothesis. Though an in-depth analysis of frequent peers on the meta frontier, such as Spandana and Vietnam Bank for Social Policies (VBSP), show that MFIs can potentially reduce poverty levels and empower women. This thesis can be used by policy makers as a reference on how to implement policies. focus on the structure and management of MFI programs like incorporating government funding and equipping women with vocational training skills.

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Chapter 1

Introduction

Poverty is still prevalent among people living in developing economies mainly located in Africa, Latin America, and Asia. According to a report by World Bank, the poverty headcount ratio at $1.90 a day decreased from 35.3% in 1990 to 10.7% in 2013(World Bank, 2016). Though poverty levels seem to have decreased, there is high concentration of the people still living below the poverty line within developing economies. The international poverty line is below $1.90 a day. Women make up a higher percentage of people living below the poverty line. This is further influenced by cultural norms that limit women's eligibility to any form of loan, unless approved or supported by the husband. Therefore, the economic growth within women is stagnated making them entirely reliant on their husbands.

In 1974, Muhammad Yunus introduced the microfinance institutions (MFI) system through the formation of Grameen bank (Grameen bank, 2018). This system allowed women, who would have otherwise been excluded by the normal banking system, to borrow small amounts of money for development related causes. Women could come in groups and borrow money for small businesses then repay it later in installments. Banerjee (2013) explains that borrowing in groups made it easier for group monitoring and reducing the risks of default. This is because each member of the group is responsible for the debt that needs to be repaid. If the debt is not repaid, then it risks the whole group from getting another loan. Therefore, members look out each other for and support those unable to pay in a timely manner. Group borrowing has encouraged women in these communities to get close together enforcing unity. Since then, this microfinance institution idea has spread

across the world, with more focus on developing economies, where most women are poverty stricken. Over the years, this system has been viewed to be efficient in eradicating poverty, through empowering women in the societies, by providing finances for entrepreneurial activities ranging from small to medium size businesses, and in turn increasing the family income. Since then MFIs have played a role of reducing poverty level, through outreach and being financially sustainable over a long time.

Measuring the efficiency of MFIs is important because it will help the organizations understand how to use the available resources to maximize output in the communities. Additionally, governments would be encouraged to be more involved in this sector, rather than solely relying on Non-Governmental Organizations. This may be done through the incorporation of funding towards the microfinance institutions into the annual budgeting and spending process to ensure constant provision of subsidies and other resources. This is clearly illustrated by Burgess and Pande (2005), by evaluating the effects of the 1:4 banking license policy by the Central bank of India on the poverty levels in unbanked areas. The authors analyzed the importance of rural banks under state implemented initiatives. According to the authors, the Central bank of India introduced a 1:4 policy where banks were required to open four other branches in selected unbanked area when they open any new branch in an already banked area. Because of this initiative, there was evidence of reduced poverty, increased saving habits among the people, and increased access to loan to families. From this illustration, it is important for governments to understand and take part in ensuring proper financial development infrastructure within the country and implementation of policies that would strengthen financial institutions through governing its operation activities for the good of the people. It is therefore important to note that,

under the cases where countries have more developed financial infrastructure through equal access to banking services to citizens and implementation of policies that govern the operation of the bank, there might be low significant results showing the relationship between efficiency scores of MFI and the Gender Inequality Index. This is because women have already experienced empowerment and are working to close the existing gap between them and men. In this case, microfinance institutions may not play that major of a role in bringing about a transformative effect of women empowerment within the societies.

This thesis argues that microfinance institutions could reduce the gender inequality by empowering women. Furthermore, it hypothesizes that efficiency scores of microfinance institutions are inversely related to gender inequality index. That is, as the efficiency score of a microfinance institution increases, the gender inequality index decreases, and vice versa. To explore this research, data of microfinance institutions was obtained from Mix Market database. The data covered a period of 14 years from 2002 to 2016 to get a clear pattern of the impact of microfinance institutions on women as the spread and acceptance of MFIs takes shape in various parts of the world. The data was collected from MFIs in 15 different countries from South Asia and East Asia, Sub-Saharan Africa, Middle East and North Africa and Latin America regions.

By applying an output oriented Meta frontier Data Envelopment Analysis, with one of the output variables, the number of women borrowers in the MFIs, directly measuring women empowerment, the anticipated results will provide an understanding on how microfinance institutions have used its limited resources to bring about positive changes in the communities through output expansion and financial sustainability. O'Donnell et al (2008) define meta frontier as the boundary consisting of all the groups in the data with

unrestricted technology. Thus, this method allows for comparison of efficiency scores across the different groups on the meta frontier. In this thesis, this method will enable the comparison of efficiency scores of microfinance institutions in one region to those in another region on the meta frontier despite the difference in culture, resources, and organizational structure.

The null hypothesis test is efficiency scores are not linearly related to the Gender Inequality Index against the alternative hypothesis that, efficiency scores and Gender Inequality Index are inversely related. Rejecting the null hypothesis indicates that microfinance efficiency scores and Gender Inequality Index are inversely related such that as the efficiency score increases, the gender inequality index decreases, and vice versa. Therefore, microfinance institutions reduce the gender inequality by empowering women in the society.

This thesis did not find enough evidence to reject the null hypothesis that efficiency scores are related to the Gender Inequality Index. Though an in-depth analysis of the frequent peers on the meta frontier, such as Spandana and Vietnam Bank for Social Policies (VBSP), reveals that there is potential for microfinance institutions to create a positive impact on reducing poverty levels and empowering women in the societies.

This thesis is organized as follows. The second chapter discusses past studies on efficiency of microfinance institutions while the third chapter explains the formulation of the analytical model. The fourth chapter explores empirical test of the theory, and the fifth chapter is the conclusion.

Chapter 2

Studies on Efficiency of Microfinance Institutions

This chapter explores the previous studies carried out by different researchers on measuring efficiency of microfinance institutions in various countries in the world. The outline of this chapter is as follows: Section 2.1 discusses the objective of microfinance institutions which helps readers understand the reason behind the introduction of microfinance institutions in the developing economies. Furthermore, it also explains the different ways of measuring social efficiency or financial sustainability. Section 2.2 explores the specification of MFIs and clearly outlines the various applied models whether intermediate or production, variables used by the researches as well as the results obtained. Section 2.3 presents subsidies as an integral part of the MFIs and further explains its effect on the ability of microfinance institutions to achieve its optimal efficiency. Section 2.4 explains women participating in the MFI leadership, and Section 2.5 highlights the contribution of this research.

2.1 Objectives of Microfinance Institutions

The objectives of microfinance institutions include financial sustainability, outreach, women empowerment and reducing poverty levels among others. There are various research papers that have covered on the efficiency of Microfinance institutions in addressing these objectives. Gobezie (2010) states that MFIs are mainly associated with women. This is because the existing gender inequality acts as a barrier to economic development and growth in the communities. The author also emphasizes that women have a better repayment rate of loan and more commitment, thus contribute to the overall efficiency and sustainability of a MFI. The author mentions that access to MFI by women increases their bargaining power in the family. This is because women can now generate income contributing to the overall household income and can have more say on the running and expenditure in the household. Furthermore, it encourages independence among women.

Lebovics, Hermes, and Hudon (2016) analyzed whether the financial and social efficiency of a microfinance institution are independent of each other, in achieving its objective of outreach and financial sustainability, using Vietnam as a case study. The authors used different output variables to capture financial and social outputs. In the case of financial sustainability, gross loan portfolio and financial revenue are the outputs used. For social output, the authors used number of depositors and then constructed a poverty outreach measure. To construct the poverty outreach measure, focus can be on the breadth or depth of the outreach. Lebovics, Hermes, and Hudon (2016) focused on both the breadth (number of poor clients reached) multiplied by the depth (extent to which the poor clients are reached). Therefore, the authors divided the average loan balance per borrower in each

MFI by the average annual income in the MFI's operating area, to obtain a value denoted as k_i. The lower the value of k_i obtained, the smaller the average loan. To capture the depth of the outreach, the authors first standardized the k_i value to fall within the (0,1) range using the formula as shown below:

$$p_i = 1 - \left[\frac{k_i - \min(k)}{\max(k) - \min(k)}\right]$$

The range of the k value consists of k values obtained from other MFIs within the same operating area. The closer the value of p is to one, it implies that the depth of outreach is higher. The p value obtained is then multiplied by the number of active borrowers in the MFI to examine the depth and breadth of the outreach. Therefore, social efficiency for a given microfinance institution is defined as being able to give numerous amount of small loans to the poor people.

Bassem (2008) investigated the efficiency of Microfinance institutions in the Mediterranean region, with a slight emphasis on the social efficiency, by looking at the depth and breadth of spread in the community. The author multiplied number of borrowers by the percentage of women to obtain the social performance of the microfinance institution. He further explains the breadth of the MFI program is reflected by the number of borrowers, while the depth is shown by selecting the percentage of women in the MFI. Microfinance institution system in the Mediterranean region is viewed as strong and more developed compared to other regions. Bassem (2008) explains that microfinance institutions in these regions have access to local funds as a way of refinancing and improving of financial services to areas without infrastructure, further leading to economic growth and development. This explains why the MFIs in the Mediterranean region might have a higher efficiency score compared to other regions. Widiarto and Emrouznejad

(2015) specifically examined the social and financial efficiency of the Islamic Microfinance institutions across the Middle East and North Africa, East Asia and Pacific and South Asia. They used assets, operating expense, portfolio at risk 30 days as inputs and financial revenue and borrowers as outputs. They covered all forms of MFIs including NGOs, global banks, and local banks.

With a further regional focus, Segun and Anjugam (2013) evaluated the efficiency of MFIs in Sub-Saharan Africa in reducing poverty levels and promoting financial stability within the organization. The authors found two efficient peers in Kenya and Senegal, which further support the idea that a microfinance institution does fulfil its objective of reducing poverty levels and empowering women. Bezboruah and Pillai's (2014) objective was to evaluate the effects of the characteristics of microfinance institution such as organization, efficiency, loan size, gender mix, legal status among others on the portion of women borrowers. The authors highlighted the effect of loan size made available to customers by a microfinance institution on number of women borrowers' present. When the average loan size is low, more poor women are targeted since they can easily repay the money. When the loan size is high, most poor women tend not to participate in the borrowing activity. This explains why most women would participate more in NGO based MFIs since they have lower average size of loan and explains why MFI system is easily adaptable and accessible to more people because of the attractiveness of the loan size. Additionally, Bezboruah and Pillai's (2014) further explain the reason why microfinance institutions mainly target women as their main clients. This is because of the role they play in the society, therefore providing access to loans will increase the women's economic

independence. This in turn will bridge the gender inequality gap, leading to more economic growth and development in the society.

Banerjee (2013) highlights some of the details of microfinance over the last two decades of its existence. He highlights the difference between money lenders and MFI behavior with a reference to Pakistan. From this he concludes that money lenders tend to be selective in whom they offer lending service to. Money lenders are more likely to lend to existing clients rather than new clients, whereas on the other hand, MFIs can lend to anyone that lives within the area and meets their criteria which are very simple. The author also finds clear evidence that microcredit under reasonable rates does breed entrepreneurial spirit through creation and/or expansion of businesses. Banerjee, Karlan and Zinman (2015) combined results of six randomized evaluations based in Ethiopia, India, Mexico, Mongolia, Bosnia and Herzegovina, and Morocco with an aim of analyzing how effective MFI is as a tool to promote development. The authors concluded that there was not much transformative change brought about by the MFI system, though they acknowledged that it brings about business growth, which might be in a way limited.

2.2 Specification of Microfinance Institutions

Microfinance institutions can be viewed either as a production unit or as an intermediary. Intermediation approach views financial institutions as intermediaries between borrowers and savers, whereas production views financial institutions as a production unit that uses standard inputs to produce financial services. The specifications of microfinance institutions resemble that of a normal banking system. Muneer and Kulshreshtha (2014) highlighted the comparison between the banking industry and the microfinance institutions approaches of measuring the efficiency: intermediaries and

production approaches. They also point out the different possible outputs and inputs that are used by banking institutions, which is applicable to MFIs. The outputs included total loans, saving balances, average loan size and number of accounts. Inputs were labor, fixed assets and capital among others. Weill (2004) further highlighted the intermediation approach of measuring efficiency. The author used loans and investment assets as outputs and personnel expenses and interest paid as inputs.

On the other hand, Segun, and Anjugam (2013) used both intermediary and production approach in evaluating the efficiency of MFIs in the Sub-Saharan Africa in reducing poverty and being financially stable. Using Intermediation approach, the output was gross loan portfolio and inputs were number of credit officers, and cost per borrower. Under the production approach, output was outstanding loan and inputs were number of employees which measures the proxy for labor and personal expense which captures the proxy for services in support of operation. Therefore, it is possible to apply either of the approaches or both to measure the efficiency of MFIs.

2.3 Subsidies as an Integral Part of the Microfinance Institutions

Microfinance institutions heavily rely on subsidies to carry out their services. Muneer and Kulshreshtha (2014) described the several ways in which MFIs raise money such as through donors and grants from other sources. Additionally, the authors categorized subsidies as assets that are possessed by microfinance institutions and can be transformed into cash. Nawaz (2010) investigated the role of subsidies in promoting the efficiency and productivity of a microfinance institution. Overall, subsidies determine the amount of money an MFI can lend its customers and the number of people it can efficiently serve. Azid et al. (2016) examined the nature of Microfinance institutions in Africa in comparison

to other microfinance institutions in various places in the world. In this study, the authors concluded that if microfinance institutions are stable, they will encourage greater risks, and have more flexible terms of payment for their active borrowers. Therefore, it is evident that the availability of subsidies affects the overall stability of the microfinance institution.

Banerjee (2013) investigates the role of reputation in obtaining subsidies for the MFI. The author explains that reputation plays a major role in distinguishing between traditional microlenders and MFIs. Most MFIs tend to be associated with social missions within the society such as health services, education, supporting poor people among others. The author points out that reputation does serve as a major role in attracting different types of donors, determining if they should have aid donors support the organization or social businesses.

2.4 Women Participation in the Leadership of Microfinance Institutions

Over time, women have started taking leadership roles in Microfinance institutions which might have an impact on their efficiency. Bezboruah and Pillai (2014) analyzed the effects of women participating in the governance of microfinance institutions in developing countries. The authors found that an increase in women borrowers led to an increase in women board members, especially in cooperative forms of institutions. Damme, Wijesiri, and Meoli (2016) determined the role of governance model in promoting financial efficiency in a microfinance institution using Sri Lanka as a case study. The authors used several examples of governance models such as size of the board, presence of women on board, CEO/chair duality and woman CEO in the organization. Under these scenarios, different efficiency levels were obtained within the microfinance institutions. The highlight of the paper was, gender diversity does increase the efficiency of MFIs. The authors found

that smaller and gender diverse boards are financially efficient and CEO/chair duality and presence of a woman CEO have a negative impact on the outreach efficiency in the Microfinance institution.

2.5 Conclusion

Different authors mentioned above have investigated the efficiency of MFIs in achieving their goals of outreach and being financially stable. Additionally, there has been literature on how women involvement on governance of the MFIs affects efficiency of the institution. While previous studies have managed to show that microfinance institutions have an impact on people's lives and involvement of women in managerial role does influence social and financial efficiency of institutions, there has not been much analysis on the empowerment for the women enrolled. This thesis will differ by evaluating the level of impact microfinance institutions have had on the women in the societies through social outreach and its own sustainability in reducing gender inequality gap.

Chapter 3

Formulation of the Analytical Model

This chapter explains the formulation of the analytical model used in this thesis. This chapter is outlined as follows: Section 3.1 explains the background information of Data Envelopment Analysis (DEA) model and outlines the various orientation and return to scales that can be applied in a DEA model and the overall importance of this model to the performance of firm and management. Section 3.2 presents an illustration of output oriented technical efficiency highlighting Koopmans and Farrell efficiencies a DMU can assume, and how to interpret a technical efficiency score of a given DMU. Section 3.3 illustrates the Linear Programming formulation used for both output oriented technical efficiency and the meta frontier technology. Section 3.4 explains the foundations of meta frontier technology for measuring efficiency i.e. meta frontier, group frontier and the GAP. This section also emphasizes on the importance of the meta frontier technology in improving performance of a DMU. Lastly, Section 3.5 outlines the hypothesis test for this thesis.

3.1 Background on DEA Model

Data Envelopment Analysis is used to measure the efficiency of an organization within a given group of organizations (Class notes, 2017). There are various types of efficiencies that can be obtained using the DEA model such as allocative, cost and technical. Coelli (1996) explains that the DEA model is used to compare an organization to other efficient peers on the production frontier using weights. Steering Committee for the Review of Commonwealth/State Service Provision (1997) further emphasizes that this method benefits management of firms and organizations by enabling them to lead more efficiently through finding answers to questions that affect overall productivity. These questions include how to select role models for their organization, understanding how much further the organization can maximize on output without necessarily increasing the input, among others.

Coelli (1996) explains that DEA model originated from Charnes, Cooper and Rhodes, who proposed an input oriented model at a Constant Return to Scale, and Banker, Charnes and Cooper who proposed the Variable Return to Scale. The author also explains that Constant Return to Scale is used when all DMUs are at optimal scale. When DMUs are not operating at Constant Return to Scale due to various factors such as finances or any other circumstance, the Variable Returns to Scale should be applied. This allows technical efficiency to be calculated without any effects of scale.

