Measuring Efficiency for Banking Sector in Selected Countries Using Data Envelopment Analysis

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Abstract

The aim of this paper is to examine efficiency scores for banking sector for thirteen countries. The sample is selected to cover developed, developing, and emerging economies. Efficiency scores are projected through a nine–year pooled data for a representative sample of 117 observations covering different countries. Efficiency scores are estimated via Data Envelopment Analysis (DEA) technique using Input–orientation and output– orientation to determine banking system tendency. Inputs are assets, reserves, debt, number of branches, number of ATM, and excess reserves. Outputs are provided loans, deposits, FDI, money supply, and remittances. Results disclose that there is a sort of great variation for efficiency scores within countries and within outputs owing to their pattern of development. Moreover, results show that most countries are input – oriented for solitary outputs. On the other hand, the gap between input – orientation and output–orientation for joint outputs is too low relative to individual outputs.

Keywords: Efficiency Scores; FDI; Deposits: Remittances; Loans; Money supply; Input – orientation; Output – orientation

JEL Classifications: C23; C51; D24; L67

Ibrahim Mosaad Elatroush

I. Introduction

There is no doubt that banking sector has an important role in promoting economic growth and economic stability. The role of the banking industry is not restricted to the nature of economic regime or whether the country is belonged to developed or developing countries. Undoubtedly, the strength and stability of the banking system will help in promoting economic growth especially in developing and emerging countries. Therefore, the banking sector requires to be operated efficiently to achieve higher levels of economic growth and economic development.

Efficiency is used to measure the success of a firm in resource allocation. It is a prerequisite for firms to survive in competitive markets. It is also used to compare or benchmark the performance of the firms in their business. From this standpoint, the efficiency or optimal results are achieved with the use of limited resources to achieve a desired level of output. In this regard, the firm or a bank has the ability to the produce the same level of output with at lower cost than other banks or has the ability to control its factors of production – input –oriented – at lower costs. In output – orientation case, the bank is output – oriented if it has the ability to achieve higher levels of output from the level of inputs. Competition motivates individual firms to be efficiency, as it is necessary for survival. Increasing the efficiency of business improves the possibilities to survive and succeed, as well as optimal use of scarce resources.

In this paper, the aim is to fill the gap in the banking literature by measuring the efficiency using microeconomic theory via employing a nonparametric technique DEA in estimating efficiency for thirteen countries from 2011 to 2019 with different regions, different regimes, and different development patterns (developed, emerging, and developing countries). Moreover, the paper has a variety in which the sample does not cover a specific economic conglomerate such as ASEAN, EU, NAFTA, etc., it includes countries across different continents. The paper uses data collected from the world bank.

The study compares banks from different countries with different currencies, so the data were translated into US dollar. The production efficiency approach is used in which factors of production are used to produce different bank products. The objective of this paper is to

Ibrahim Mosaad Elatroush

estimate efficiency scores for banks productive efficiency using different countries with different characteristics. As the intention of the study to test the internal efficiency, we only employ factors such as assets, number of ATM per 100,000-person, number of branches, reserves, and excess reserves.

Brief description of bank systems in selected countries

Egypt

According to the Central Band of Egypt (CBE), the Egyptian banking system consists of 40 banks categorized as commercial, non-commercial public and private sector. The number of branches is 7000 with 20000 ATM. In practice, the vast majority of these banks operate as commercial banks, although there are a few specialized banks (i.e. agriculture and real estate). The National Bank of Egypt, Bank Misr, and Banque Du Caire are large public-sector banks which control 40 percent of the banking sector. All banks in Egypt are subject to supervision by the CBE; however, the Arab International Bank, Naser Social Bank and the National Investment Bank are exempted due to special provisions in law and treaty.

Morocco

Morocco continues to modernize its banking system. The sector has a reasonably competitive landscape, with a number of homegrown financial institutions with international footprints, as well as several subsidiaries of foreign banks. According to the 2017 Annual Report on Banking Supervision published on July 2018 by the Central Bank (Bank Al Maghrib), the sector includes 19 traditional banks, five participatory banks (Umnia Bank, Bank Assafa, BTI Bank, Bank Al Yousr, Al Akhdar Bank), 32 financing firms, 13 microcredit lenders, seven offshore banks and nine money transfer firms. The number of branches is 8880 with 10360 ATM. The sector is dominated by locally owned banks, which account for 82.3% of industry assets. Credit is allocated freely, and the central bank uses indirect methods to control the interest rate and volume of credit.