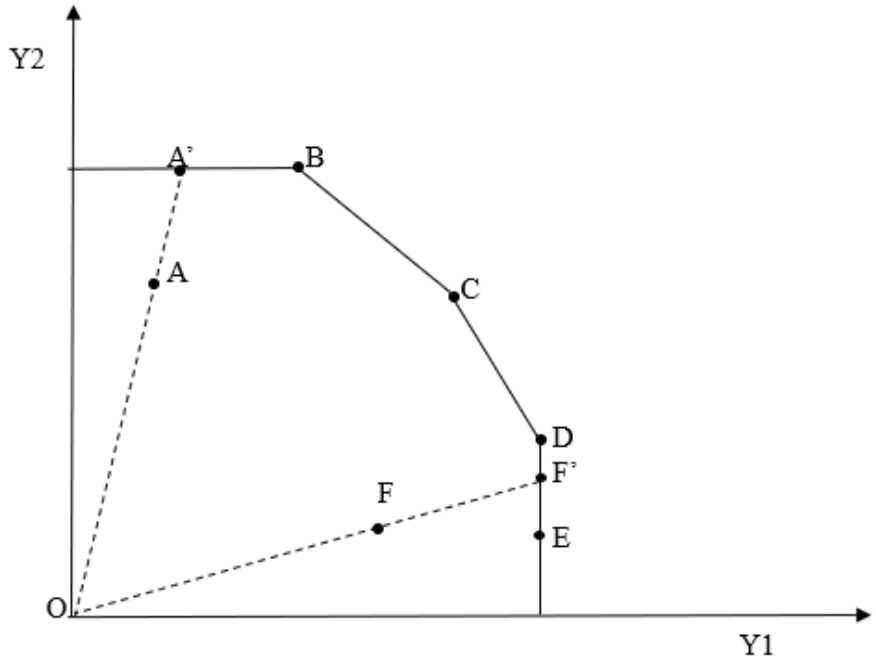
There are two approaches under DEA that can be used to calculate the technical efficiency depending on the desired outcome. These are the input oriented model and the output oriented model. Coelli (1996) illustrates that the difference between the input oriented and output oriented model in measuring efficiency is that input oriented model

minimizes inputs given a constant output variable, whereas the output oriented model maximizes the output given a constant input variable. In this thesis, the output oriented Data Envelopment Analysis (DEA) will be used to calculate technical efficiency of a microfinance institution at variable returns to scale. This model is ideal because it will enable the evaluation of efficiency of the microfinance institution in utilizing its limited resources to attain its goal of women empowerment as its output.

3.2 Illustration of Output Oriented Technical Efficiency

Given the same level of inputs, peers B, C, D and E are all efficient; therefore, they define the production possibility frontier. A and F are inefficient since they both fall inside the frontier and can maximize their outputs proportionally given the constant inputs to A' and F' respectively. The increase in outputs from F to F' on the frontier with reference to D and E is defined as technical efficiency and is derived from the formula TE = OF/OF'. A unit is efficient when the technical efficiency value is equal to 1. On the other hand, it is inefficient when the technical efficiency value is less than 1. If the technical efficiency score obtained for DMU F is 0.8, it shows that this DMU can produce 80% of maximum potential output using the current inputs holding the output mix constant.

Figure 1: Illustration of Technical Efficiency



There are two types of efficiencies namely Farrell and Koopmans. A unit on the frontier might be either Koopmans or Farrell efficient or both. In figure 1, B, C, and D are observed points on the frontier that are both Farrell and Koopmans efficient. E is Farrell but not Koopmans efficient. A and F are neither Farrell nor Koopmans efficient points. To make A Farrell efficient, it has to move along the ray from the origin through point A to A' which is on the frontier. This movement is known as radial slack. When A' moves to B, there is increase in the level of y_1 while y_2 remains the same. This implies that A' is not Koopmans efficient point while B is. This increase in quantity of y_1 from A' to B is a non-radial slack in y_1. F' is Farrell efficient though there is surplus in y_2 such that it could move to point D to become Koopmans efficient.

3.3 Linear Programming Formulation for Variable Returns to Scale

The Linear Programming formulation below represent an output oriented model.

Objective is to find $TE^{k} = [\max \theta]^{-1}$

Subject to

$$\begin{pmatrix} y_{1,1} & y_{2,1} & y_{3,1} & - & y_{j,1} \\ y_{1,2} & y_{2,2} & y_{3,2} & - & y_{j,2} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ y_{1,m} & y_{2,m} & y_{3,m} & - & y_{j,m} \end{pmatrix} \begin{pmatrix} z_{k,1} \\ z_{k,2} \\ \vdots \\ z_{k,j} \end{pmatrix} \geq \begin{pmatrix} y_{k,1} \\ y_{k,2} \\ \vdots \\ y_{k,m} \end{pmatrix} \theta$$

$$\begin{pmatrix} x_{1,1} & x_{2,1} & x_{3,1} & - & x_{j,1} \\ x_{1,2} & x_{2,2} & x_{3,2} & - & x_{j,2} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ x_{1,n} & x_{2,n} & x_{3,n} & - & x_{j,n} \end{pmatrix} \begin{pmatrix} z_{k,1} \\ z_{k,2} \\ \vdots \\ z_{k,j} \end{pmatrix} \leq \begin{pmatrix} x_{k,1} \\ x_{k,2} \\ \vdots \\ x_{k,n} \end{pmatrix}$$

$$\begin{pmatrix} z_{k,1} \\ z_{k,2} \\ \vdots \\ z_{k,j} \end{pmatrix} \geq 0 \text{ (non-negativity)}$$

$$z_{k,1} + z_{k,2} + \cdots z_{k,j} = 1$$

$j = 1, \ldots . \text{j is the number of units, and k} = \text{unit being assessed}$

$x_n = \text{input } n, n = 1, \ldots . n \text{ , and } y_m = \text{output } m, m = 1, \ldots . m$

$z_{k,j} =$ estimated weight for unit j when efficiency for unit k is calculated

$\theta =$ scale indicating how far unit k needs to expand its output to be effiecient

The Linear Programming formulation above represents output orientation model with variable returns to scale (VRS). It is used to measure the efficiency of DMU k in comparison to other DMUs. The output frontier has the sum of the weighted DMUs with respect to DMU k greater than or equal to that of DMU k. The input frontier consists of the sum of weighted DMUs with respect to DMU k less than or equal to DMU k. The best

frontier is obtained by linear formulation of the DMUs present in the sample. Theta indicates how far a DMU needs to expand its output to operate on the frontier.

Z represents weight which is unique to each DMU, and efficient peers have weight that is greater than zero (Z>0). The non-negativity is equal or greater to zero. Since the Linear programming formulation above applies variable returns to scale, the sum of the weight (Z) is equal to one.

3.4 Meta frontier Production Technology

According to class notes (2017), meta frontier production technology is viewed as presenting traditionally conceived neoclassical production functions. O'Donnell et al (2008) explained that meta frontier production consists of the groups/regions frontiers and the meta frontier. The authors further explained a meta frontier as the boundary consisting of all the groups in the data with unrestricted technology, whereas group frontier is the restricted technology and consists of only the group data boundary. Additionally, the authors described that measuring efficiency using the meta frontier technology is done relative to the meta frontier and group frontier, then the GAP is derived as a ratio of meta frontier efficiency scores and group frontier efficiency scores.

The GAP value is less than or equal to 1. The closer the GAP value of a DMU is to 1, the more efficient it is given the meta frontier technology.

Figure 2: Illustration of Meta Frontier Technology

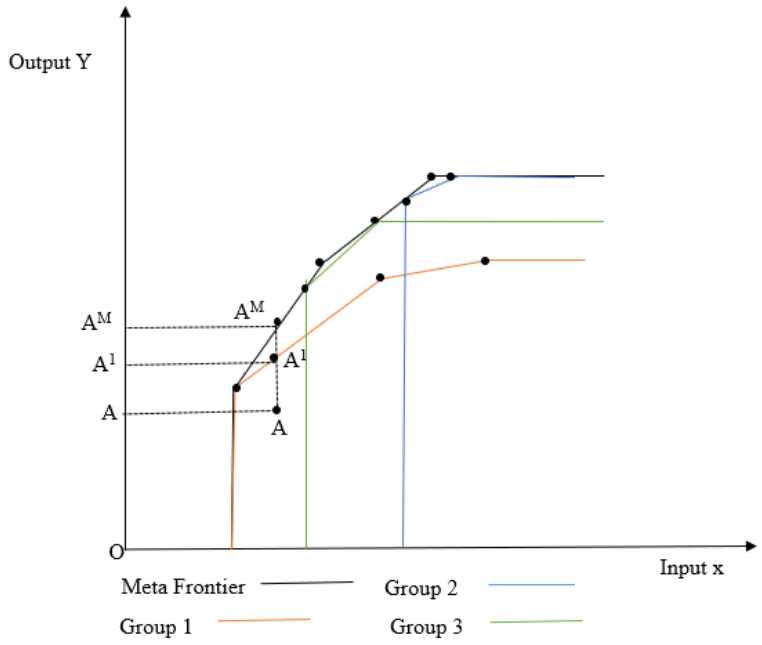


Figure 2 above displays 3 groups frontiers and the meta frontier with one input and one output. Given the input x and output y, the DMU A is not efficient relative to its group 1 and the meta frontier. To obtain the technical efficiency of DMU A relative to the group frontier 1, $TE^{A,1}= OA/OA^1$ and the value obtained is less than 1. Technical efficiency of DMU A relative to the meta frontier is equal to $TE^{A, M}= OA/OA^M$. GAP is the ratio of technical efficiency score relative to the meta frontier over technical efficiency score relative to the group frontier; $TE^{A, M}/TE^{A,1}$ which is less than equal to 1. Given that $TE^{A,1}$ is 0.7 it implies with constant set of inputs for DMU A and the group 1 technology, DMU A produces 70% of its maximum.

If $TE^{A, M}$ is 0.4 it means that DMU A produces 40% of its maximum output using the constant set of inputs. Therefore, GAP is (0.4/0.7) = 0.57, thus DMU A maximum output is 57% of the output using the meta frontier technology. Given these efficiency scores obtained at group frontier and meta frontier respectively, DMU A is more efficient

within the group compared to the meta frontier. It is anticipated that access to the unrestricted and common technology will increase the efficiency of DMU A given the same set of inputs. Though, in this case, the maximum output DMU A could achieve given its technology is only 57% of the maximum output had DMU A have access to the unrestricted technology on the meta frontier.

The meta frontier production allows comparison of DMU efficiencies within a group with other DMUs in different groups irrespective of the regional differences such as culture, natural resources among others and organizational structures. Additionally, meta frontier production highlights the efficiency performance of a given DMU, both at a group frontier and meta frontier level, by comparing the maximum percentage output the DMU produces, given the inputs and access to unrestricted technology. Through this, DMUs that have little access to the meta frontier can identify role models, and have technology transfer by learning what the role models do differently and then trying to incorporate these ideas in their programs. O'Donnell et al (2008) emphasize the importance of measuring GAP since it can be used to bring about performance improvement by designing and implementing programs that involve changes to production in each group.

3. 5 Hypothesis Tests

This thesis has four different hypothesis that are tested using the Kruskal-Wallis nonparametric test method at 1% significant level. The main argument of this thesis is, microfinance institutions could reduce gender inequality by empowering women. Therefore, the null hypothesis test is efficiency scores are not related to the Gender Inequality Index against the alternative hypothesis that, efficiency scores and Gender Inequality Index are inversely related Rejecting the null hypothesis indicates that

microfinance efficiency scores and Gender Inequality Index are inversely related such that as the efficiency score increases, the gender inequality index decreases, and vice versa. Therefore, microfinance institutions reduce the gender inequality by empowering women in the society.

Secondly, this thesis tests the average efficiency score of DMUs across all regions, and hypothesizes that the average efficiency scores are the same across all regions. The alternative hypothesis is that average efficiency scores are not the same across all regions. This thesis also tests the distribution of GAP. The null hypothesis states that GAP distribution is the same across all regions and the alternative hypothesis is that GAP distribution is not the same across regions.

Lastly, this thesis used the Spearman rank correlation to test whether the rankings of MFI efficiency obtained from the two models are correlated. The null hypothesis states that rankings of MFI efficiency in model 1 is not related to the rankings of MFI efficiency in model 2 against the alternative hypothesis that the rankings of MFI efficiency in model 1 is related to the rankings of MFI efficiency in model 2.

Chapter 4

Empirical Test of the Theory

This chapter explains the empirical test of the theory used in this research. This chapter is arranged as follows: Section 4.1 presents data and variables where the readers will be able to understand where the data was obtained from and the time frame of the data, Additionally, the reader will be able to understand the selection criteria of the input and output variables used and what it captures in the analysis. Section 4.2 includes the descriptive analysis and outlier analysis of the data by each region and whole data set. This section brings out a visual summary of the data used in the research thus enabling comparison of variable distribution between regions. Section 4.3 presents the efficiency scores and hypothesis tests results found from running Meta frontier DEA analysis and different hypothesis. Lastly Section 4.4 summarizes the findings of the thesis in comparison to the hypothesis of the thesis.

4.1 Data and Variables

MFIs are viewed either as a production unit or intermediation. Intermediation approach views financial institutions as intermediaries between borrowers and savers, whereas production views financial institutions as a production unit that uses standard inputs to produce financial services. In this thesis, production approach is applied to calculate the efficiency score of MFIs. These MFIs use various inputs such as technology, finances, and human capital to produce the financial services that are offered to the community and sustainability of daily operations.

Data

This thesis uses data obtained from the Mix Market Data Base over a period of 14 years between 2002-2016. Analyzing this data frame highlights a clear pattern of the influence of microfinance institutions in the communities. Data from each year in any given microfinance institution is treated as a single Decision-Making Unit (DMU). This data covers various microfinance institutions from 17 countries from Latin America, Mediterranean and North Africa, East Asia, South Asia and Sub-Saharan Africa regions.

Input Variables

Muneer and Kulshreshtha (2014) use assets, operational costs and number of loan officers as inputs to calculate efficiency scores of the MFIs. Using this basic conceptual framework for selecting variable with some modification to avoid double counting of variables, the inputs used in this thesis are operating assets, Administration and Depreciation & Amortization expense and number of loan officers.

Operating assets includes the sum of cash and cash equivalents, net fixed asset and other assets. Cash & cash equivalents is defined as cash at hand or any other liquid form

of investment whose purpose is for short term use. Net fixed assets are any tangible assets owned by an organization and used for production or supply of goods and services i.e. office space, equipment. Net fixed assets are expected to be used for more than a year and take longer time to be converted into cash. Other asset includes accounts such as inventories, long-term investments, goodwill, tax assets, trade and other receivables among others. This variable captures the value of the microfinance institution both in the short and long-term aspects through the property it owns and resources available to enables operation in an efficient and sustainable way.

Administration and Depreciation & Amortization expense variable is the difference between operating expense and personnel expense. Excluding personnel expense from the operating expense eliminates double counting of personnel since it is already represented by the number of loan officers as an input variable. This variable captures the expenses that are directly incurred through the provision of financial services to the clients.

Loan officers are staff personnel responsible for recommending and approving loan request in the microfinance institution. This aspect captures the outreach level of a production unit to the community at large. Having enough number of loan officers that match to the population of the community will ensure that there is enough outreach and production unit will work more efficiently.

Output Variables

This thesis uses outputs that demonstrate the financial sustainability and social outreach of microfinance institutions. The basic conceptual framework for selecting the output variables have been drawn from Damme, Wijesiri, and Meoli (2016), Bezboruah and Pillai (2014), Lebovics, Hermes, and Hudon (2016) and Muneer and Kulshreshtha (2014).

Muneer and Kulshreshtha (2014) use total number of active borrowers as an output to measure the breadth of the outreach of MFIs in India. Total number of active borrowers might constitute of both men and women borrowers within the MFI or only women borrowers. Based on this framework, both the number of male borrowers and number of women borrowers were used as two separate variables in this thesis. This is because incorporating number of men borrowers in the model, prevents biasness in the results obtained, through the assumption that the MFIs directs all their resources to only woman as their only clients.

Damme, Wijesiri, and Meoli (2016) use number of women borrowers as one of its outputs to measure the governance and efficiency of microfinance institutions in Sri Lanka. Number of women borrowers captured the outreach of the MFIs. Additionally, Bezboruah and Pillai (2014) identified the effect of varying number of women borrowers participating in financial cooperatives and credit unions in developing countries. Therefore, to capture the depth and broadness of the social outreach objective of the microfinance institutions assessed in this thesis, number of women borrowers was utilized. Number of women borrowers is the number represented by women in the total number of borrowers in the

microfinance institution. This variable is used to show the depth of microfinance institutions by evaluating the number of women enrolled in the program.

Lebovics, Hermes, and Hudon (2016) use gross loan portfolio as one of the outputs in evaluating if microfinance institutions' financial and social efficiency are independent of each other in Vietnam. Also, Muneer and Kulshreshtha (2014) use gross loan portfolio as one of the outputs that captures all the outstanding loans such as current, delinquent and restructured loans. This thesis applies the above concept and uses net loan portfolio as output variable. Net loan portfolio is defined as all outstanding principals that are due from all client loans minus the impairment loss allowance. This variable captures the financial sustainability of the microfinance institution since it uses the principal from loans and repaid loans from clients to finance more loans to the people.

Muneer and Kulshreshtha (2014) use average loan balance as output variable that captures the depth of outreach of Indian microfinance institutions. Based on this framework, Lebovics, Hermes, and Hudon (2016) further builds on this variable and construct a social output that captures both the breadth and depth of outreach. The authors first divide average loan balance per borrower by average annual income in MFIs operating areas to obtain breadth of outreach denoted as k_i. The k_i is first standardized before being subtracted from 1, to get the depth of the MFI outreach, denoted as p_i. Lastly, the authors multiply the value p_i by the number of active borrowers in the MFI to get a measure of the breadth and depth of outreach. By employing this similar concept, this thesis will only calculate the breadth of outreach of the MFIs to the low-income population by dividing average loan balance per borrower by Gross National Income (GNI) per capita as an output variable and is measured in percentage. A higher percentage of the average loan balance

per per-capita GNI implies that the given MFI reaches out to more potential poor borrowers and therefore it is an output that can by expanded by the MFI.