Indonesia

As of March 2018, Indonesia had 115 commercial banks and 1,630 rural banks. The largest four banks hold over 45 percent of bank assets. As

ranked by assets, the following are the four largest state-owned banks: Bank Mandiri, Bank Rakyat Indonesia, Bank Negara Indonesia, and BTPN. The Financial Services Authority ("Otoritas Jasa Keuangan" or OJK) regulates key aspects of the banking and financial system, including bank regulation and supervision, whereas the Central Bank of Indonesia, an independent state institution, regulates payment systems and conducts foreign exchange supervision. Indonesia is encouraging the development of Islamic banking and seeks to increase its share of total banking assets to more than 5%. As of February 2018, Islamic banking institutions in Indonesia held 3.93 % of total banking system assets. The Indonesian Islamic banking sector has 13 full-service Islamic banks, 21 banks with Islamic finance units, and 167 Islamic rural banks. The number of branches is 40500 with 143100 ATM.

Japan

The Japanese banking industry is among one of the largest in the world. In 2019, banks held more than 18 trillion U.S. dollars' worth of assets and the banking industry's ordinary profits amounted to more than four trillion Japanese yen. Due to an ongoing low interest environment and the demographic shift, banks are under pressure to reduce costs, a development that has been further accelerated by the coronavirus pandemic. Commercial banks are regulated under the banking act and supervised by Japan's primary financial regulator, the Financial Services Agency (FSA). They are commonly divided into city banks, trust banks, regional banks and regional banks II, foreign banks, or other banks. City banks, which include the three megabanks, MUFG Bank, Sumitomo Banking Corporation, and Mizuho Bank, are the largest banks in Japan. Trust banks offer trust and investment-related services in addition to ordinary banking services. For historical reasons, regional banks are divided into regional banks of the first and second tier, although performing the same functions. They provide banking services to residents and local small and medium-sized businesses. The number of branches is 40800 with 148800 ATM.

Mexico

Currently, 48 banks are operating in Mexico: seven of which (BBVA Bancomer, CitiBanamex, Santander, Banorte, HSBC, Inbursa, and Scotia

Bank) control 78 percent of the market share by total assets. Mexico's commercial banking sector is open to foreign competition. Almost all major banks, except for Banorte, are under the control of foreign banks. In general, small and medium-sized enterprises (SMEs) have trouble accessing credit. The Mexican Government has enacted several incentives to encourage more lending to SMEs, and banks have followed suit with new lending policies, but it remains to be seen whether the largest segment of the Mexican economy will gain better access to credit. The number of branches is 17500 with 76250 ATM.

Malaysia

The structure of the Malaysian financial system has evolved to become less fragmented through consolidation and rationalization. The country's central bank, Bank Negara Malaysia (BNM), directed the merger of Malaysia's local banking institutions into ten anchor banks, which was completed in 2002. The government encouraged further mergers among the local banking institutions to ensure competitiveness with international banks. The Malaysian banking sector consist of 27 commercial banks (including 19 licensed foreign banks), 11 investment banks, 18 Islamic banks as well as non-bank financial institutions. Affin Bank – A wholly owned subsidiary of Affin Holdings Berhad (AHB). The number of branches is 3200 with 14080 ATM.

Philippines

The Philippines' banks are classified into three types: universal and commercial banking, rural and cooperative banking, and thrift banking. Universal and commercial banking leading the banking sector in the Philippines. As of October 2020, the value of loans granted by universal and commercial banks in the Philippines amounted to nearly 9.7 trillion Philippine pesos. Of these loans, approximately 364 billion Philippine pesos have been granted for motor vehicle loans for household consumption and approximately 1.6 trillion Philippine pesos worth of loans granted for production of real estate businesses in the country. In 2019, the number of rural and cooperative banks in the Philippines amounted to 456 institutions, leading other bank types. The total number of banks in the Philippines was at around 552 institutions in that year. The number of branches is 9450 with 30450 ATM. https://www.statista.com/

Ibrahim Mosaad Elatroush

Russia

 The Russian banking industry, which ranks among the 10 largest in Europe, is characterized by a high level of capital consolidation and a many credit institutions. Since 2013, however, the Central Bank of Russia implemented a policy for reducing the volume of financial institutions in the country, as a result of which, over 500 bank licenses were revoked by the state. There are 339 operating banks (232 banks with a universal license and 107 banks with a basic license) and 36 non-bank financial institutions in Russia. Banks and non-bank financial institutions offer financial services to clients based on banking licenses issued by the Bank of Russia. As of December 2019, nearly two thirds of the banking sector's total assets were held by the three major banks, with more than half belonging to Sberbank – the largest bank in Russia. The number of branches is 35000 with 231000 ATM.

South Africa

South Africa is home to various types of banking institutions. These include locally controlled banks, mutual banks, co-operative banks, international banks and foreign banks. Banks in South Africa hold a total of around R6 trillion in deposits. According to the Prudential Authority, there are currently 31 banking entities in South Africa – 18 local banks, and 13 local branches of foreign banks. According to a 2019 report by Deloitte, around 80% of South Africans have a bank account, but the majority of day-to-day purchases are paid for with cash. The four biggest banking groups in South Africa are Standard Bank Group, FirstRand Ltd (which operates First National Bank), Absa Group, and Nedbank Group. These four banking groups provide more than 80% of banking services in South Africa. The number of branches is 5200 with 33800 ATM.

Turkey

The Central Bank has the usual central bank responsibilities. As of January 2021, there are a total of 48 banks operating with 9,880 branches in Turkey and 71 branches abroad with 69720 ATM. At present, the Turkish banking sector is among the strongest and most expansive in East Europe, the Middle East and Central Asia. More than 34% of the assets in the Turkish banking sector are concentrated in the Agricultural Bank (Ziraat Bankası),

Ibrahim Mosaad Elatroush

Housing Bank (Yapı Kredi Bankası), Isbank (Türkiye İş Bankası) and Akbank. A number of Arabian trading banks, which practice an Islamic banking, are also present in the country.

Thailand

Thailand's numerous banks and financial institutions speak for her growing economy and her place in Southeast Asian region as a growing economic force. Its growth in terms of economy and finance once earned Thailand the name "Tiger of Southeast Asia". Commercial Banks are key players in Thai financial system. Thai Banking System has 30 licensed banks: 15 Thai Banks. 11 Foreign Banks & 4 Subsidiaries. The number of branches is 7370 with 77050 ATM.

Brazil

Brazil is the largest economy in Latin America in terms of (GDP). Brazil also holds the title of the most populous country in the region, with over 211 million inhabitants as of that year. With such a large population and a growing economy, it is not surprising that the banking industry is considered an important sector and an economic driver for growth and development. The Brazilian banking system consists of 174 banks including 153 commercial banks, 12 investment banks, 4 development banks and 4 exchange banks. The four largest Brazilian banks are Itaú Unibanco, Banco do Brasil, Bradesco and Caixa Economica Federal. The number of branches is 39600 with 180,000 ATM.

Qatar

There are (20) commercial banks operating in Qatar. Among them there are (12) national banks, (4) of which are Islamic banks; and they all operate through 223 local branches with 1540 ATM. You will find many options when it comes to local and international banks to serve your everyday needs in Qatar. All the commercial banks are regulated by the Qatar Central Bank. Alternatively, if you prefer to open an international account, you will also find some foreign banks such as HSBC which are widely established in the country.

The paper is divided as follows: section II covers the literature review; section III provides a brief description for collected data; section IV

provides the employed model; section V handles the obtained results and the analysis of these results; section VI displays conclusions; and finally, section VII displays references.

II. Literature Review

Unfortunately, the majority of efficiency papers related to banking sector are focused on specific regions or economic cluster such as ASEAN, EU countries, or within counties and most literature mainly focuses on merging, ownership, Islamic banks, commercial banks, or market structure topic. The selected countries cover different countries at different regions with different levels of income and different regimes. Therefore, a brief literature review is provided whereas the literature related to sole countries is excluded since it is too much and irrelevant.

Bank efficiency papers and studies continued for decades and have been grounded on the methodological advances in DEA and SFA. Berger and Humphrey (1998) provide an overview of 130 studies of bank efficiency published until 1997. They find that estimated average efficiency levels vary substantially across methods, contexts, and model specifications. Fioderlisi, Marques-Ibanez and Molyneux (2010) stated that inefficient banks have the tendency to make risky steps that are dangerous for the entire financial system. Furthermore, they also found that banks, reaching the high productivity, operate with lower costs and do not tend to do operations that include moral hazard.