In this thesis, there are two models that have been applied in processing the data; model 1 has average loan outstanding per borrower per GNI capita while model 2 is without this variable. Results from the two models will be analyzed in this thesis. All inputs and outputs with monetary values are converted to constant 2005 dollars using the following formula:

$$2005\ constant\ Dollar\ value_{year\ x} = \frac{Dollar\ value_{year\ x} * Average\ CPI_{2005}}{Average\ CPI_{year\ x}}$$

4.2 Outlier and Descriptive Analysis

Outlier Analysis

The outlier analysis was performed for each region separately. The box plot was used to eliminate the extreme values that were found outside the +/- 3 interquartile range. One hundred and five observations were eliminated from the whole sample of 638 original observations. This includes 19 observations from Latin America region, 16 observations from Mediterranean and North Africa region, 20 observations from East Asia, 30 observations from South Asia region and 20 observations from Sub-Sahara Africa region.

Descriptive Statistics Analysis

Tables 1-6 show the descriptive statistics of input-output variables in each region and the entire sample used to form the meta frontier. The coefficient of variation (C.V.) is used to compare the variation across variables. A small coefficient of variation indicates that the data for a specific variable in consideration is closely distributed across observations in the sample and a larger value indicates that the data is highly scattered.

Analyzing the mean average values of variables across the regions, the operating assets ranges between 9.43 and 87.53 million 2005 constant USD. South Asia and Sub-Saharan Africa regions have high operating assets value of 80.6 and 87.5 respectively, while MENA has the lowest value of 9.43 in comparison to the meta frontier average value of 48.69. The Administration, Depreciation and Amortization expense variable has a range between 2.56 and 9.80 and the meta frontier average of 5.03. The number of loan officer values are between 242 and 3004 across the regions. The number of loan officers in all regions, except one are below the meta frontier sample average of 1074. South Asia has exceptionally higher value of 3004.

Net loan portfolio values fall between 45.59 and 158.75, with South Asia having the highest value and MENA the lowest one. Sub-Saharan Africa and Latin America regions have almost similar net loan portfolio values, 128.30 and 127.58 respectively. There are more women borrowers than men borrowers across all regions. Though South Asia has the highest number of women borrowers, approx. 1.3 million while its average men borrowers are only 44,327. Latin America and MENA has lower values of difference between women and men borrowers approximately 10205 and 10814 respectively. The average loan per borrower/GNI capita varies from 15.42% in South Asia to 136.81% in Sub-Saharan Africa. This implies that MFIs Sub-Saharan Africa are targeting more poor people in the communities.

In the tables below, the C.V values obtained range from 30% to 554% implying that the distribution of data in this thesis is highly scattered. South Asia and MENA regions have a close distribution of Average loan balance per borrower/GNI per capita variable across observations because of their low C.V value of 31.17% and 43.78% respectively.

East Asia, South Asia, MENA and the meta frontier have highly scattered distribution of the number of male borrower variable in each region with the high C.V value of 554.77%, 265.98%, 167.77% and 341.93% respectively. In general, MFIs in East Asia differ from the other regions because of high variations across variables, i.e. MFIs in this region appear to be differed widely in terms of their mix of inputs and outputs.

Table 1: Descriptive Statistics for Latin America Region Data

Latin America (N=121)					
Variables	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**CV (%)**
Inputs:					
Operating Assets (million 2005 constant USD)	43.62	86.56	0.12	468.24	198.45
Admin, D&A expense (million 2005 constant USD)	5.10	7.33	0.04	31.51	143.79
#Loan officers	242	285	7	1141	117.36
Outputs:					
Net Loan Portfolio (million 2005 constant USD)	127.58	232.76	0.29	1114.13	182.44
#women borrowers	30559	34974	361	141044	114.45
#male borrowers	20354	28397	0	122839	139.51
Average loan balance/GNI per capita (%)	125.48	249.00	4.91	2005.07	198.44

Table 2: Descriptive Statistics for Middle East and North Africa Region Data

MENA (N=108)					
Variables	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**CV (%)**
Inputs:					
Operating Assets (million 2005 constant USD)	9.43	14.28	0.19	62.05	151.38
Admin, D&A expense (million 2005 constant USD)	2.56	3.47	0.10	16.88	135.58
#Loan officers	314	407	19	2109	129.76
Outputs:					
Net Loan Portfolio (million 2005 constant USD)	45.59	65.94	0.68	292.74	144.65
#women borrowers	45324	50417	2259	227920	111.24
#male borrowers	34510	57896	0	258369	167.77
Average loan balance/GNI per capita (%)	17.01	7.45	6.33	37.54	43.78

Table 3: Descriptive Statistics for East Asia Region Data

East Asia (N=86)					
Variables	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**CV (%)**
Inputs:					
Operating Assets (million 2005 constant USD)	18.15	38.83	0.54	270.97	213.91
Admin, D&A expense (million 2005 constant USD)	4.21	8.93	0.17	78.72	212.29
#Loan officers	555	619	50	2989	111.65
Outputs:					
Net Loan Portfolio (million 2005 constant USD)	116.97	463.96	1.61	4262.00	396.65
#women borrowers	175356	488808	6049	4440150	278.75
#male borrowers	47603	264084	0	2459850	554.77
Average loan balance/GNI per capita (%)	82.59	103.21	3.97	535.41	124.97

Table 4: Descriptive Statistics for South Asia Region Data

South Asia (N=143)					
Variables	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**CV (%)**
Inputs:					
Operating Assets (million 2005 constant USD)	80.64	181.99	0.37	1156.95	225.70
Admin, D&A expense (million 2005 constant USD)	4.81	7.47	0.14	39.08	155.12
#Loan officers	3004	3910	94	15331	130.15
Outputs:					
Net Loan Portfolio (million 2005 constant USD)	158.75	235.56	1.48	1140.51	148.39
#women borrowers	1290361	1817038	15987	7037766	140.82
#male borrowers	44327	117903	0	613872	265.98
Average loan balance/GNI per capita (%)	15.42	4.81	5.20	40.41	31.17

Table 5: Descriptive Statistics for Sub-Saharan Africa Region Data

Sub-Saharan Africa (N=75)					
Variables	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**CV (%)**
Inputs:					
Operating Assets (million 2005 constant USD)	87.53	188.90	0.94	922.94	215.82
Admin, D&A expense (million 2005 constant USD)	9.80	17.26	0.27	85.14	176.10
#Loan officers	426	472	23	1847	110.81
Outputs:					
Net Loan Portfolio (million 2005 constant USD)	128.30	271.46	3.34	1474.31	211.59
#women borrowers	70229	101974	2474	413040	145.20
#male borrowers	51003	99437	0	497200	194.96
Average loan balance/GNI per capita (%)	136.81	84.05	14.15	340.88	61.43

Table 6: Descriptive Statistics for Meta Frontier Data

Meta Frontier Data (N=533)					
Variables	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**CV (%)**
Inputs:					
Operating Assets (million 2005 constant USD)	48.69	129.36	0.12	1156.95	265.66
Admin, D&A expense (million 2005 constant USD)	5.03	9.39	0.04	85.14	186.84
#Loan officers	1074	2367	7	15331	220.39
Outputs:					
Net Loan Portfolio (million 2005 constant USD)	117.72	272.21	0.29	4262.00	231.24
#women borrowers	400492	1102192	361	7037766	275.21
#male borrowers	38364	131176	0	2459850	341.93
Average loan balance/GNI per capita (%)	68.65	139.32	3.97	2005.07	202.95

4.3 Efficiency and Hypothesis Tests Results

4.3.1 Meta Frontier Efficiency Scores

There are two models that have been used in the calculation of efficiency scores of MFIs in this thesis: model 1 has average loan outstanding per borrower per GNI per capita, while model 2 does not have this variable. The results obtained from both models are presented in table 7.

Table 7: Average Efficiency Scores for Meta Frontier, Group Frontier and GAP

Region	N	Model 1			Model 2		
		Average vrsteM	Average vrsteG	Average GAP	Average vrsteM	Average vrsteG	Average GAP
Latin America	121	0.60	0.89	0.67	0.49	0.84	0.57
Middle East & North Africa	108	0.47	0.85	0.55	0.43	0.80	0.54
East Asia	86	0.65	0.83	0.77	0.52	0.73	0.72
South Asia	143	0.69	0.83	0.83	0.68	0.73	0.93
Sub-Sahara Africa	75	0.59	0.95	0.62	0.38	0.89	0.42
Meta Frontier	533	0.60			0.52		

This thesis will first discuss the results from the meta frontier with reference to table 7 above. The average efficiency values on the meta frontier or by region for model 1is higher than those in model 2. This is because model one has an additional output variable (average loan balance per borrower per GNI per capita), which increases its efficiency score.

The meta frontier average efficiency score for model 1 (0.60) is higher than that of model 2 (0.52). Additionally, the average vrsteM value for regions in model 1 are higher than those in model 2. In model 1, South Asia has the highest value whereas MENA has the lowest value of vrsteM, whereas in model two, South Asia has the highest score (0.68) and Sub-Saharan Africa has the lowest score (0.38). For details on the efficiency score of each model, see Appendices I and II.

The thesis will now discuss the efficient peers and the characteristics of the frequent role models on the meta frontier. Table 8 below provides information on the number of

efficient firms on the meta frontier and the number of efficient firms on the group frontier by region.

Table 8: Efficient Peers on Meta Frontier and Group Frontier

Region	#Efficient firms on the meta frontier	#Efficient firms on the group frontier
Model 1		
Latin America(N=121)	13	50
MENA(N=108)	1	34
East Asia(N=86)	13	36
South Asia(N=143)	23	42
Sub-Saharan Africa (N=75)	6	39
Meta frontier	56	
Model 2		
Latin America(N=121)	10	39
MENA(N=108)	1	34
East Asia(N=86)	5	18
South Asia(N=143)	23	33
Sub-Saharan Africa (N=75)	1	29
Meta frontier	40	

An efficient peer operates on the meta frontier, has an average efficiency score of 1, thus produces a maximum output of 100% given the set of inputs and the unrestricted technology. As shown in table 8 above, model 1 has 56 efficient peers on the meta frontier (vrsteM); South Asia has concentrated number of efficient peers (23) in comparison to other regions. Latin America and East Asia have 13 efficient peers and lastly MENA and Sub-Saharan Africa has 1 and 6 efficient peers respectively. Model 2 has 40 efficient peers on the meta frontier; South Asia is highly concentrated with efficient peers in comparison to other regions. It has 23 efficient peers, Latin America has 10, East Asia had 5, MENA and Sub-Saharan Africa have 1 efficient peer. Therefore, DMUs in South Asia region have more access to the meta frontier technology whereas those in Sub-Saharan Africa have the least access.

Each inefficient DMU has one or more other peer DMUs that it can model after, if it wants to improve its performance through technology transfer. The number of times a certain DMU appears as a role model for other DMUs is defined as peer count. DMUs with high peer count are considered ideal and their model replicable for improvement of results. Starting with model 1, the frequent peers for the meta frontier are mainly located in Latin America, East Asia and South Asia regions. MENA has 1 frequent peer and Sub-Saharan Africa has 4. Vietnam Bank for Social Policies (VBSP), firm 302, located in East Asia and has a peer count of 396. In South Asia, Spandana, firm 442, has the highest number of peer count of 127 and Banco Fassil, firm 12, in Latin America has a peer count of 110. Inmaa, firm 194, is the only firm with a frequent peer in MENA with peer count of 24. Now on to model 2, Vietnam Bank for Social Policies (VBSP), firm 302, has the peer count of 428 and Spandana, firm 442 has a peer count of 196. CDS Cameroun, firm 488, the only efficient DMU in the Sub-Saharan Africa region in model 2. Overall, Vietnam Bank for Social Policies (VBSP), firm 302, has the highest number of peer counts in both models, indicating that this firm has been widely used as role models for other firms in both models and is considered an ideal DMU. For more details about frequent peers and regions located in, see Appendices III and IV

Spandana microfinance institution located in Hyderabad, India. Banerjee et al. (2015) outline that Spandana is a profit organization mainly targets women between age of 18-59 with proper identification and residential proof and does not require borrowers to have any microentrepreneurial idea/activity. The authors further explain that the organization has a year loan term with a weekly repayment method and 24% interest rate.

These are group loans given to groups of roughly 6-10 people and repayment relies on groups. The average loan size as a proportion of income is approximately 22%.

Vietnam Bank for Social Policies (VBSP) is a non-profit organization established as a government policy to reduce poverty and increase access to affordable and sustainable financial services to the underserved across the country. The funds for this program come from government budgeting, state budgeting, auctioning of VBSP bonds among others. This program mainly targets people who cannot access commercial banks in remotes areas of the country. VBSP encourages borrowers to take loan for business purposes, home improvement, and increase access of safe water and electricity (Devex, n.d.). VBSP also provides educational scholarships to students from low-income families, access to finance for households for labor migrants and businesses that provide jobs for disadvantaged ethnic minority and former drug addicts.

As explained in Mix Market brochure (2016), VBSP partnered with the local organization such as Women Union, Farmer Union, Veteran Union and Youth union that assisted in lending process by communicating loan policies and programs being offered. Furthermore, these organization assist in identifying poor people in the local communities because of the knowledge on the people living in the area. The article further mentions that the process of selecting eligible households involved a committee made of local organizations, local authorities and village elders, which was a better way of identifying a good candidate for the loan: one who needs it and can repay it back, thus efficient loan procedures and management. The brochure also highlights that VBSP publicly displayed a list of active borrowers and non-performing loans, which encourage high credibility among borrowers in the community. Lastly, the brochure emphasizes that VBSP had set dates and

points that they will be carrying out financial services within the community to ensure consistency, convenience and easy of transactions.

Both Spandana and VBSP focus on the wellness of the community through microlending. While Spandana focuses on women, VBSP focuses on the poverty levels across genders. VBSP stands out as a government-sponsored microfinance institution initiated to implement government programs that involves the local people in making decisions. For instance, eligibility of the candidate depends on the need of aid and reputation based on the knowledge of the local committee.

4.3.2 Efficiency Score for DMUs by Region

This section will focus on the group frontier efficiency scores of MFIs with reference to table 7. The average vrsteG in model 1 are higher than in model 2. In model 1, the average vrsteG ranges from 0.83 to 0.95, Sub-Saharan Africa has the highest value and East Asia and South Asia with the lowest at 0.83. This range relatively implies that the MFIs in the regions produce at least between 83% and 95% of the maximum output given the constant set of inputs and technology in each respective region. In model 2, the average vrsteG ranges from 0.73 to 0.89, with Sub-Saharan Africa having the highest score. Thus, the MFIs produces between 73% and 89% of the maximum output given the technology and the inputs. With reference to table 8, Latin America region has the highest number of efficient peer on the group frontier in both model 1 and 2. MENA has the least number of efficient peers (34) in model 1 and East Asia (18) in model 2. For further details on group frontier efficiency scores of DMUs by region, see Appendices V-IX.

Based on the information in table 7, MFIs have higher average efficiency scores on group frontier than on the meta frontier. For instance, the average efficiency score of Sub-Saharan Africa on group frontier is 0.95 and 0.59 on the meta frontier in model 1. This

thesis will focus on exploring the characteristics that make Credit Du Sahel (CDS) located in Cameroon (Sub-Saharan Africa region), which is efficient on the group frontier but inefficient on the meta frontier and VBSP is one of its efficient peers in the meta frontier model. CDS was established in 1997 as a corporative bank then later added the microfinance institution aspect in 2004 as explained by Andre (2008). The author mentioned that CDS has various stages of authentication before a potential client is given a loan. The author further outlined the stages as follows: first, getting the application file, where the client should have an Identification card, pay slips from the last three months, and a duty certificate. Second, background details on the client is done based on morality, account movements and commission drawn on the account. Third, credit committee decides. Fourth, collateral or any material to show guarantee of payment is given. Fifth, terms and conditions on the loan are defined and lastly the credit agreement signed. After all these stages, the client can now access the loan. The MFI has further tightened its operations to minimize any debt by giving a production based loan guarantee (Business in Cameroon, 2018). This article explains that MFI takes charge of the crops grown by farmers, then 2-3 months after harvesting they sell the produce. The profit obtained is then used to cover the loan plus the interest and the rest is directed to the farmers. CDS ensures financial sustainability by taking charge of production and selling of the crops. CDS is also much stricter when it comes to requirements for a loan compared to its role model: VBSP. VBSP entirely depends on local committee to assist in the selection of eligible clients for a loan entirely based on need and character of the client. VBSP is a government run initiative whereas CDS is a for profit cooperative as well as a microfinance institution. Therefore, for CDS to improve its efficiency on the meta frontier, it can alter its potential

client identification process to need based or reducing the requirements. Additionally, CDS can involve more people from the local communities to assist in determining if a client is eligible for loan or not.

4.3.3 Evaluation of GAP Values by Region

This thesis will now discuss the average GAP value with reference to table 7. GAP is the ratio of meta frontier efficiency scores to group frontier efficiency scores. GAP value shows the maximum output level given the group frontier technology and the DMU's input level as a percentage of the maximum output level possible had the DMU have access to the meta frontier technology. Therefore, the closer the GAP value is to 1, the higher the DMU's ability to access the meta frontier technology. Average GAP values in model 1 are greater than those of model 2. South Asia region has the highest average GAP values of 0.83 and 0.93 in model 1 and 2 respectively. This implies that DMUs from this region produce 83% and 93% of maximum potential output, given the set on inputs and meta frontier technology in respective models, after eliminating inefficiency relative to the group frontier. Sub-Saharan Africa has an average GAP value of 0.62 and 0.42 in models 1 and 2 respectively. Despite the Sub-Saharan Africa region being highly efficient in the group frontier, the MFIs in this region have very limit access to the meta frontier technology, compared to MFIs in other regions. For DMUs in Sub-Saharan Africa to improve their efficiency performance on the meta frontier, they must experience technology transfer through role modelling.