Banks with balanced capital structure can afford to do business with higher risk. Olson and Zoubi (2011) found that most MENA banks are somewhat smaller than the optimal size. The average bank (relative to the best practice banks in the region), operates at a cost efficiency lower than in North American banks, but in line with studies of the banking industry in many European countries and in developing economies. MENA banks are more profitable and show less discrepancy between cost and profit efficiency measures than has been found in other countries, while Islamic banks in the region are more profitable, but less cost efficient than conventional MENA banks.

Noor, H. et.al (2020) in their study the determinants of the bank regulation and supervision on the efficiency of Islamic banks in different

country's income level investigate the impact of the country's governance on the revenue efficiency of 108 Islamic banks from 26 countries offering Islamic banking and finance products services using DEA. They found that the stricter the supervisory power, the less strict capital requirement, the tighter the restrictions on non-banking activities, and the stricter the private monitoring enhance statistically significantly the level of efficiency of Islamic banks. Hernández, Palazzo and Fernández (2019) analyze the factors that can explain the differences in commercial bank efficiency among 17 countries in Latin America via DEA. They found that scores reveal the heterogeneity of average efficiency within the region. Regarding the factors that may explain the differences in performance in the Latin America banking sector, the results allow to state that certain internal variables such as bank size, the ratio of loans to total assets and the ratio of nonperforming loans show the expected relationship to efficiency, in line with much of the previous literature.

Ngo and Le (2018) investigate the causal relationship between banking efficiency and capital market development in 86 countries between 2006 and 2011. They follow the two-stage framework: data envelopment analysis (DEA) to achieve efficiency scores. Thereafter, those efficiency scores will be linked with the development level of the capital markets of the corresponding country in the second stage using the generalized method of moments in a simultaneous. They found that banking systems around the world were still inefficient, suggesting that it would take time for the global banking system to recover after the global financial crisis 2007/2008. More importantly, the findings demonstrated that the larger the capital market is, the less efficient its banking system would be. In contrast, banking efficiency can positively influence the development of the capital market. Svitalkova (2014) measures and compares the efficiency of banking system in selected countries (Czech Republic, Slovakia, Austria, Poland, Hungary, Slovenia) via DEA. She investigates the real state of the bank system and whether there is a place for improvement, or whether banks are already on the production possibility frontier. Detailed knowledge about financial conditions and the economic situation of banks helps to strengthen the financial system and enables better decision making for responsible persons.

Balcerzak et.al (2017) measured the degree of efficiency of banking sectors in the EU countries. They found that there are differences between the efficiency of banking sectors of "old" fifteen and "new" EU member countries. They also confirmed that there is a noticeable difference between the efficiency of banking sectors within the European Monetary Union members and Countries which do not belong to the Euro-zone.

Garcia-Herrero et al. and Fu et al.9 tested the market structure-performance relationship in China and Asia Pacific countries in the years 1997- 2004 and 2007-2008, respectively, and found that banks are more efficient in less concentrated banking markets. Similarly, Maudos and Fernandez de Guevara, based on research of the European banking sector in the years 1995-2001, stated that the increase in concentration and market power leads to a fall in efficiency.

From a geographical point of view, some studies have examined banking performance on a global scale (Bhimjee et al., 2016), while others have focused on emerging economies (Huang and Fu, 2013), transition economies (Weill, 2003; Yildirim and Philippatos, 2007), developed economies (Berger, 2007) or other particular economic areas.

III. Data

Available data about selected countries is collected from the World Bank. The data covers a representative sample of thirteen countries contain developing, emerging, developed, and higher income countries. The countries are as follows, Brazil, Egypt, Japan, Indonesia, Malaysia, Mexico, Morocco, Philippines, Qatar, Russia, South Africa, Thailand, and Turkey. The data covers the period from 2011 to 2019 with the sample of 117 observations. The dependent variables are assets, total reserves, excess reserves, debt, number of branches, number of atm machines. The regressors are as follows; deposits, loans, money supply, FDI, and remittances. All values for the variables are converted from domestic currencies to the US dollar.

IV. The Model and variables

Data is estimated via Data Envelopment Analysis (DEA). DEA is nonparametric technique utilizes linear programming to estimate efficiency scores for decision making units or firms in which efficient firms lie on the production frontier. Boles (1966) & Afriat (1972) proposed linear programming method as a nonparametric technique to estimate efficiency. The DEA has more interest and becomes familiar after the paper of Charnes, Cooper & Rhodes (1978) "Measuring the Efficiency of Decision-Making Units." They employ constant returns to scale (CRS) then many extensions to DEA have been proposed in the literature. Banker, Charnes & Cooper (1984) propose Variable Returns to Scale (VRS) model in case of whether there is a difference between efficiency scores between the availability of a firm to control its inputs or outputs.

The firm can apply input-oriented measures if it has the ability to control its inputs efficiently or if it has the ability to produce the same level of output with minimum level of inputs or has the ability to control production costs. This is what is called input orientation. An input-oriented measure of technical efficiency as a function can be depicted as follows:

$$TE_I \ (y, \ x) = \min \ \{\theta: \theta \ x \ \epsilon \ L \ (y)\}$$

where TE_I is the technical efficiency according to input- orientation method, X is a vector of inputs, L (y) is input possibility set and θ is efficiency score of each observation. The output- oriented measure can be applied by a firm if it is capable of controlling its output or achieve maximum amount of output from the same level of inputs. The functional form of output-oriented measure of technical efficiency is shown as follows:

$$TE_O \ (y, \ x) = [\max \ \{\Phi: \Phi \ y \ \epsilon \ p \ (x)\}]$$

where TE_O is the technical efficiency in accordance with output-orientation method, y is maximum amount of output can firm achieve from the same inputs X, p (x) is output possibility set and Φ is efficiency score of each observation. The VRS is utilized to examine whether the banking system is input-oriented or output- oriented or both the same.

Ibrahim Mosaad Elatroush

Efficiency scores for the banking sector in each country and for each output is estimated in which five models is estimated for each output and another five models after adding the input variable debt are estimated using 9 countries after excluding Brazil, Japan, Malaysia, and Qatar because the value of the variable is zero in four countries. Then the efficiency scores for output variables remittances and FDI are estimated for 9 and for 13 countries. Additionally, the efficiency scores for variables loans and FDI are also estimated for 9 and for 13 countries. Finally, the impact of inputs on loans, FDI and remittances is estimated for both 9 and 13 countries. Efficiency scores are estimated via LIMDEP 9 Software.

Dependent variables:

a. LOANS: provided loans

b. DEPOSITS: total deposits in the banking system

c. FDI: Foreign Direct Investment

d. REMITTEN: transferred remittances

e. MSUPPLY: Money supply in the banking system

Independent variables are:

a. ASSET which represents assets

b. RESERVES which represent banking system

c. EXRESERV: excess reserves

d. ATM: Number of Automated teller machines

e. BRANCH: number of branches   f. DEBT: total debts

V. Empirical Results

Part one

In this part, we estimate efficiency scores for each dependent variable.

1. a Loans and Efficiency scores for 13 countries

The following table shows efficiency scores for banking sector for 13 countries. The average efficiency scores for input-orientation are 65% with minimum 15% for Russia in 2011 and maximum of 100% for several

Ibrahim Mosaad Elatroush

countries except Mexico, Malaysia, Philippines, Russia, Turkey, Thailand, and Brazil. The average efficiency scores for output-orientation are 54% with minimum of 7% for Philippines in 2011 and maximum of 100%. The lowest scores are for Mexico, Malaysia, Philippines, Russia, and Japan. Results show that most loanable fund policies in major countries in the sample is inefficient and is input – oriented than output – oriented.