Based on table 8, South Asia contributes the most to the construction of the meta frontier with 23 out of 56 meta frontier efficient MFIs. East Asia and Latin America have the second largest share on the meta frontier. Only one MFI in MENA region has access to

the meta frontier technology. In model 2, MFIs from South Asia make up 57.5% of the meta frontier while MENA and Sub-Saharan Africa each contribute to only 2.5% with one out of 40 meta frontier efficient MFIs come from each region. It is evident that MFIs in South Asia region have more access to the unrestricted technology.

4.3.4 Hypothesis Testing Results for Efficiency Scores

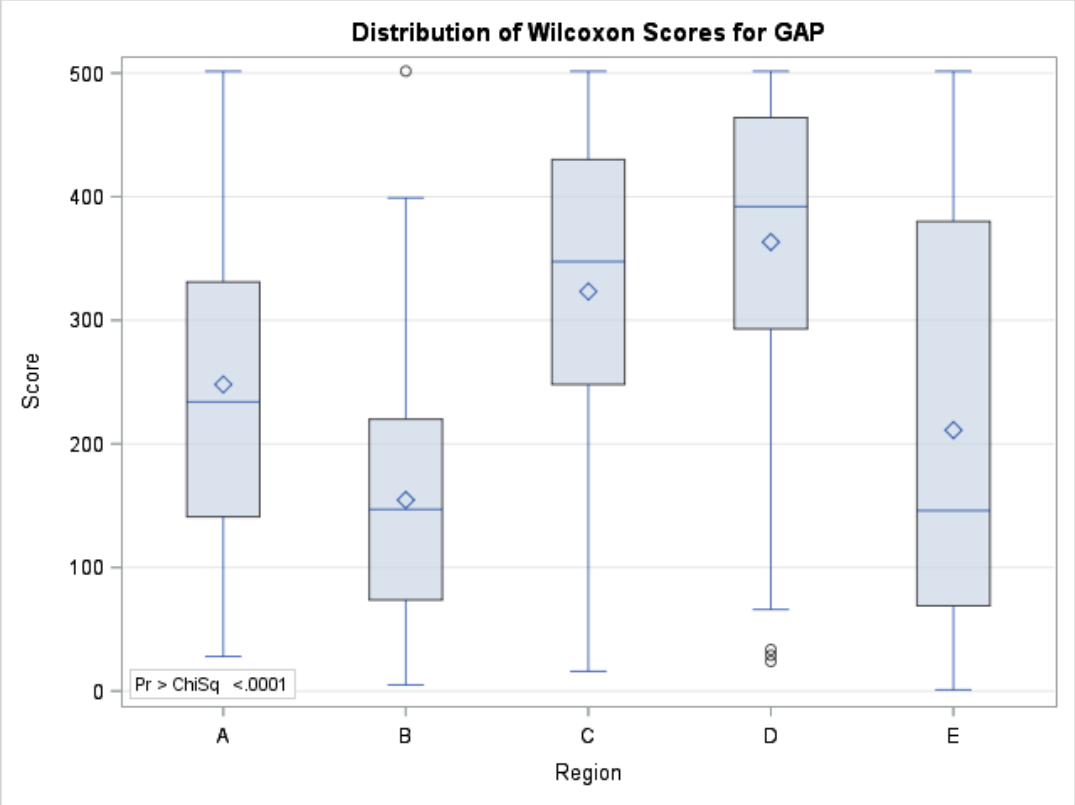
This thesis carries out several hypothesis tests as outlined in Section 3.5. One of the hypothesis is that the average efficiency scores are the same across all regions, against the alternative hypothesis that average efficiency scores are not the same across all regions. This thesis uses Kruskal-Wallis nonparametric test to test whether the meta-frontier efficiency scores, on average, differ across regions. The Chi-square statistic for model 1 is 68.7 and for model 2 is 113.4. Both are statistically significance at the 1%, indicating that average meta-frontier efficiency scores differ across regions. In other words, MFIs in each region are not equally efficient. For details of the tests, see Appendices X and XI.

This thesis also tests the distributions of GAP. The null hypothesis states that GAP distribution is the same across all regions and the alternative hypothesis is that GAP distribution is not the same across regions. Based on the Kruskal-Wallis nonparametric test, the Chi-square statistics for models 1 and 2 are 137.0 and 283.9, respectively. These statistics are statistically significance at the 1% level. Therefore, this thesis finds evidence to reject the null hypothesis that the distribution of GAP is same across regions. For details of the test, see Appendices XII and XIII.

This thesis further analyzes the distribution of GAP across regions using boxplots. Figures 3 and 4 below show the distribution of GAP across region for model 1 and 2 respectively. In the figures below, letters A, B, C, D and E represents each distinct region

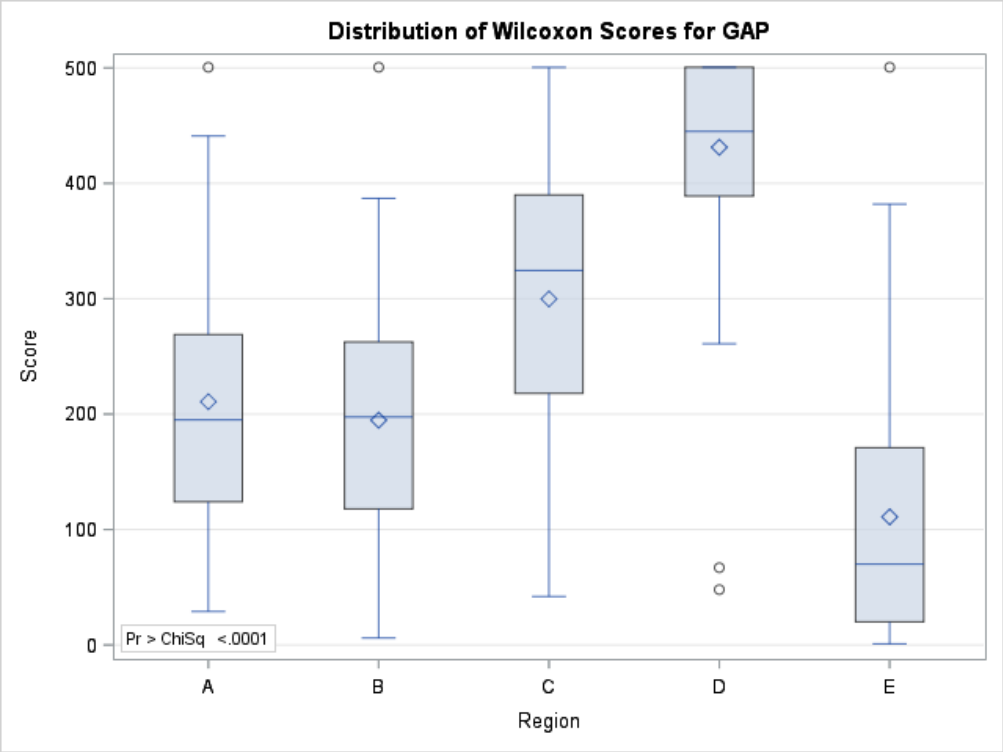
used in the data as follows: A= Latin America, B= Middle East and North Africa, C= East Asia, D= South Asia and E= Sub-Saharan Africa.

Figure 3: Distribution of GAP for Model 1



In figure 3, MENA (B) region and South Asia (D) have outliers, though South Asia has outlier in the lower quartile of the boxplot. South Asia and East Asia regions largely contribute toward the meta frontier. This is because the mean scores of GAP is relatively high. On the other hand, MENA (B) and Sub-Saharan Africa (E) have relatively lower means scores and have a lower contribution to the meta frontier as shown in table 8.

Figure 4: Distribution of GAP for Model 2



In figure 4 above, Latin America (A), MENA (B), Sub-Saharan Africa (E) and South Asia (D) have outliers though the South Asia has outliers below the lower quartile of the boxplot. It is also clear that South Asia heavily contributes to the meta frontier since the mean scores are relatively high. MENA and Sub-Saharan Africa DMUs on the other hand do not largely contribute to the meta frontier as shown in table 8.

4.3.5 Ranking of Efficiency Score in Models 1 and 2

This thesis uses the Spearman rank correlation to test whether the rankings of MFI efficiency obtained from the two models are correlated. The null hypothesis states that rankings of MFI efficiency in model 1 is not related to the rankings of MFI efficiency in model 2 against the alternative hypothesis that the rankings of MFI efficiency in model 1 is related to the rankings of MFI efficiency in model 2.

Table 9 below shows the results obtained from ranking the efficiency scores in model 1 and 2. The correlation coefficient values range between 0.76 and 0.96 and are significant at 1% level. MENA has the highest value and East Asia the lowest value. The correlation values obtained imply that there is a high and positive correlation between the ranking in model 1 and 2. In other words, MFIs in the sample receive similar ranks, regardless of the model specification. Hence, our results are robust across models.

Table 9: Spearman' s Correlation Rank for Models 1 and 2

Region	**Group: Mean TEVRS1**	**Group: Mean TEVRS2**	**Correlation coefficient**	**P value**
Latin America(N=121)	0.89	0.84	0.88	<.0001
MENA(N=108)	0.85	0.80	0.96	<.0001
East Asia(N=86)	0.83	0.73	0.76	<.0001
South Asia(N=143)	0.83	0.73	0.80	<.0001
Sub-Saharan Africa (N=75)	0.95	0.89	0.82	<.0001

4.3.6 Correlation between Efficiency Scores and Gender Inequality Index

In this section, we test the null hypothesis test that efficiency scores are not linearly related to the Gender Inequality Index against the alternative hypothesis that, efficiency scores and Gender Inequality Index are linearly related. This thesis uses correlation coefficient as a measure of linear association between the two variables. Rejecting the null hypothesis indicates that microfinance efficiency scores and Gender Inequality Index are related. The sign of the correlation coefficient indicates the direction of the relationship. This thesis expects that the correlation coefficient has negative sign, meaning that the efficiency scores are inversely related to the Gender Inequality Index; as the efficiency score increases, the gender inequality index decreases, and vice versa.

Gender Inequality Index (GII) is used to measure the disparity between male and female in any given community. The GII ranges from 0 to 1. A lower value of GII indicates less inequality present and higher value shows more inequality present. The GII data was available for 1995, 2000, 2005 and 2010-2015. Due to missing data on the years between 2002-2016, this thesis used 2005, 2010 and 2015. Additionally, the GII values for Madagascar were not reported, thus the 6 MFIs from the country were excluded from the analysis, reducing the number of DMUs in Sub-Saharan Africa to 69 that were used to test this hypothesis. Therefore, only 16 countries were used in the analysis. Table 10 below, shows the GII values of countries in the data across regions. Cameroon has the highest GII value of 0.661 in 2005 and Vietnam has the lowest of 0.317 in 2005.

Table 10: Gender Inequality Index for Countries in the Data

Country	2005	2010	2015
Bangladesh	0.591	0.559	0.52
Bolivia	0.559	0.503	0.446
Brazil	0.469	0.454	0.414
Cambodia	0.561	0.492	0.479
Cameroon	0.661	0.623	0.568
Ethiopia	0.611	0.576	0.499
Guatemala	0.57	0.54	0.494
Honduras	0.515	0.513	0.461
India	0.619	0.591	0.53
Jordan	0.557	0.488	0.478
Kenya	0.654	0.616	0.565
Lebanon	-	0.404	0.381
Morocco	0.58	0.563	0.494
Pakistan	0.595	0.57	0.546
Senegal	0.629	0.575	0.521
Viet Nam	0.317	0.324	0.337

Source: United Nations Human Development database

The efficiency score of DMUs in regions were first classified by country of operation then average values of efficiency scores obtained between years 2002-2005, 2006-2010 and 2011-2016. These average efficiency scores calculated between 2002-

2005, 2006-2010 and 2011-2016 were then correlated with the 2005, 2010 and 2015 GII values to obtain coefficient values as shown in table 11 below.

Table 11: Correlation Results Between GII and Average Efficiency Scores

Model 1		
Region	Correlation coefficient	P value
Latin America(N=121)	0.29	0.39
MENA(N=108)	0.45	0.23
East Asia(N=86)	-0.67	0.14
South Asia(N=143)	0.18	0.64
Sub-Saharan Africa (N=69)	-0.16	0.7
Model 2		
Region	Correlation coefficient	P value
Latin America(N=121)	-0.09	0.8
MENA(N=108)	0.3	0.43
East Asia(N=86)	-0.7	0.12
South Asia(N=143)	0.13	0.72
Sub-Saharan Africa (N=69)	-0.25	0.56

From table 11, the correlation coefficient values range from -0.70 to 0.45. Within this range, the negative values show a negative correlation between the efficiency scores and GII variables, such that as efficiency scores of MFIs increase, the GII decreases and vice versa. East Asia region has a negative correlation coefficient of -0.67 in model 1 and -0.70 in model 2, which are the closest value to a perfect negative correlation of -1. This implies that East Asia in comparison to other regions has a stronger negative correlation between the GII and efficiency score variable.

On the other hand, the positive correlation coefficient value implies that both the efficiency score increases and GII increase simultaneously. MENA region, in comparison to other regions, has the highest positive value of correlation coefficients of 0.45 and 0.30 in models 1 and 2 respectively.

The p values of the correlation coefficient values obtained range between 0.12 and 0.80. The p values are greater than 0.01, therefore this thesis does not find evidence to reject the null hypothesis that efficiency scores are not linearly related to the Gender Inequality Index.

4.4 Results Conclusion

In summary, the results reflect that the average efficiency scores and the distribution of GAP vary across regions on the meta frontier. Also, the efficiency ranking in model 1 and 2 are highly related which confirms the robustness of the results obtained in the research. Regarding the correlation between GII and efficiency scores, the results obtained were not significant at 1% level since the p values were greater than 0.01. This thesis does not find enough supporting evidence to reject the null hypothesis that efficiency scores are not linearly related to the Gender Inequality Index.

Chapter 5

Conclusion

The primary focus of this thesis is to evaluate how the efficiency of a microfinance institutions affects Gender Inequality Index. The null hypothesis test is efficiency scores are not related to the Gender Inequality Index against the alternative hypothesis that, efficiency scores and Gender Inequality Index are inversely related. Rejecting the null hypothesis indicates that microfinance efficiency scores and Gender Inequality Index are inversely related; that is, as the efficiency score increases, the gender inequality index decreases, and vice versa. Consequently, microfinance institutions reduce the gender inequality by empowering women in the society.

This thesis did not find sufficient evidence to reject the null hypothesis. Though an in-depth analysis of the frequent peers in the meta frontier, such as Spandana and Vietnam Bank for Social Policies (VBSP), showed that there is potential for microfinance institutions to reduce poverty levels and empower women in the society. Therefore, this thesis serves as an additional evidence that can be used by policy makers to better the structure and efficiency of microfinance institutions in their communities.

The first policy recommendation might focus on designing programs that provide vocational training such as tailoring, hairdressing, finance classes among others. This is because women start to actively contribute towards the overall GDP of a country by being involved in business activities unlike when they are working in the household and contributing more to the wellness of the family. Therefore, equipping women with better skills on how to run a successful business will not only provide financial freedom but also empower women and sustainable development of the country.

The second policy recommendation might include designing and implementing policies that would encourage governments to take part in MFIs financing and management. Governments can finance MFI projects in various ways such as selling bonds, incorporating annual budgeting and subsidizing interest rates on loans. By incorporating MFIs spending into the national budget, the government sets aside a fraction of the country's revenue in a fiscal year, specifically designed for expanding, subsidizing interest rates on loans and ensuring financial sustainability within the MFI sector. VBSP clearly demonstrated a government-led initiative that has successfully being implemented and has had a positive impact on the people. Vietnam has maintained a relatively low GII value of around 0.335 as of 2015. Access to finance plays a significant role in improving standards of living and poverty levels. According to Mix Market brochure (2016), VBSP brought about positive results in reducing the overall poverty rate from 7.8% in 2013 to 4.5% in 2015. For instance, the VBSP loan is encouraged for various reasons such as education, housing, business, water and electricity. Therefore, the loans aim at the overall wellness of the community.

One of the limitations of this thesis is that, it does not clearly capture the effects of a country's already established infrastructure on the efficiency of microfinance institutions. Microfinance institutions in countries with already developed financial infrastructure may not reflect significant results on its effect in the community. Additionally, some countries have low Gender Inequality Index value therefore MFIs might be more efficient in these places because of low cost of operating assets and Administration and Depreciation & Amortization expense. Therefore, under these circumstances MFIs might not necessarily cause women empowerment even if they are efficient.

Another limitation of this thesis is that Gender Inequality Index is affected with other factors such as labor market participation, access to education, and reproductive health other than empowerment. For GII value to change these factors need to shift almost simultaneously to bring about reduction in gender inequality. Controlling for the above limitations, this research can be furthered to evaluate effects of microfinance institutions on women empowerment in the communities.