Table 1-a: Loans Efficiency scores for 13 countries

```
+---------------------------------------------------------------------------+
| Data Envelopment Analysis                                                 |
| Output Variables:  LOANS                                                  |
| Input Variables:   ASSET    RESERVES EXRESERV ATM      BRANCH             ||
| Underlying Technology assumes VARIABLE Returns to Scale.                   |
+---------------------------------------------------------------------------+
| Estimated Efficiencies:     Mean     Std.Deviation    Minimum   Maximum   |
| Technical Efficiency      =======   =============     =======   =======   |
|      Input Oriented        .6524       .2867           .1482    1.0000    |
|      Output Oriented       .5352       .3409           .0730    1.0000    |
| Sample Size:           117 Observations.    117 Complete observations     |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E           |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE           |
| Incomplete observations are filled with zeros for efficiency values.      |
+---------------------------------------------------------------------------+
```

```
+-----------------------------------------+  +-----------------------------------------+
| Kernel Density Estimator for DEAEFF_I  |  | Kernel Density Estimator for DEAEFF_O  |
| Observations        =          117     |  | Observations        =          117     |
| Points plotted      =          117     |  | Points plotted      =          117     |
| Bandwidth           =       .098583    |  | Bandwidth           =       .107296    |
| Statistics for abscissa values----     |  | Statistics for abscissa values----     |
| Mean                =       .652396    |  | Mean                =       .535209    |
| Standard Deviation  =       .286698    |  | Standard Deviation  =       .340914    |
| Minimum             =       .148236    |  | Minimum             =       .072960    |
| Maximum             =      1.000000    |  | Maximum             =      1.000000    |
+-----------------------------------------+  +-----------------------------------------+
| Kernel Function     =      Logistic    |  | Kernel Function     =      Logistic    |
| Cross val. M.S.E.   =       .000000    |  | Cross val. M.S.E.   =       .000000    |
+-----------------------------------------+  +-----------------------------------------+
```

figure1.a-a: efficiency scores for loan input-oriented   figure1.a-b: efficiency scores for loan output-oriented

Ibrahim Mosaad Elatroush

1. b Loans and Efficiency scores for 9 countries

The following table shows efficiency scores for banking sector for 9 countries after excluding four countries that they haven't debt variable (Brazil, Japan, Malaysia, and Qatar). The average efficiency scores for input-orientation are 81% with minimum 50% for Philippines in 2019 and maximum of 100%. The lowest efficiency scores are for Philippines, Mexico, Russia, and Thailand. The average efficiency scores for output-orientation are 76% with minimum of 23% for Mexico 2011 and maximum of 100%. The lowest scores are for Indonesia, Mexico, and Philippines. Results show that minimum efficiency scores for 9 countries are better and higher than13countries. It is clear that input–orientation and output–orientation tend to be converged.

Table1.b Loans Efficiency scores for 9 countries

```
+------------------------------------------------------------------+
| Data Envelopment Analysis                                        |
| Output Variables:  LOANS                                         |
| Input Variables:   ASSET    RESERVES EXRESERV ATM    BRANCH  DEBT|
| Underlying Technology assumes VARIABLE Returns to Scale.         |
+------------------------------------------------------------------+
| Estimated Efficiencies:     Mean      Std.Deviation   Minimum   Maximum |
| Technical Efficiency        =======   =============   =======   ======= |
|       Input Oriented        .8120           .1722       .4980    1.0000 |
|       Output Oriented       .7580           .2238       .2256    1.0000 |
| Sample Size:          81 Observations.        81 Complete observations  |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E         |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE         |
| Incomplete observations are filled with zeros for efficiency values.    |
+------------------------------------------------------------------+
| Kernel Density Estimator for DEAEFF_I || Kernel Density Estimator for DEAEFF_O |
| Observations       =          81      || Observations       =          81      |
| Points plotted     =          81      || Points plotted     =          81      |
| Bandwidth          =     .062539      || Bandwidth          =     .083643      |
| Statistics for abscissa values----    || Statistics for abscissa values----    |
| Mean               =     .812045      || Mean               =     .757985      |
| Standard Deviation =     .172249      || Standard Deviation =     .223812      |
```
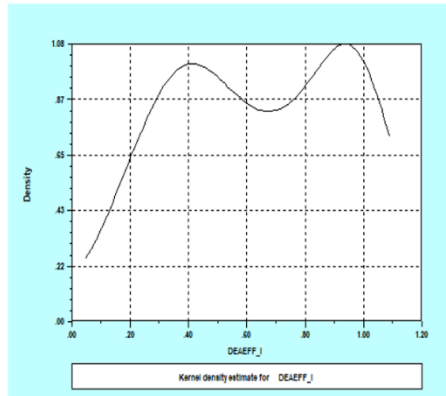
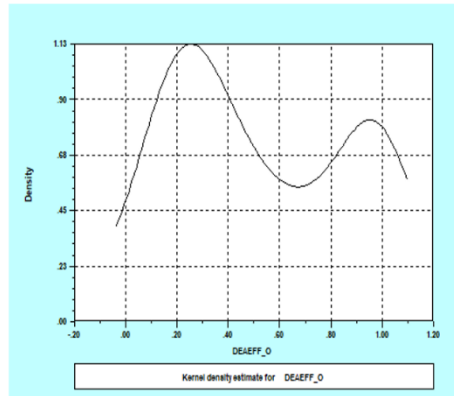