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Appendices

Appendix I

Efficiency Scores for Meta Frontier, Group Frontier and the GAP: Model 1

firm	**vrsteM**	vrsteG	GAP	Region
1	**1**	**1**	1.00	LA
2	**1**	**1**	1.00	LA
3	**1**	**1**	1.00	LA
4	**0.994**	**1**	0.99	LA
5	**0.906**	**0.982**	0.92	LA
6	**0.772**	**1**	0.77	LA
7	**1**	**1**	1.00	LA
8	**0.777**	**1**	0.78	LA
9	**0.693**	**1**	0.69	LA
10	**0.437**	**0.688**	0.64	LA
11	**0.5**	**0.57**	0.88	LA
12	**1**	**1**	1.00	LA
13	**0.721**	**0.78**	0.92	LA
14	**0.57**	**0.666**	0.86	LA
15	**0.553**	**0.676**	0.82	LA
16	**0.442**	**0.544**	0.81	LA
17	**0.431**	**0.545**	0.79	LA
18	**0.413**	**0.618**	0.67	LA
19	**0.74**	**0.955**	0.77	LA
20	**1**	**1**	1.00	LA
21	**1**	**1**	1.00	LA
22	**0.639**	**0.848**	0.75	LA
23	**0.59**	**0.969**	0.61	LA
24	**0.496**	**0.909**	0.55	LA
25	**0.498**	**0.931**	0.53	LA

firm	**vrsteM**	vrsteG	GAP	Region
26	**0.591**	**1**	0.59	LA
27	**0.59**	**1**	0.59	LA
28	**0.581**	**0.99**	0.59	LA
29	**0.561**	**0.97**	0.58	LA
30	**0.638**	**0.985**	0.65	LA
31	**0.661**	**1**	0.66	LA
32	**0.646**	**1**	0.65	LA
33	**0.62**	**1**	0.62	LA
34	**0.631**	**1**	0.63	LA
35	**0.654**	**1**	0.65	LA
36	**0.698**	**1**	0.70	LA
37	**0.601**	**0.815**	0.74	LA
38	**0.641**	**0.993**	0.65	LA
39	**0.63**	**1**	0.63	LA
40	**0.506**	**0.7**	0.72	LA
41	**0.428**	**0.679**	0.63	LA
42	**0.484**	**0.874**	0.55	LA
43	**0.448**	**0.753**	0.59	LA
44	**0.366**	**0.627**	0.58	LA
45	**0.315**	**0.604**	0.52	LA
46	**0.257**	**0.636**	0.40	LA
47	**0.763**	**0.992**	0.77	LA
48	**0.468**	**0.884**	0.53	LA
49	**0.36**	**0.861**	0.42	LA
50	**0.345**	**0.88**	0.39	LA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
51	**0.349**	**0.904**	0.39	LA
52	**0.369**	**0.886**	0.42	LA
53	**0.372**	**0.897**	0.41	LA
54	**0.423**	**0.816**	0.52	LA
55	**0.459**	**0.765**	0.60	LA
56	**0.599**	**0.891**	0.67	LA
57	**0.553**	**0.902**	0.61	LA
58	**0.632**	**0.961**	0.66	LA
59	**0.634**	**1**	0.63	LA
60	**1**	**1**	1.00	LA
61	**0.604**	**0.604**	1.00	LA
62	**0.775**	**1**	0.78	LA
63	**0.423**	**0.711**	0.59	LA
64	**1**	**1**	1.00	LA
65	**0.447**	**1**	0.45	LA
66	**0.629**	**1**	0.63	LA
67	**0.476**	**0.948**	0.50	LA
68	**0.422**	**0.899**	0.47	LA
69	**0.407**	**0.958**	0.42	LA
70	**0.376**	**0.944**	0.40	LA
71	**0.359**	**0.883**	0.41	LA
72	**0.369**	**0.901**	0.41	LA
73	**0.417**	**0.945**	0.44	LA
74	**0.477**	**1**	0.48	LA
75	**0.469**	**1**	0.47	LA

firm	**vrsteM**	vrsteG	GAP	Region
76	**0.471**	**0.925**	0.51	LA
77	**0.564**	**1**	0.56	LA
78	**0.577**	**1**	0.58	LA
79	**0.458**	**1**	0.46	LA
80	**0.51**	**1**	0.51	LA
81	**0.541**	**1**	0.54	LA
82	**0.536**	**0.987**	0.54	LA
83	**0.66**	**1**	0.66	LA
84	**0.578**	**0.957**	0.60	LA
85	**0.514**	**0.897**	0.57	LA
86	**0.495**	**0.984**	0.50	LA
87	**0.658**	**0.933**	0.71	LA
88	**0.753**	**1**	0.75	LA
89	**0.871**	**1**	0.87	LA
90	**0.51**	**0.816**	0.63	LA
91	**0.495**	**0.813**	0.61	LA
92	**0.509**	**0.868**	0.59	LA
93	**0.61**	**1**	0.61	LA
94	**0.54**	**1**	0.54	LA
95	**0.579**	**0.736**	0.79	LA
96	**1**	**1**	1.00	LA
97	**1**	**1**	1.00	LA
98	**0.907**	**1**	0.91	LA
99	**0.959**	**1**	0.96	LA
100	**0.344**	**0.482**	0.71	LA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
101	**0.313**	**0.491**	0.64	LA
102	**0.345**	**0.523**	0.66	LA
103	**0.33**	**0.508**	0.65	LA
104	**0.362**	**0.479**	0.76	LA
105	**0.616**	**1**	0.62	LA
106	**0.581**	**1**	0.58	LA
107	**0.416**	**0.723**	0.58	LA
108	**0.451**	**0.767**	0.59	LA
109	**0.676**	**0.761**	0.89	LA
110	**1**	**1**	1.00	LA
111	**1**	**1**	1.00	LA
112	**0.776**	**0.979**	0.79	LA
113	**0.669**	**0.853**	0.78	LA
114	**0.586**	**0.921**	0.64	LA
115	**0.704**	**0.973**	0.72	LA
116	**0.686**	**1**	0.69	LA
117	**0.689**	**1**	0.69	LA
118	**0.53**	**1**	0.53	LA
119	**0.482**	**1**	0.48	LA
120	**0.332**	**0.692**	0.48	LA
121	**0.334**	**0.648**	0.52	LA
122	**0.647**	**1**	0.65	MENA
123	**0.532**	**0.874**	0.61	MENA
124	**0.567**	**0.892**	0.64	MENA
125	**0.444**	**0.695**	0.64	MENA

firm	**vrsteM**	vrsteG	GAP	Region
126	**0.376**	**0.599**	0.63	MENA
127	**0.397**	**0.552**	0.72	MENA
128	**0.533**	**0.836**	0.64	MENA
129	**0.253**	**0.45**	0.56	MENA
130	**0.325**	**0.551**	0.59	MENA
131	**0.338**	**0.546**	0.62	MENA
132	**0.357**	**0.61**	0.59	MENA
133	**0.895**	**1**	0.90	MENA
134	**0.861**	**1**	0.86	MENA
135	**0.635**	**1**	0.64	MENA
136	**0.477**	**1**	0.48	MENA
137	**0.646**	**1**	0.65	MENA
138	**0.545**	**0.945**	0.58	MENA
139	**0.65**	**1**	0.65	MENA
140	**0.584**	**0.964**	0.61	MENA
141	**0.587**	**0.977**	0.60	MENA
142	**0.654**	**1**	0.65	MENA
143	**0.665**	**1**	0.67	MENA
144	**0.283**	**0.452**	0.63	MENA
145	**0.309**	**0.467**	0.66	MENA
146	**0.364**	**0.584**	0.62	MENA
147	**0.42**	**0.75**	0.56	MENA
148	**0.494**	**0.806**	0.61	MENA
149	**0.522**	**0.901**	0.58	MENA
150	**0.45**	**0.817**	0.55	MENA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
151	**0.435**	**0.852**	0.51	MENA
152	**0.466**	**0.914**	0.51	MENA
153	**0.441**	**0.884**	0.50	MENA
154	**0.402**	**0.918**	0.44	MENA
155	**0.499**	**1**	0.50	MENA
156	**0.406**	**1**	0.41	MENA
157	**0.328**	**0.759**	0.43	MENA
158	**0.316**	**0.711**	0.44	MENA
159	**0.538**	**1**	0.54	MENA
160	**0.318**	**0.63**	0.50	MENA
161	**0.179**	**0.412**	0.43	MENA
162	**0.312**	**0.592**	0.53	MENA
163	**0.326**	**0.612**	0.53	MENA
164	**0.266**	**0.538**	0.49	MENA
165	**0.235**	**0.501**	0.47	MENA
166	**0.247**	**0.499**	0.49	MENA
167	**0.259**	**0.455**	0.57	MENA
168	**0.237**	**0.486**	0.49	MENA
169	**0.585**	**0.825**	0.71	MENA
170	**0.318**	**0.874**	0.36	MENA
171	**0.265**	**0.869**	0.30	MENA
172	**0.841**	**1**	0.84	MENA
173	**0.569**	**1**	0.57	MENA
174	**0.47**	**0.884**	0.53	MENA
175	**0.368**	**0.918**	0.40	MENA

firm	**vrsteM**	vrsteG	GAP	Region
176	**0.423**	**1**	0.42	MENA
177	**0.331**	**0.903**	0.37	MENA
178	**0.259**	**0.94**	0.28	MENA
179	**0.252**	**0.924**	0.27	MENA
180	**0.287**	**0.874**	0.33	MENA
181	**0.357**	**0.741**	0.48	MENA
182	**0.499**	**0.976**	0.51	MENA
183	**0.599**	**1**	0.60	MENA
184	**0.698**	**1**	0.70	MENA
185	**0.525**	**0.88**	0.60	MENA
186	**0.412**	**0.71**	0.58	MENA
187	**0.396**	**0.774**	0.51	MENA
188	**0.33**	**0.727**	0.45	MENA
189	**0.306**	**0.714**	0.43	MENA
190	**0.408**	**0.932**	0.44	MENA
191	**0.276**	**0.834**	0.33	MENA
192	**0.286**	**0.784**	0.36	MENA
193	**0.786**	**1**	0.79	MENA
194	**1**	**1**	1.00	MENA
195	**0.596**	**0.876**	0.68	MENA
196	**0.445**	**0.704**	0.63	MENA
197	**0.693**	**0.958**	0.72	MENA
198	**0.455**	**0.875**	0.52	MENA
199	**0.712**	**0.854**	0.83	MENA
200	**0.434**	**0.889**	0.49	MENA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
201	**0.466**	**0.751**	0.62	MENA
202	**0.401**	**0.687**	0.58	MENA
203	**0.438**	**0.751**	0.58	MENA
204	**0.366**	**0.599**	0.61	MENA
205	**0.408**	**0.956**	0.43	MENA
206	**0.444**	**0.951**	0.47	MENA
207	**0.494**	**1**	0.49	MENA
208	**0.575**	**1**	0.58	MENA
209	**0.623**	**1**	0.62	MENA
210	**0.565**	**0.98**	0.58	MENA
211	**0.522**	**1**	0.52	MENA
212	**0.513**	**1**	0.51	MENA
213	**0.503**	**1**	0.50	MENA
214	**0.428**	**1**	0.43	MENA
215	**0.391**	**0.945**	0.41	MENA
216	**0.415**	**1**	0.42	MENA
217	**0.403**	**1**	0.40	MENA
218	**0.573**	**1**	0.57	MENA
219	**0.439**	**0.951**	0.46	MENA
220	**0.598**	**1**	0.60	MENA
221	**0.596**	**1**	0.60	MENA
222	**0.379**	**0.987**	0.38	MENA
223	**0.454**	**1**	0.45	MENA
224	**0.869**	**1**	0.87	MENA
225	**0.561**	**0.915**	0.61	MENA

firm	**vrsteM**	vrsteG	GAP	Region
226	**0.579**	**1**	0.58	MENA
227	**0.486**	**0.997**	0.49	MENA
228	**0.372**	**0.921**	0.40	MENA
229	**0.246**	**0.915**	0.27	MENA
230	**0.771**	**0.844**	0.91	EA
231	**0.839**	**0.939**	0.89	EA
232	**0.721**	**0.921**	0.78	EA
233	**0.656**	**0.825**	0.80	EA
234	**0.735**	**1**	0.74	EA
235	**0.588**	**0.993**	0.59	EA
236	**0.518**	**0.778**	0.67	EA
237	**0.399**	**0.729**	0.55	EA
238	**0.339**	**0.605**	0.56	EA
239	**0.333**	**0.525**	0.63	EA
240	**0.394**	**0.527**	0.75	EA
241	**0.471**	**0.523**	0.90	EA
242	**0.526**	**0.547**	0.96	EA
243	**0.706**	**0.748**	0.94	EA
244	**0.348**	**0.6**	0.58	EA
245	**0.293**	**0.636**	0.46	EA
246	**0.28**	**0.763**	0.37	EA
247	**0.297**	**0.863**	0.34	EA
248	**0.383**	**1**	0.38	EA
249	**0.315**	**0.863**	0.37	EA
250	**0.385**	**0.96**	0.40	EA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
251	**0.37**	**1**	0.37	EA
252	**0.346**	**0.877**	0.39	EA
253	**0.394**	**0.956**	0.41	EA
254	**0.371**	**0.973**	0.38	EA
255	**1**	**1**	1.00	EA
256	**0.862**	**1**	0.86	EA
257	**0.803**	**0.932**	0.86	EA
258	**0.588**	**0.636**	0.92	EA
259	**0.825**	**0.827**	1.00	EA
260	**1**	**1**	1.00	EA
261	**1**	**1**	1.00	EA
262	**0.928**	**1**	0.93	EA
263	**1**	**1**	1.00	EA
264	**1**	**1**	1.00	EA
265	**1**	**1**	1.00	EA
266	**1**	**1**	1.00	EA
267	**0.749**	**0.767**	0.98	EA
268	**0.716**	**0.767**	0.93	EA
269	**0.691**	**0.717**	0.96	EA
270	**0.709**	**0.774**	0.92	EA
271	**0.585**	**0.701**	0.83	EA
272	**0.524**	**0.628**	0.83	EA
273	**0.652**	**0.783**	0.83	EA
274	**0.765**	**0.921**	0.83	EA
275	**0.778**	**1**	0.78	EA

firm	**vrsteM**	vrsteG	GAP	Region
276	**0.982**	**1**	0.98	EA
277	**1**	**1**	1.00	EA
278	**1**	**1**	1.00	EA
279	**0.628**	**0.66**	0.95	EA
280	**0.784**	**0.797**	0.98	EA
281	**0.733**	**0.746**	0.98	EA
282	**1**	**1**	1.00	EA
283	**1**	**1**	1.00	EA
284	**0.997**	**1**	1.00	EA
285	**0.806**	**0.944**	0.85	EA
286	**0.684**	**0.79**	0.87	EA
287	**0.74**	**0.954**	0.78	EA
288	**0.712**	**0.918**	0.78	EA
289	**0.728**	**0.891**	0.82	EA
290	**0.868**	**0.933**	0.93	EA
291	**1**	**1**	1.00	EA
292	**0.692**	**1**	0.69	EA
293	**0.484**	**0.748**	0.65	EA
294	**0.579**	**1**	0.58	EA
295	**0.683**	**1**	0.68	EA
296	**0.51**	**0.805**	0.63	EA
297	**0.824**	**0.969**	0.85	EA
298	**0.536**	**0.725**	0.74	EA
299	**0.535**	**0.792**	0.68	EA
300	**0.505**	**0.679**	0.74	EA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
301	**0.467**	**0.621**	0.75	EA
302	**1**	**1**	1.00	EA
303	**0.643**	**1**	0.64	EA
304	**0.552**	**0.801**	0.69	EA
305	**0.971**	**1**	0.97	EA
306	**0.46**	**0.576**	0.80	EA
307	**0.364**	**0.543**	0.67	EA
308	**0.365**	**0.583**	0.63	EA
309	**0.413**	**0.651**	0.63	EA
310	**0.454**	**0.709**	0.64	EA
311	**0.408**	**0.62**	0.66	EA
312	**0.46**	**0.724**	0.64	EA
313	**0.447**	**0.692**	0.65	EA
314	**0.429**	**0.612**	0.70	EA
315	**0.359**	**0.501**	0.72	EA
316	**0.986**	**1**	0.99	SA
317	**1**	**1**	1.00	SA
318	**1**	**1**	1.00	SA
319	**1**	**1**	1.00	SA
320	**0.924**	**0.928**	1.00	SA
321	**1**	**1**	1.00	SA
322	**0.847**	**0.934**	0.91	SA
323	**0.582**	**0.628**	0.93	SA
324	**0.651**	**0.669**	0.97	SA
325	**0.607**	**0.707**	0.86	SA

firm	**vrsteM**	vrsteG	GAP	Region
326	**0.717**	**0.721**	0.99	SA
327	**0.808**	**0.898**	0.90	SA
328	**0.77**	**1**	0.77	SA
329	**1**	**1**	1.00	SA
330	**1**	**1**	1.00	SA
331	**0.758**	**0.759**	1.00	SA
332	**0.914**	**0.914**	1.00	SA
333	**0.91**	**0.912**	1.00	SA
334	**0.841**	**0.853**	0.99	SA
335	**0.802**	**0.824**	0.97	SA
336	**1**	**1**	1.00	SA
337	**1**	**1**	1.00	SA
338	**0.611**	**1**	0.61	SA
339	**0.495**	**0.807**	0.61	SA
340	**0.517**	**0.706**	0.73	SA
341	**0.545**	**0.677**	0.81	SA
342	**0.661**	**0.788**	0.84	SA
343	**0.694**	**0.729**	0.95	SA
344	**0.997**	**1**	1.00	SA
345	**1**	**1**	1.00	SA
346	**0.782**	**0.782**	1.00	SA
347	**1**	**1**	1.00	SA
348	**1**	**1**	1.00	SA
349	**0.954**	**1**	0.95	SA
350	**0.729**	**1**	0.73	SA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
351	**0.709**	**0.89**	0.80	SA
352	**0.58**	**0.669**	0.87	SA
353	**0.415**	**0.498**	0.83	SA
354	**0.366**	**0.384**	0.95	SA
355	**0.431**	**0.539**	0.80	SA
356	**0.798**	**1**	0.80	SA
357	**0.54**	**0.946**	0.57	SA
358	**0.712**	**0.963**	0.74	SA
359	**0.742**	**0.996**	0.74	SA
360	**0.569**	**0.912**	0.62	SA
361	**0.612**	**0.858**	0.71	SA
362	**0.406**	**0.67**	0.61	SA
363	**0.587**	**0.651**	0.90	SA
364	**0.704**	**1**	0.70	SA
365	**0.615**	**0.758**	0.81	SA
366	**0.666**	**0.883**	0.75	SA
367	**0.837**	**0.997**	0.84	SA
368	**0.899**	**1**	0.90	SA
369	**0.302**	**0.677**	0.45	SA
370	**0.431**	**0.616**	0.70	SA
371	**0.496**	**0.6**	0.83	SA
372	**0.453**	**0.534**	0.85	SA
373	**0.549**	**0.563**	0.98	SA
374	**0.574**	**0.575**	1.00	SA
375	**0.782**	**0.782**	1.00	SA

firm	**vrsteM**	vrsteG	GAP	Region
376	**0.804**	**0.804**	1.00	SA
377	**0.795**	**0.796**	1.00	SA
378	**0.92**	**0.92**	1.00	SA
379	**0.792**	**0.793**	1.00	SA
380	**0.673**	**0.725**	0.93	SA
381	**0.347**	**0.5**	0.69	SA
382	**0.345**	**0.465**	0.74	SA
383	**1**	**1**	1.00	SA
384	**0.55**	**0.556**	0.99	SA
385	**0.784**	**0.794**	0.99	SA
386	**0.587**	**0.592**	0.99	SA
387	**0.656**	**0.661**	0.99	SA
388	**0.72**	**0.729**	0.99	SA
389	**0.792**	**0.801**	0.99	SA
390	**0.795**	**0.8**	0.99	SA
391	**0.892**	**0.901**	0.99	SA
392	**0.903**	**1**	0.90	SA
393	**1**	**1**	1.00	SA
394	**0.991**	**1**	0.99	SA
395	**0.972**	**1**	0.97	SA
396	**0.96**	**0.992**	0.97	SA
397	**0.965**	**0.982**	0.98	SA
398	**1**	**1**	1.00	SA
399	**0.494**	**1**	0.49	SA
400	**0.41**	**0.79**	0.52	SA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
401	**0.533**	**0.764**	0.70	SA
402	**0.409**	**0.807**	0.51	SA
403	**0.625**	**0.73**	0.86	SA
404	**0.683**	**0.765**	0.89	SA
405	**0.331**	**0.495**	0.67	SA
406	**0.487**	**0.702**	0.69	SA
407	**0.594**	**0.803**	0.74	SA
408	**0.703**	**0.845**	0.83	SA
409	**0.709**	**0.894**	0.79	SA
410	**1**	**1**	1.00	SA
411	**0.963**	**1**	0.96	SA
412	**0.891**	**1**	0.89	SA
413	**0.736**	**0.979**	0.75	SA
414	**0.616**	**0.886**	0.70	SA
415	**0.598**	**0.819**	0.73	SA
416	**0.533**	**0.832**	0.64	SA
417	**0.521**	**0.78**	0.67	SA
418	**0.497**	**0.842**	0.59	SA
419	**0.432**	**0.904**	0.48	SA
420	**0.392**	**0.786**	0.50	SA
421	**0.354**	**0.929**	0.38	SA
422	**0.563**	**0.942**	0.60	SA
423	**0.454**	**1**	0.45	SA
424	**0.399**	**1**	0.40	SA
425	**0.493**	**0.812**	0.61	SA

firm	**vrsteM**	vrsteG	GAP	Region
426	**0.458**	**0.627**	0.73	SA
427	**0.488**	**0.598**	0.82	SA
428	**0.477**	**0.478**	1.00	SA
429	**0.496**	**0.496**	1.00	SA
430	**0.341**	**0.548**	0.62	SA
431	**0.369**	**0.555**	0.66	SA
432	**0.319**	**0.572**	0.56	SA
433	**0.381**	**0.653**	0.58	SA
434	**0.453**	**0.757**	0.60	SA
435	**0.368**	**0.94**	0.39	SA
436	**0.6**	**0.774**	0.78	SA
437	**0.404**	**0.735**	0.55	SA
438	**0.526**	**0.857**	0.61	SA
439	**0.421**	**0.648**	0.65	SA
440	**0.974**	**1**	0.97	SA
441	**0.469**	**0.807**	0.58	SA
442	**1**	**1**	1.00	SA
443	**0.995**	**0.995**	1.00	SA
444	**1**	**1**	1.00	SA
445	**1**	**1**	1.00	SA
446	**1**	**1**	1.00	SA
447	**1**	**1**	1.00	SA
448	**1**	**1**	1.00	SA
449	**1**	**1**	1.00	SA
450	**1**	**1**	1.00	SA

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
451	**0.734**	**0.893**	0.82	SA
452	**0.553**	**0.862**	0.64	SA
453	**0.5**	**0.611**	0.82	SA
454	**0.506**	**0.664**	0.76	SA
455	**0.594**	**0.676**	0.88	SA
456	**0.736**	**0.881**	0.84	SA
457	**0.786**	**0.884**	0.89	SA
458	**0.846**	**1**	0.85	SA
459	**1**	**1**	1.00	SUB
460	**1**	**1**	1.00	SUB
461	**0.671**	**1**	0.67	SUB
462	**0.678**	**1**	0.68	SUB
463	**0.597**	**1**	0.60	SUB
464	**0.792**	**0.97**	0.82	SUB
465	**0.714**	**1**	0.71	SUB
466	**0.711**	**0.849**	0.84	SUB
467	**0.928**	**1**	0.93	SUB
468	**0.884**	**0.944**	0.94	SUB
469	**0.778**	**0.826**	0.94	SUB
470	**0.479**	**0.824**	0.58	SUB
471	**0.478**	**0.796**	0.60	SUB
472	**0.498**	**0.817**	0.61	SUB
473	**0.4**	**0.788**	0.51	SUB
474	**0.402**	**0.808**	0.50	SUB
475	**0.422**	**0.785**	0.54	SUB

firm	**vrsteM**	vrsteG	GAP	Region
476	**0.435**	**0.818**	0.53	SUB
477	**0.416**	**0.915**	0.45	SUB
478	**0.321**	**0.791**	0.41	SUB
479	**0.987**	**1**	0.99	SUB
480	**0.905**	**1**	0.91	SUB
481	**0.907**	**1**	0.91	SUB
482	**0.882**	**1**	0.88	SUB
483	**0.778**	**0.901**	0.86	SUB
484	**0.876**	**1**	0.88	SUB
485	**0.785**	**1**	0.79	SUB
486	**0.697**	**1**	0.70	SUB
487	**0.61**	**1**	0.61	SUB
488	**1**	**1**	1.00	SUB
489	**0.533**	**1**	0.53	SUB
490	**0.582**	**0.84**	0.69	SUB
491	**0.509**	**0.96**	0.53	SUB
492	**0.536**	**0.933**	0.57	SUB
493	**0.503**	**1**	0.50	SUB
494	**0.439**	**0.912**	0.48	SUB
495	**0.452**	**0.974**	0.46	SUB
496	**0.443**	**1**	0.44	SUB
497	**0.33**	**0.805**	0.41	SUB
498	**0.468**	**1**	0.47	SUB
499	**0.253**	**0.917**	0.28	SUB
500	**0.566**	**1**	0.57	SUB

Appendix I: Continuation

firm	**vrsteM**	vrsteG	GAP	Region
501	**0.399**	**1**	0.40	SUB
502	**0.349**	**1**	0.35	SUB
503	**0.403**	**1**	0.40	SUB
504	**0.493**	**0.994**	0.50	SUB
505	**0.534**	**1**	0.53	SUB
506	**0.542**	**1**	0.54	SUB
507	**0.453**	**1**	0.45	SUB
508	**0.322**	**0.999**	0.32	SUB
509	**0.245**	**0.896**	0.27	SUB
510	**0.341**	**1**	0.34	SUB
511	**0.419**	**0.925**	0.45	SUB
512	**0.484**	**0.901**	0.54	SUB
513	**0.541**	**1**	0.54	SUB
514	**0.492**	**0.912**	0.54	SUB
515	**0.462**	**0.977**	0.47	SUB
516	**0.552**	**1**	0.55	SUB
517	**0.271**	**1**	0.27	SUB
518	**0.429**	**1**	0.43	SUB
519	**0.424**	**1**	0.42	SUB
520	**0.236**	**0.973**	0.24	SUB
521	**0.232**	**0.883**	0.26	SUB
522	**0.21**	**1**	0.21	SUB
523	**0.23**	**0.988**	0.23	SUB
524	**1**	**1**	1.00	SUB
525	**0.891**	**0.98**	0.91	SUB

firm	**vrsteM**	vrsteG	GAP	Region
526	**0.953**	**0.972**	0.98	SUB
527	**1**	**1**	1.00	SUB
528	**0.858**	**1**	0.86	SUB
529	**1**	**1**	1.00	SUB
530	**0.898**	**1**	0.90	SUB
531	**0.717**	**0.867**	0.83	SUB
532	**0.674**	**0.863**	0.78	SUB
533	**0.69**	**0.9**	0.77	SUB

Appendix II

Efficiency Scores for Meta Frontier, Group Frontier and the GAP: Model 2

firm	vrsteM	vrsteG	GAP	Region
1	1	1	1.00	LA
2	1	1	1.00	LA
3	1	1	1.00	LA
4	0.982	1	0.98	LA
5	0.796	0.981	0.81	LA
6	0.544	1	0.54	LA
7	1	1	1.00	LA
8	0.496	1	0.50	LA
9	0.503	1	0.50	LA
10	0.17	0.286	0.59	LA
11	0.184	0.295	0.62	LA
12	0.418	0.65	0.64	LA
13	0.296	0.442	0.67	LA
14	0.286	0.453	0.63	LA
15	0.354	0.523	0.68	LA
16	0.353	0.529	0.67	LA
17	0.361	0.545	0.66	LA
18	0.413	0.618	0.67	LA
19	0.74	0.955	0.77	LA
20	1	1	1.00	LA
21	1	1	1.00	LA
22	0.42	0.734	0.57	LA
23	0.398	0.712	0.56	LA
24	0.389	0.769	0.51	LA
25	0.404	0.876	0.46	LA

firm	vrsteM	vrsteG	GAP	Region
26	0.482	0.959	0.50	LA
27	0.526	1	0.53	LA
28	0.532	0.982	0.54	LA
29	0.522	0.962	0.54	LA
30	0.607	0.981	0.62	LA
31	0.631	1	0.63	LA
32	0.625	1	0.63	LA
33	0.598	1	0.60	LA
34	0.609	1	0.61	LA
35	0.654	1	0.65	LA
36	0.497	1	0.50	LA
37	0.399	0.679	0.59	LA
38	0.382	0.938	0.41	LA
39	0.383	0.947	0.40	LA
40	0.293	0.644	0.45	LA
41	0.255	0.637	0.40	LA
42	0.291	0.842	0.35	LA
43	0.242	0.72	0.34	LA
44	0.229	0.587	0.39	LA
45	0.201	0.573	0.35	LA
46	0.187	0.61	0.31	LA
47	0.292	0.784	0.37	LA
48	0.258	0.787	0.33	LA
49	0.259	0.828	0.31	LA
50	0.271	0.859	0.32	LA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
51	0.299	0.883	0.34	LA
52	0.332	0.872	0.38	LA
53	0.37	0.886	0.42	LA
54	0.386	0.792	0.49	LA
55	0.421	0.744	0.57	LA
56	0.565	0.891	0.63	LA
57	0.517	0.895	0.58	LA
58	0.586	0.961	0.61	LA
59	0.601	1	0.60	LA
60	1	1	1.00	LA
61	0.22	0.36	0.61	LA
62	0.542	0.846	0.64	LA
63	0.308	0.711	0.43	LA
64	1	1	1.00	LA
65	0.422	1	0.42	LA
66	0.6	1	0.60	LA
67	0.444	0.948	0.47	LA
68	0.389	0.885	0.44	LA
69	0.373	0.944	0.40	LA
70	0.366	0.934	0.39	LA
71	0.341	0.877	0.39	LA
72	0.355	0.9	0.39	LA
73	0.405	0.945	0.43	LA
74	0.461	1	0.46	LA
75	0.375	1	0.38	LA

firm	vrsteM	vrsteG	GAP	Region
76	0.354	0.858	0.41	LA
77	0.438	0.952	0.46	LA
78	0.475	1	0.48	LA
79	0.379	0.99	0.38	LA
80	0.447	1	0.45	LA
81	0.494	1	0.49	LA
82	0.485	0.987	0.49	LA
83	0.61	1	0.61	LA
84	0.532	0.957	0.56	LA
85	0.47	0.897	0.52	LA
86	0.449	0.962	0.47	LA
87	0.416	0.749	0.56	LA
88	0.498	0.712	0.70	LA
89	0.712	1	0.71	LA
90	0.392	0.779	0.50	LA
91	0.404	0.775	0.52	LA
92	0.434	0.868	0.50	LA
93	0.563	1	0.56	LA
94	0.493	1	0.49	LA
95	0.451	0.736	0.61	LA
96	1	1	1.00	LA
97	1	1	1.00	LA
98	0.907	1	0.91	LA
99	0.959	1	0.96	LA
100	0.263	0.444	0.59	LA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
101	0.278	0.491	0.57	LA
102	0.319	0.523	0.61	LA
103	0.296	0.508	0.58	LA
104	0.281	0.466	0.60	LA
105	0.459	0.917	0.50	LA
106	0.465	0.953	0.49	LA
107	0.299	0.557	0.54	LA
108	0.288	0.725	0.40	LA
109	0.273	0.655	0.42	LA
110	0.377	0.777	0.49	LA
111	0.432	0.832	0.52	LA
112	0.408	0.869	0.47	LA
113	0.348	0.766	0.45	LA
114	0.545	0.921	0.59	LA
115	0.704	0.973	0.72	LA
116	0.686	1	0.69	LA
117	0.689	1	0.69	LA
118	0.513	1	0.51	LA
119	0.471	1	0.47	LA
120	0.32	0.691	0.46	LA
121	0.313	0.637	0.49	LA
122	0.496	1	0.50	MENA
123	0.487	0.812	0.60	MENA
124	0.538	0.81	0.66	MENA
125	0.418	0.676	0.62	MENA

firm	vrsteM	vrsteG	GAP	Region
126	0.341	0.514	0.66	MENA
127	0.373	0.526	0.71	MENA
128	0.517	0.836	0.62	MENA
129	0.231	0.43	0.54	MENA
130	0.298	0.511	0.58	MENA
131	0.314	0.522	0.60	MENA
132	0.338	0.556	0.61	MENA
133	0.895	1	0.90	MENA
134	0.861	1	0.86	MENA
135	0.629	1	0.63	MENA
136	0.472	1	0.47	MENA
137	0.639	1	0.64	MENA
138	0.539	0.945	0.57	MENA
139	0.645	1	0.65	MENA
140	0.579	0.957	0.61	MENA
141	0.582	0.974	0.60	MENA
142	0.65	1	0.65	MENA
143	0.66	1	0.66	MENA
144	0.219	0.416	0.53	MENA
145	0.245	0.416	0.59	MENA
146	0.296	0.536	0.55	MENA
147	0.377	0.75	0.50	MENA
148	0.475	0.806	0.59	MENA
149	0.516	0.901	0.57	MENA
150	0.446	0.817	0.55	MENA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
151	0.43	0.852	0.50	MENA
152	0.466	0.914	0.51	MENA
153	0.441	0.884	0.50	MENA
154	0.4	0.918	0.44	MENA
155	0.499	1	0.50	MENA
156	0.312	1	0.31	MENA
157	0.249	0.691	0.36	MENA
158	0.273	0.676	0.40	MENA
159	0.49	1	0.49	MENA
160	0.277	0.543	0.51	MENA
161	0.153	0.38	0.40	MENA
162	0.277	0.533	0.52	MENA
163	0.287	0.524	0.55	MENA
164	0.223	0.439	0.51	MENA
165	0.191	0.384	0.50	MENA
166	0.199	0.361	0.55	MENA
167	0.21	0.365	0.58	MENA
168	0.182	0.322	0.57	MENA
169	0.554	0.775	0.71	MENA
170	0.298	0.804	0.37	MENA
171	0.255	0.685	0.37	MENA
172	0.831	1	0.83	MENA
173	0.556	1	0.56	MENA
174	0.453	0.826	0.55	MENA
175	0.354	0.792	0.45	MENA

firm	vrsteM	vrsteG	GAP	Region
176	0.416	1	0.42	MENA
177	0.326	0.806	0.40	MENA
178	0.254	0.744	0.34	MENA
179	0.246	0.701	0.35	MENA
180	0.278	0.714	0.39	MENA
181	0.326	0.741	0.44	MENA
182	0.491	0.976	0.50	MENA
183	0.589	1	0.59	MENA
184	0.687	1	0.69	MENA
185	0.51	0.831	0.61	MENA
186	0.399	0.658	0.61	MENA
187	0.383	0.752	0.51	MENA
188	0.318	0.679	0.47	MENA
189	0.293	0.628	0.47	MENA
190	0.388	0.93	0.42	MENA
191	0.261	0.754	0.35	MENA
192	0.273	0.667	0.41	MENA
193	0.786	1	0.79	MENA
194	1	1	1.00	MENA
195	0.54	0.765	0.71	MENA
196	0.417	0.625	0.67	MENA
197	0.575	0.718	0.80	MENA
198	0.329	0.446	0.74	MENA
199	0.619	0.805	0.77	MENA
200	0.364	0.67	0.54	MENA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
201	0.392	0.579	0.68	MENA
202	0.332	0.507	0.65	MENA
203	0.368	0.578	0.64	MENA
204	0.3	0.425	0.71	MENA
205	0.313	0.772	0.41	MENA
206	0.365	0.716	0.51	MENA
207	0.468	1	0.47	MENA
208	0.518	1	0.52	MENA
209	0.597	1	0.60	MENA
210	0.54	0.976	0.55	MENA
211	0.514	1	0.51	MENA
212	0.504	1	0.50	MENA
213	0.497	1	0.50	MENA
214	0.425	1	0.43	MENA
215	0.387	0.945	0.41	MENA
216	0.409	1	0.41	MENA
217	0.399	1	0.40	MENA
218	0.432	1	0.43	MENA
219	0.297	0.837	0.35	MENA
220	0.542	1	0.54	MENA
221	0.575	1	0.58	MENA
222	0.373	0.987	0.38	MENA
223	0.443	1	0.44	MENA
224	0.74	1	0.74	MENA
225	0.504	0.911	0.55	MENA