figure1.b-a: efficiency scores for loans input-oriented

figure1.1b-b: efficiency scores for loans output-oriented

Ibrahim Mosaad Elatroush

2. a Deposits and Efficiency scores for 13 countries

 Table 2.a represents deposits efficiency scores for banking sector for 13 countries. The average efficiency score for input-orientation is 80% with minimum about50% for Russia in 2016 and maximum of 100% for several countries except Malaysia, Philippines, Russia, South Africa, Thailand, and Brazil. The average efficiency scores for output-orientation are 75% with minimum of 38% for South Africa in 2016 and maximum of 100%. The lowest scores are for Malaysia, Philippines, South Africa, and Thailand. Results also show that efficiency scores for most countries for output- orientation are declined by the time which means most banks in such countries are in need for providing new products to attract deposits.

Table 2.a Deposits Efficiency scores for 13 countries

```
+----------------------------------------------------------------------+
| Data Envelopment Analysis                                            |
| Output Variables:  DEPOSITS                                          |
| Input Variables:   ASSET    RESERVES EXRESERV ATM      BRANCH        |
| Underlying Technology assumes VARIABLE Returns to Scale.             |
+----------------------------------------------------------------------+
| Estimated Efficiencies:    Mean    Std.Deviation    Minimum  Maximum |
| Technical Efficiency       =======  =============   =======  ======= |
|     Input Oriented          .8018       .1744        .4953   1.0000  |
|     Output Oriented         .7492       .2192        .3840   1.0000  |
| Sample Size:        117 Observations.      117 Complete observations |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E      |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE      |
| Incomplete observations are filled with zeros for efficiency values. |
+-----------------------------------------+----------------------------+
| Kernel Density Estimator for DEAEFF_I   | Kernel Density Estimator for DEAEFF_O |
| Observations          =         117     | Observations          =         117   |
| Points plotted        =         117     | Points plotted        =         117   |
| Bandwidth             =     .058412     | Bandwidth             =     .071296   |
| Statistics for abscissa values----      | Statistics for abscissa values----    |
| Mean                  =     .801772     | Mean                  =     .749230   |
| Standard Deviation    =     .174361     | Standard Deviation =       .219188    |
| Minimum               =     .495314     | Minimum               =     .384004   |
| Maximum               =    1.000000     | Maximum               =    1.000000   |
| ----------------------------------      | ------------------------------------  |
| Kernel Function       =    Logistic     | Kernel Function       =    Logistic   |
| Cross val. M.S.E.     =     .000000     | Cross val. M.S.E.     =     .000000   |
| Results matrix        =      KERNEL     | Results matrix        =      KERNEL   |
+-----------------------------------------+----------------------------+
```

figure2.a-a: efficiency scores for deposits input-oriented   figure2.a-b: efficiency scores for deposits output-oriented

2. b Deposits and Efficiency scores for 9 countries

Table 2.b displays deposits efficiency scores for banking sector for 9 countries. The average efficiency score for input-orientation is 88% with minimum about 54% for South Africa in 2016 and maximum of 100% for several countries except Thailand, and South Africa. Other countries show decline in efficiency scores from 2016. The average efficiency score for output-orientation is 86% with minimum of 45% for South Africa in 2019 and maximum of 100%. The lowest scores are for South Africa, and Thailand. Results also show that efficiency scores for most countries for output- orientation are declined by the time which means that most banks have to pay more attention for providing new products that suit clients' needs to attract deposits.