firm	vrsteM	vrsteG	GAP	Region
226	0.519	1	0.52	MENA
227	0.452	0.997	0.45	MENA
228	0.336	0.921	0.36	MENA
229	0.191	0.915	0.21	MENA
230	0.758	0.844	0.90	EA
231	0.819	0.939	0.87	EA
232	0.706	0.921	0.77	EA
233	0.634	0.81	0.78	EA
234	0.71	0.983	0.72	EA
235	0.557	0.938	0.59	EA
236	0.502	0.747	0.67	EA
237	0.375	0.668	0.56	EA
238	0.303	0.54	0.56	EA
239	0.299	0.437	0.68	EA
240	0.363	0.428	0.85	EA
241	0.441	0.467	0.94	EA
242	0.484	0.507	0.95	EA
243	0.653	0.688	0.95	EA
244	0.346	0.6	0.58	EA
245	0.29	0.636	0.46	EA
246	0.278	0.763	0.36	EA
247	0.296	0.863	0.34	EA
248	0.383	1	0.38	EA
249	0.315	0.863	0.37	EA
250	0.385	0.96	0.40	EA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
251	0.37	1	0.37	EA
252	0.346	0.877	0.39	EA
253	0.394	0.956	0.41	EA
254	0.371	0.973	0.38	EA
255	0.889	1	0.89	EA
256	0.766	1	0.77	EA
257	0.722	0.917	0.79	EA
258	0.537	0.611	0.88	EA
259	0.788	0.814	0.97	EA
260	1	1	1.00	EA
261	1	1	1.00	EA
262	0.926	1	0.93	EA
263	1	1	1.00	EA
264	1	1	1.00	EA
265	0.374	1	0.37	EA
266	0.4	0.757	0.53	EA
267	0.335	0.404	0.83	EA
268	0.456	0.551	0.83	EA
269	0.462	0.521	0.89	EA
270	0.469	0.5	0.94	EA
271	0.384	0.439	0.87	EA
272	0.358	0.383	0.93	EA
273	0.501	0.532	0.94	EA
274	0.603	0.635	0.95	EA
275	0.636	0.664	0.96	EA

firm	vrsteM	vrsteG	GAP	Region
276	0.404	1	0.40	EA
277	0.47	1	0.47	EA
278	0.535	1	0.54	EA
279	0.412	0.561	0.73	EA
280	0.519	0.714	0.73	EA
281	0.364	0.466	0.78	EA
282	0.428	0.66	0.65	EA
283	0.513	0.676	0.76	EA
284	0.566	0.667	0.85	EA
285	0.402	0.437	0.92	EA
286	0.402	0.428	0.94	EA
287	0.391	0.446	0.88	EA
288	0.441	0.495	0.89	EA
289	0.455	0.497	0.92	EA
290	0.614	0.661	0.93	EA
291	0.733	0.783	0.94	EA
292	0.563	0.584	0.96	EA
293	0.392	0.729	0.54	EA
294	0.427	1	0.43	EA
295	0.552	1	0.55	EA
296	0.418	0.77	0.54	EA
297	0.807	0.969	0.83	EA
298	0.509	0.691	0.74	EA
299	0.522	0.782	0.67	EA
300	0.488	0.658	0.74	EA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
301	0.439	0.578	0.76	EA
302	1	1	1.00	EA
303	0.523	1	0.52	EA
304	0.4	0.801	0.50	EA
305	0.861	1	0.86	EA
306	0.36	0.48	0.75	EA
307	0.313	0.451	0.69	EA
308	0.328	0.512	0.64	EA
309	0.37	0.564	0.66	EA
310	0.424	0.651	0.65	EA
311	0.375	0.559	0.67	EA
312	0.44	0.684	0.64	EA
313	0.426	0.645	0.66	EA
314	0.407	0.565	0.72	EA
315	0.332	0.435	0.76	EA
316	0.986	0.987	1.00	SA
317	1	1	1.00	SA
318	1	1	1.00	SA
319	1	1	1.00	SA
320	0.923	0.923	1.00	SA
321	1	1	1.00	SA
322	0.838	0.859	0.98	SA
323	0.575	0.575	1.00	SA
324	0.648	0.649	1.00	SA
325	0.603	0.649	0.93	SA

firm	vrsteM	vrsteG	GAP	Region
326	0.716	0.721	0.99	SA
327	0.805	0.876	0.92	SA
328	0.768	1	0.77	SA
329	1	1	1.00	SA
330	1	1	1.00	SA
331	0.758	0.758	1.00	SA
332	0.914	0.914	1.00	SA
333	0.909	0.909	1.00	SA
334	0.84	0.841	1.00	SA
335	0.801	0.814	0.98	SA
336	1	1	1.00	SA
337	1	1	1.00	SA
338	0.382	1	0.38	SA
339	0.453	0.531	0.85	SA
340	0.486	0.489	0.99	SA
341	0.544	0.567	0.96	SA
342	0.658	0.723	0.91	SA
343	0.694	0.696	1.00	SA
344	0.996	0.997	1.00	SA
345	1	1	1.00	SA
346	0.782	0.782	1.00	SA
347	1	1	1.00	SA
348	1	1	1.00	SA
349	0.954	1	0.95	SA
350	0.688	1	0.69	SA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
351	0.694	0.89	0.78	SA
352	0.576	0.669	0.86	SA
353	0.41	0.41	1.00	SA
354	0.365	0.367	0.99	SA
355	0.428	0.489	0.88	SA
356	0.798	1	0.80	SA
357	0.505	0.513	0.98	SA
358	0.688	0.688	1.00	SA
359	0.729	0.729	1.00	SA
360	0.552	0.552	1.00	SA
361	0.593	0.593	1.00	SA
362	0.384	0.384	1.00	SA
363	0.577	0.577	1.00	SA
364	0.695	0.71	0.98	SA
365	0.601	0.601	1.00	SA
366	0.651	0.651	1.00	SA
367	0.818	0.827	0.99	SA
368	0.88	0.961	0.92	SA
369	0.267	0.285	0.94	SA
370	0.411	0.42	0.98	SA
371	0.484	0.488	0.99	SA
372	0.448	0.455	0.98	SA
373	0.547	0.547	1.00	SA
374	0.574	0.575	1.00	SA
375	0.782	0.782	1.00	SA

firm	vrsteM	vrsteG	GAP	Region
376	0.804	0.804	1.00	SA
377	0.795	0.795	1.00	SA
378	0.92	0.92	1.00	SA
379	0.792	0.792	1.00	SA
380	0.667	0.667	1.00	SA
381	0.34	0.427	0.80	SA
382	0.34	0.387	0.88	SA
383	1	1	1.00	SA
384	0.55	0.556	0.99	SA
385	0.784	0.793	0.99	SA
386	0.587	0.592	0.99	SA
387	0.656	0.661	0.99	SA
388	0.72	0.729	0.99	SA
389	0.792	0.801	0.99	SA
390	0.795	0.8	0.99	SA
391	0.892	0.901	0.99	SA
392	0.902	0.988	0.91	SA
393	1	1	1.00	SA
394	0.989	0.997	0.99	SA
395	0.972	1	0.97	SA
396	0.96	0.986	0.97	SA
397	0.965	0.982	0.98	SA
398	1	1	1.00	SA
399	0.351	1	0.35	SA
400	0.379	0.618	0.61	SA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
401	0.519	0.684	0.76	SA
402	0.398	0.493	0.81	SA
403	0.622	0.71	0.88	SA
404	0.682	0.747	0.91	SA
405	0.329	0.343	0.96	SA
406	0.483	0.585	0.83	SA
407	0.59	0.717	0.82	SA
408	0.699	0.835	0.84	SA
409	0.707	0.894	0.79	SA
410	1	1	1.00	SA
411	0.917	1	0.92	SA
412	0.833	0.833	1.00	SA
413	0.663	0.688	0.96	SA
414	0.53	0.632	0.84	SA
415	0.519	0.573	0.91	SA
416	0.451	0.496	0.91	SA
417	0.45	0.551	0.82	SA
418	0.431	0.548	0.79	SA
419	0.36	0.379	0.95	SA
420	0.378	0.421	0.90	SA
421	0.322	0.357	0.90	SA
422	0.544	0.805	0.68	SA
423	0.429	0.591	0.73	SA
424	0.358	0.441	0.81	SA
425	0.479	0.508	0.94	SA

firm	vrsteM	vrsteG	GAP	Region
426	0.455	0.459	0.99	SA
427	0.488	0.598	0.82	SA
428	0.477	0.478	1.00	SA
429	0.496	0.496	1.00	SA
430	0.33	0.33	1.00	SA
431	0.361	0.371	0.97	SA
432	0.309	0.338	0.91	SA
433	0.373	0.437	0.85	SA
434	0.418	0.455	0.92	SA
435	0.289	0.32	0.90	SA
436	0.547	0.61	0.90	SA
437	0.37	0.393	0.94	SA
438	0.506	0.527	0.96	SA
439	0.398	0.415	0.96	SA
440	0.974	1	0.97	SA
441	0.419	0.438	0.96	SA
442	1	1	1.00	SA
443	0.995	0.995	1.00	SA
444	1	1	1.00	SA
445	1	1	1.00	SA
446	1	1	1.00	SA
447	1	1	1.00	SA
448	1	1	1.00	SA
449	1	1	1.00	SA
450	1	1	1.00	SA

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
451	0.732	0.831	0.88	SA
452	0.529	0.694	0.76	SA
453	0.497	0.513	0.97	SA
454	0.503	0.664	0.76	SA
455	0.594	0.676	0.88	SA
456	0.736	0.881	0.84	SA
457	0.786	0.884	0.89	SA
458	0.844	1	0.84	SA
459	0.812	1	0.81	SUB
460	0.722	1	0.72	SUB
461	0.591	1	0.59	SUB
462	0.592	1	0.59	SUB
463	0.129	0.849	0.15	SUB
464	0.184	0.89	0.21	SUB
465	0.213	0.996	0.21	SUB
466	0.201	0.8	0.25	SUB
467	0.241	1	0.24	SUB
468	0.192	0.68	0.28	SUB
469	0.157	0.519	0.30	SUB
470	0.247	0.698	0.35	SUB
471	0.339	0.676	0.50	SUB
472	0.422	0.774	0.55	SUB
473	0.353	0.699	0.51	SUB
474	0.369	0.771	0.48	SUB
475	0.405	0.771	0.53	SUB

firm	vrsteM	vrsteG	GAP	Region
476	0.399	0.777	0.51	SUB
477	0.363	0.908	0.40	SUB
478	0.229	0.769	0.30	SUB
479	0.782	1	0.78	SUB
480	0.793	1	0.79	SUB
481	0.881	1	0.88	SUB
482	0.876	1	0.88	SUB
483	0.761	0.901	0.84	SUB
484	0.856	1	0.86	SUB
485	0.449	1	0.45	SUB
486	0.593	1	0.59	SUB
487	0.489	1	0.49	SUB
488	1	1	1.00	SUB
489	0.286	0.996	0.29	SUB
490	0.232	0.686	0.34	SUB
491	0.281	0.933	0.30	SUB
492	0.296	0.889	0.33	SUB
493	0.319	1	0.32	SUB
494	0.298	0.879	0.34	SUB
495	0.35	0.966	0.36	SUB
496	0.347	1	0.35	SUB
497	0.185	0.644	0.29	SUB
498	0.446	1	0.45	SUB
499	0.209	0.888	0.24	SUB
500	0.559	1	0.56	SUB

Appendix 2: Continuation

firm	vrsteM	vrsteG	GAP	Region
501	0.399	1	0.40	SUB
502	0.349	0.981	0.36	SUB
503	0.403	1	0.40	SUB
504	0.493	0.977	0.50	SUB
505	0.534	1	0.53	SUB
506	0.477	1	0.48	SUB
507	0.387	1	0.39	SUB
508	0.285	0.999	0.29	SUB
509	0.209	0.896	0.23	SUB
510	0.291	1	0.29	SUB
511	0.21	0.891	0.24	SUB
512	0.272	0.853	0.32	SUB
513	0.34	0.922	0.37	SUB
514	0.398	0.844	0.47	SUB
515	0.388	0.963	0.40	SUB
516	0.513	1	0.51	SUB
517	0.252	1	0.25	SUB
518	0.415	1	0.42	SUB
519	0.413	1	0.41	SUB
520	0.219	0.971	0.23	SUB
521	0.207	0.864	0.24	SUB
522	0.157	1	0.16	SUB
523	0.178	0.986	0.18	SUB
524	0.151	0.812	0.19	SUB
525	0.169	0.592	0.29	SUB

firm	vrsteM	vrsteG	GAP	Region
526	0.175	0.807	0.22	SUB
527	0.196	0.872	0.22	SUB
528	0.194	0.887	0.22	SUB
529	0.184	0.78	0.24	SUB
530	0.378	0.986	0.38	SUB
531	0.205	0.52	0.39	SUB
532	0.237	0.566	0.42	SUB
533	0.273	0.648	0.42	SUB

Appendix III

Peer Count Summary: Model 1

firm	peer count	Region
1	92	Latin America
2	4	Latin America
3	109	Latin America
7	10	Latin America
12	110	Latin America
20	31	Latin America
21	51	Latin America
60	26	Latin America
64	26	Latin America
96	1	Latin America
97	8	Latin America
110	36	Latin America
111	104	Latin America
194	24	MENA
255	1	East Asia
260	14	East Asia
261	108	East Asia
263	42	East Asia
265	73	East Asia
266	72	East Asia
277	3	East Asia
278	25	East Asia
282	1	East Asia
283	55	East Asia
291	7	East Asia
302	396	East Asia

firm	peer count	Region
317	5	South Asia
319	45	South Asia
321	8	South Asia
329	60	South Asia
336	29	South Asia
337	39	South Asia
345	5	South Asia
347	1	South Asia
348	9	South Asia
383	35	South Asia
393	1	South Asia
398	8	South Asia
410	12	South Asia
442	127	South Asia
444	32	South Asia
445	13	South Asia
446	17	South Asia
448	64	South Asia
449	4	South Asia
450	123	South Asia
459	25	South Asia
488	4	Sub-Sahara
524	53	Sub-Sahara
527	10	Sub-Sahara
529	21	Sub-Sahara

Appendix IV

Peer Count Summary: Model 2

Firm	Peer count	Region		Firm	Peer count	Region
1	143	Latin America		330	5	South Asia
2	13	Latin America		336	20	South Asia
3	101	Latin America		337	28	South Asia
7	16	Latin America		345	5	South Asia
20	27	Latin America		347	1	South Asia
21	17	Latin America		348	7	South Asia
60	29	Latin America		383	44	South Asia
64	68	Latin America		393	1	South Asia
97	21	Latin America		398	8	South Asia
194	25	MENA		410	18	South Asia
260	20	MENA		442	196	South Asia
261	109	MENA		444	38	South Asia
263	56	MENA		445	12	South Asia
302	428	East Asia		446	12	South Asia
317	4	South Asia		448	40	South Asia
319	52	South Asia		449	4	South Asia
321	7	South Asia		450	121	South Asia
329	51	South Asia		488	2	Sub-Saharan

Appendix V

Latin America Efficiency Scores

	Model 1	Model 2
firm	**vrste**	**vrste**
1	**1**	**1**
2	**1**	**1**
3	**1**	**1**
4	**1**	**1**
5	**0.982**	**0.981**
6	**1**	**1**
7	**1**	**1**
8	**1**	**1**
9	**1**	**1**
10	**0.688**	**0.286**
11	**0.57**	**0.295**
12	**1**	**0.65**
13	**0.78**	**0.442**
14	**0.666**	**0.453**
15	**0.676**	**0.523**
16	**0.544**	**0.529**
17	**0.545**	**0.545**
18	**0.618**	**0.618**
19	**0.955**	**0.955**
20	**1**	**1**
21	**1**	**1**
22	**0.848**	**0.734**
23	**0.969**	**0.712**
24	**0.909**	**0.769**
25	**0.931**	**0.876**
26	**1**	**0.959**
27	**1**	**1**
28	**0.99**	**0.982**
29	**0.97**	**0.962**
30	**0.985**	**0.981**
31	**1**	**1**
32	**1**	**1**
33	**1**	**1**
34	**1**	**1**
35	**1**	**1**
36	**1**	**1**
37	**0.815**	**0.679**
38	**0.993**	**0.938**
39	**1**	**0.947**
40	**0.7**	**0.644**
41	**0.679**	**0.637**
42	**0.874**	**0.842**
43	**0.753**	**0.72**
44	**0.627**	**0.587**
45	**0.604**	**0.573**
46	**0.636**	**0.61**
47	**0.992**	**0.784**
48	**0.884**	**0.787**
49	**0.861**	**0.828**
50	**0.88**	**0.859**
51	**0.904**	**0.883**
52	**0.886**	**0.872**
53	**0.897**	**0.886**
54	**0.816**	**0.792**
55	**0.765**	**0.744**
56	**0.891**	**0.891**
57	**0.902**	**0.895**
58	**0.961**	**0.961**
59	**1**	**1**
60	**1**	**1**
61	**0.604**	**0.36**
62	**1**	**0.846**
63	**0.711**	**0.711**
64	**1**	**1**
65	**1**	**1**
66	**1**	**1**
67	**0.948**	**0.948**
68	**0.899**	**0.885**
69	**0.958**	**0.944**
70	**0.944**	**0.934**
71	**0.883**	**0.877**
72	**0.901**	**0.9**
73	**0.945**	**0.945**
74	**1**	**1**
75	**1**	**1**
76	**0.925**	**0.858**
77	**1**	**0.952**
78	**1**	**1**
79	**1**	**0.99**
80	**1**	**1**
81	**1**	**1**
82	**0.987**	**0.987**
83	**1**	**1**
84	**0.957**	**0.957**
85	**0.897**	**0.897**
86	**0.984**	**0.962**
87	**0.933**	**0.749**
88	**1**	**0.712**
89	**1**	**1**
90	**0.816**	**0.779**
91	**0.813**	**0.775**
92	**0.868**	**0.868**
93	**1**	**1**
94	**1**	**1**
95	**0.736**	**0.736**
96	**1**	**1**
97	**1**	**1**
98	**1**	**1**
99	**1**	**1**
100	**0.482**	**0.444**
101	**0.491**	**0.491**
102	**0.523**	**0.523**
103	**0.508**	**0.508**
104	**0.479**	**0.466**
105	**1**	**0.917**
106	**1**	**0.953**
107	**0.723**	**0.557**
108	**0.767**	**0.725**
109	**0.761**	**0.655**
110	**1**	**0.777**
111	**1**	**0.832**
112	**0.979**	**0.869**
113	**0.853**	**0.766**
114	**0.921**	**0.921**
115	**0.973**	**0.973**
116	**1**	**1**
117	**1**	**1**
118	**1**	**1**
119	**1**	**1**
120	**0.692**	**0.691**
121	**0.648**	**0.637**

Appendix VI

MENA Efficiency Scores

	Model 1	Model 2
firm	**vrste**	**vrste**
1	**1**	**1**
2	**0.874**	**0.812**
3	**0.892**	**0.81**
4	**0.695**	**0.676**
5	**0.599**	**0.514**
6	**0.552**	**0.526**
7	**0.836**	**0.836**
8	**0.45**	**0.43**
9	**0.551**	**0.511**
10	**0.546**	**0.522**
11	**0.61**	**0.556**
12	**1**	**1**
13	**1**	**1**
14	**1**	**1**
15	**1**	**1**
16	**1**	**1**
17	**0.945**	**0.945**
18	**1**	**1**
19	**0.964**	**0.957**
20	**0.977**	**0.974**
21	**1**	**1**
22	**1**	**1**
23	**0.452**	**0.416**
24	**0.467**	**0.416**
25	**0.584**	**0.536**
26	**0.75**	**0.75**
27	**0.806**	**0.806**
28	**0.901**	**0.901**
29	**0.817**	**0.817**
30	**0.852**	**0.852**
31	**0.914**	**0.914**
32	**0.884**	**0.884**
33	**0.918**	**0.918**
34	**1**	**1**
35	**1**	**1**
36	**0.759**	**0.691**

	Model 1	Model 2
firm	**vrste**	**vrste**
37	**0.711**	**0.676**
38	**1**	**1**
39	**0.63**	**0.543**
40	**0.412**	**0.38**
41	**0.592**	**0.533**
42	**0.612**	**0.524**
43	**0.538**	**0.439**
44	**0.501**	**0.384**
45	**0.499**	**0.361**
46	**0.455**	**0.365**
47	**0.486**	**0.322**
48	**0.825**	**0.775**
49	**0.874**	**0.804**
50	**0.869**	**0.685**
51	**1**	**1**
52	**1**	**1**
53	**0.884**	**0.826**
54	**0.918**	**0.792**
55	**1**	**1**
56	**0.903**	**0.806**
57	**0.94**	**0.744**
58	**0.924**	**0.701**
59	**0.874**	**0.714**
60	**0.741**	**0.741**
61	**0.976**	**0.976**
62	**1**	**1**
63	**1**	**1**
64	**0.88**	**0.831**
65	**0.71**	**0.658**
66	**0.774**	**0.752**
67	**0.727**	**0.679**
68	**0.714**	**0.628**
69	**0.932**	**0.93**
70	**0.834**	**0.754**
71	**0.784**	**0.667**
72	**1**	**1**

	Model 1	Model 2
firm	**vrste**	**vrste**
73	**1**	**1**
74	**0.876**	**0.765**
75	**0.704**	**0.625**
76	**0.958**	**0.718**
77	**0.875**	**0.446**
78	**0.854**	**0.805**
79	**0.889**	**0.67**
80	**0.751**	**0.579**
81	**0.687**	**0.507**
82	**0.751**	**0.578**
83	**0.599**	**0.425**
84	**0.956**	**0.772**
85	**0.951**	**0.716**
86	**1**	**1**
87	**1**	**1**
88	**1**	**1**
89	**0.98**	**0.976**
90	**1**	**1**
91	**1**	**1**
92	**1**	**1**
93	**1**	**1**
94	**0.945**	**0.945**
95	**1**	**1**
96	**1**	**1**
97	**1**	**1**
98	**0.951**	**0.837**
99	**1**	**1**
100	**1**	**1**
101	**0.987**	**0.987**
102	**1**	**1**
103	**1**	**1**
104	**0.915**	**0.911**
105	**1**	**1**
106	**0.997**	**0.997**
107	**0.921**	**0.921**
108	**0.915**	**0.915**

Appendix VII

East Asia Efficiency Scores

	Model 1	Model 2
firm	**vrste**	**vrste**
1	**0.844**	**0.844**
2	**0.939**	**0.939**
3	**0.921**	**0.921**
4	**0.825**	**0.81**
5	**1**	**0.983**
6	**0.993**	**0.938**
7	**0.778**	**0.747**
8	**0.729**	**0.668**
9	**0.605**	**0.54**
10	**0.525**	**0.437**
11	**0.527**	**0.428**
12	**0.523**	**0.467**
13	**0.547**	**0.507**
14	**0.748**	**0.688**
15	**0.6**	**0.6**
16	**0.636**	**0.636**
17	**0.763**	**0.763**
18	**0.863**	**0.863**
19	**1**	**1**
20	**0.863**	**0.863**
21	**0.96**	**0.96**
22	**1**	**1**
23	**0.877**	**0.877**
24	**0.956**	**0.956**
25	**0.973**	**0.973**
26	**1**	**1**
27	**1**	**1**
28	**0.932**	**0.917**
29	**0.636**	**0.611**

	Model 1	Model 2
firm	**vrste**	**vrste**
30	**0.827**	**0.814**
31	**1**	**1**
32	**1**	**1**
33	**1**	**1**
34	**1**	**1**
35	**1**	**1**
36	**1**	**1**
37	**1**	**0.757**
38	**0.767**	**0.404**
39	**0.767**	**0.551**
40	**0.717**	**0.521**
41	**0.774**	**0.5**
42	**0.701**	**0.439**
43	**0.628**	**0.383**
44	**0.783**	**0.532**
45	**0.921**	**0.635**
46	**1**	**0.664**
47	**1**	**1**
48	**1**	**1**
49	**1**	**1**
50	**0.66**	**0.561**
51	**0.797**	**0.714**
52	**0.746**	**0.466**
53	**1**	**0.66**
54	**1**	**0.676**
55	**1**	**0.667**
56	**0.944**	**0.437**
57	**0.79**	**0.428**
58	**0.954**	**0.446**

	Model 1	Model 2
firm	**vrste**	**vrste**
59	**0.918**	**0.495**
60	**0.891**	**0.497**
61	**0.933**	**0.661**
62	**1**	**0.783**
63	**1**	**0.584**
64	**0.748**	**0.729**
65	**1**	**1**
66	**1**	**1**
67	**0.805**	**0.77**
68	**0.969**	**0.969**
69	**0.725**	**0.691**
70	**0.792**	**0.782**
71	**0.679**	**0.658**
72	**0.621**	**0.578**
73	**1**	**1**
74	**1**	**1**
75	**0.801**	**0.801**
76	**1**	**1**
77	**0.576**	**0.48**
78	**0.543**	**0.451**
79	**0.583**	**0.512**
80	**0.651**	**0.564**
81	**0.709**	**0.651**
82	**0.62**	**0.559**
83	**0.724**	**0.684**
84	**0.692**	**0.645**
85	**0.612**	**0.565**
86	**0.501**	**0.435**

Appendix VIII

South Asia Efficiency Scores

	Model 1	Model 2
firm	**vrste**	**vrste**
1	**1**	**0.987**
2	**1**	**1**
3	**1**	**1**
4	**1**	**1**
5	**0.928**	**0.923**
6	**1**	**1**
7	**0.934**	**0.859**
8	**0.628**	**0.575**
9	**0.669**	**0.649**
10	**0.707**	**0.649**
11	**0.721**	**0.721**
12	**0.898**	**0.876**
13	**1**	**1**
14	**1**	**1**
15	**1**	**1**
16	**0.759**	**0.758**
17	**0.914**	**0.914**
18	**0.912**	**0.909**
19	**0.853**	**0.841**
20	**0.824**	**0.814**
21	**1**	**1**
22	**1**	**1**
23	**1**	**1**
24	**0.807**	**0.531**
25	**0.706**	**0.489**
26	**0.677**	**0.567**
27	**0.788**	**0.723**
28	**0.729**	**0.696**
29	**1**	**0.997**
30	**1**	**1**

	Model 1	Model 2
firm	**vrste**	**vrste**
31	**0.782**	**0.782**
32	**1**	**1**
33	**1**	**1**
34	**1**	**1**
35	**1**	**1**
36	**0.89**	**0.89**
37	**0.669**	**0.669**
38	**0.498**	**0.41**
39	**0.384**	**0.367**
40	**0.539**	**0.489**
41	**1**	**1**
42	**0.946**	**0.513**
43	**0.963**	**0.688**
44	**0.996**	**0.729**
45	**0.912**	**0.552**
46	**0.858**	**0.593**
47	**0.67**	**0.384**
48	**0.651**	**0.577**
49	**1**	**0.71**
50	**0.758**	**0.601**
51	**0.883**	**0.651**
52	**0.997**	**0.827**
53	**1**	**0.961**
54	**0.677**	**0.285**
55	**0.616**	**0.42**
56	**0.6**	**0.488**
57	**0.534**	**0.455**
58	**0.563**	**0.547**
59	**0.575**	**0.575**
60	**0.782**	**0.782**

	Model 1	Model 2
firm	**vrste**	**vrste**
61	**0.804**	**0.804**
62	**0.796**	**0.795**
63	**0.92**	**0.92**
64	**0.793**	**0.792**
65	**0.725**	**0.667**
66	**0.5**	**0.427**
67	**0.465**	**0.387**
68	**1**	**1**
69	**0.556**	**0.556**
70	**0.794**	**0.793**
71	**0.592**	**0.592**
72	**0.661**	**0.661**
73	**0.729**	**0.729**
74	**0.801**	**0.801**
75	**0.8**	**0.8**
76	**0.901**	**0.901**
77	**1**	**0.988**
78	**1**	**1**
79	**1**	**0.997**
80	**1**	**1**
81	**0.992**	**0.986**
82	**0.982**	**0.982**
83	**1**	**1**
84	**1**	**1**
85	**0.79**	**0.618**
86	**0.764**	**0.684**
87	**0.807**	**0.493**
88	**0.73**	**0.71**
89	**0.765**	**0.747**
90	**0.495**	**0.343**

Appendix VIII: continuation

	Model 1	Model 2
firm	**vrste**	**vrste**
91	**0.702**	**0.585**
92	**0.803**	**0.717**
93	**0.845**	**0.835**
94	**0.894**	**0.894**
95	**1**	**1**
96	**1**	**1**
97	**1**	**0.833**
98	**0.979**	**0.688**
99	**0.886**	**0.632**
100	**0.819**	**0.573**
101	**0.832**	**0.496**
102	**0.78**	**0.551**
103	**0.842**	**0.548**
104	**0.904**	**0.379**
105	**0.786**	**0.421**
106	**0.929**	**0.357**
107	**0.942**	**0.805**
108	**1**	**0.591**
109	**1**	**0.441**
110	**0.812**	**0.508**

	Model 1	Model 2
firm	**vrste**	**vrste**
111	**0.627**	**0.459**
112	**0.598**	**0.598**
113	**0.478**	**0.478**
114	**0.496**	**0.496**
115	**0.548**	**0.33**
116	**0.555**	**0.371**
117	**0.572**	**0.338**
118	**0.653**	**0.437**
119	**0.757**	**0.455**
120	**0.94**	**0.32**
121	**0.774**	**0.61**
122	**0.735**	**0.393**
123	**0.857**	**0.527**
124	**0.648**	**0.415**
125	**1**	**1**
126	**0.807**	**0.438**
127	**1**	**1**
128	**0.995**	**0.995**
129	**1**	**1**
130	**1**	**1**

	Model 1	Model 2
firm	**vrste**	**vrste**
131	**1**	**1**
132	**1**	**1**
133	**1**	**1**
134	**1**	**1**
135	**1**	**1**
136	**0.893**	**0.831**
137	**0.862**	**0.694**
138	**0.611**	**0.513**
139	**0.664**	**0.664**
140	**0.676**	**0.676**
141	**0.881**	**0.881**
142	**0.884**	**0.884**
143	**1**	**1**

Appendix IX

Sub-Saharan Africa Efficiency cores

	Model 1	Model 2
firm	**vrste**	**vrste**
1	**1**	**1**
2	**1**	**1**
3	**1**	**1**
4	**1**	**1**
5	**1**	**0.849**
6	**0.97**	**0.89**
7	**1**	**0.996**
8	**0.849**	**0.8**
9	**1**	**1**
10	**0.944**	**0.68**
11	**0.826**	**0.519**
12	**0.824**	**0.698**
13	**0.796**	**0.676**
14	**0.817**	**0.774**
15	**0.788**	**0.699**
16	**0.808**	**0.771**
17	**0.785**	**0.771**
18	**0.818**	**0.777**
19	**0.915**	**0.908**
20	**0.791**	**0.769**
21	**1**	**1**
22	**1**	**1**
23	**1**	**1**
24	**1**	**1**
25	**0.901**	**0.901**

	Model 1	Model 2
firm	**vrste**	**vrste**
26	**1**	**1**
27	**1**	**1**
28	**1**	**1**
29	**1**	**1**
30	**1**	**1**
31	**1**	**0.996**
32	**0.84**	**0.686**
33	**0.96**	**0.933**
34	**0.933**	**0.889**
35	**1**	**1**
36	**0.912**	**0.879**
37	**0.974**	**0.966**
38	**1**	**1**
39	**0.805**	**0.644**
40	**1**	**1**
41	**0.917**	**0.888**
42	**1**	**1**
43	**1**	**1**
44	**1**	**0.981**
45	**1**	**1**
46	**0.994**	**0.977**
47	**1**	**1**
48	**1**	**1**
49	**1**	**1**
50	**0.999**	**0.999**

	Model 1	Model 2
firm	**vrste**	**vrste**
51	**0.896**	**0.896**
52	**1**	**1**
53	**0.925**	**0.891**
54	**0.901**	**0.853**
55	**1**	**0.922**
56	**0.912**	**0.844**
57	**0.977**	**0.963**
58	**1**	**1**
59	**1**	**1**
60	**1**	**1**
61	**1**	**1**
62	**0.973**	**0.971**
63	**0.883**	**0.864**
64	**1**	**1**
65	**0.988**	**0.986**
66	**1**	**0.812**
67	**0.98**	**0.592**
68	**0.972**	**0.807**
69	**1**	**0.872**
70	**1**	**0.887**
71	**1**	**0.78**
72	**1**	**0.986**
73	**0.867**	**0.52**
74	**0.863**	**0.566**
75	**0.9**	**0.648**

Appendix X

Average Efficiency Score Hypothesis Results for Model 1

Wilcoxon Scores for vrsteM Classified by Region					
Region	**N**	**Sum of Scores**	**Expected Under H0**	**Std Dev Under H0**	**Mean Score**
Latin America	121	32288	32307	1488.57	266.84
MENA	108	18398	28836	1428.34	170.35
East Asia	86	25426	22962	1307.16	295.65
South Asia	143	46965	38181	1574.4	328.43
Sub-Saharan Africa	75	19234	20025	1235.63	256.45
Average scores were used for ties					

Kruskal-Wallis Test	
Chi-Square	68.69
DF	4
Pr > Chi-Square	<.0001

Appendix XI

Average Efficiency Scores Hypothesis Results for Model 2

Wilcoxon Scores for vrsteM Classified by Region					
Region	**N**	**Sum of Scores**	**Expected Under H0**	**Std Dev Under H0**	**Mean Score**
Latin America	121	29944	32307	1489.11	247.47
MENA	108	23512	28836	1428.87	217.70
East Asia	86	23598	22962	1307.64	274.40
South Asia	143	53083.5	38181	1575.02	371.21
Sub-Saharan Africa	75	12173.5	20025	1236.09	162.31
Average scores were used for ties.					

Kruskal-Wallis Test	
Chi-Square	113.39
DF	4
Pr > Chi-Square	<.0001

Appendix XII

GAP Distribution Hypothesis Results for Model 1

Wilcoxon Scores (Rank Sums) for Variable GAP Classified by Variable Region					
Region	**N**	**Sum of Scores**	**Expected Under H0**	**Std Dev Under H0**	**Mean Score**
Latin America	121	30021	32307	1488.14	248.10
MENA	108	16693	28836	1427.94	154.56
East Asia	86	27810	22962	1306.79	323.37
South Asia	143	51955	38181	1574.00	363.32
Sub-Saharan Africa	75	15833	20025	1235.28	211.10
Average scores were used for ties.					

Kruskal-Wallis Test	
Chi-Square	136.9614
DF	4
Pr > Chi-Square	<.0001

Appendix XIII

GAP Distribution Hypothesis Results for Model 2

Wilcoxon Scores (Rank Sums) for Variable GAP Classified by Variable Region					
Region	**N**	**Sum of Scores**	**Expected Under H0**	**Std Dev Under H0**	**Mean Score**
Latin America	121	25504.50	32307	1488.02	210.78
MENA	108	21033.50	28836	1427.82	194.75
East Asia	86	25784.00	22962	1306.68	299.81
South Asia	143	61664.50	38181	1573.87	431.22
Sub-Saharan Africa	75	8324.50	20025	1235.18	110.99
Average scores were used for ties.					

Kruskal-Wallis Test	
Chi-Square	283.8852
DF	4
Pr > Chi-Square	<.0001