Table 2.b Deposits Efficiency scores for 9 Countries

```
+------------------------------------------------------------------------+
| Data Envelopment Analysis                                              |
| Output Variables:  DEPOSITS                                            |
| Input Variables:   ASSET    RESERVES EXRESERV ATM      BRANCH   DEBT   |
| Underlying Technology assumes VARIABLE Returns to Scale.               |
+------------------------------------------------------------------------+
| Estimated Efficiencies:    Mean      Std.Deviation    Minimum   Maximum|
| Technical Efficiency      =======    =============    =======   =======|
|      Input Oriented        .8808        .1464          .5390    1.0000 |
|      Output Oriented       .8607        .1708          .4456    1.0000 |
| Sample Size:        81 Observations.      81 Complete observations     |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E        |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE        |
| Incomplete observations are filled with zeros for efficiency values.   |
+------------------------------------------------------------------------+
```

```
+----------------------------------------+  +----------------------------------------+
| Kernel Density Estimator for DEAEFF_I  |  | Kernel Density Estimator for DEAEFF_O  |
| Observations           =           81  |  | Observations           =           81  |
| Points plotted         =           81  |  | Points plotted         =           81  |
| Bandwidth              =      .054700  |  | Bandwidth              =      .063829  |
| Statistics for abscissa values----     |  | Statistics for abscissa values----     |
| Mean                   =      .880821  |  | Mean                   =      .860744  |
| Standard Deviation =          .146367  |  | Standard Deviation =          .170794  |
| Minimum                =      .539040  |  | Minimum                =      .445580  |
| Maximum                =     1.000000  |  | Maximum                =     1.000000  |
|----------------------------------------|  |----------------------------------------|
| Kernel Function    =        Logistic   |  | Kernel Function    =        Logistic   |
| Cross val. M.S.E.  =         .000000   |  | Cross val. M.S.E.  =         .000000   |
| Results matrix     =          KERNEL   |  | Results matrix     =          KERNEL   |
+----------------------------------------+  +----------------------------------------+
```
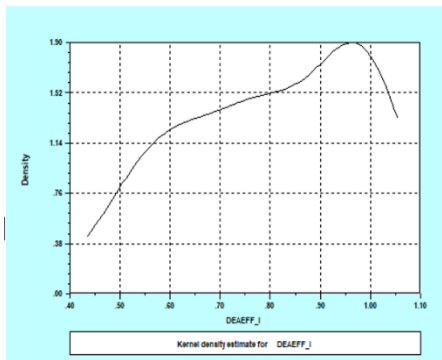
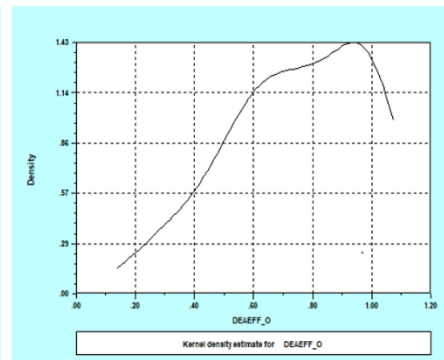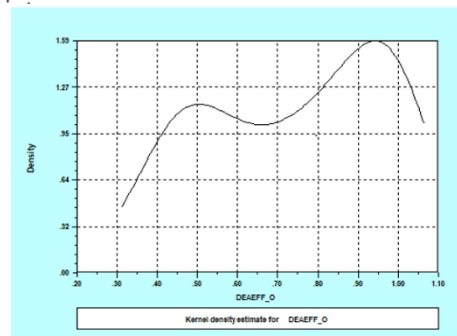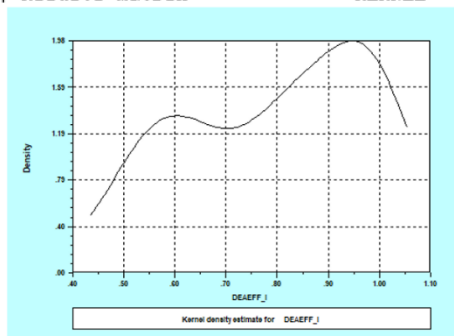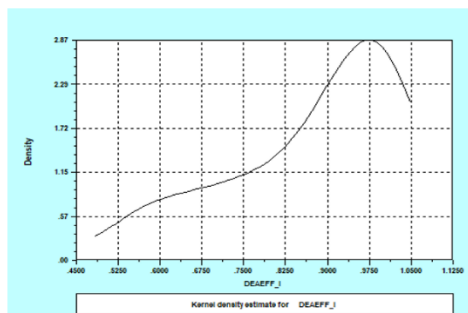figure2.b-a: efficiency scores for deposits input-oriented   figure2.b-b: efficiency scores for deposits output-oriented

Ibrahim Mosaad Elatroush

3.a FDI and Efficiency scores for 13 countries

Table 3.a exhibits FDI efficiency score for banking sector for 13 countries. The average efficiency score for input-orientation is 69% with minimum about 26% for Brazil in 2012 and maximum of 100% for several countries except Morocco from 2014, Indonesia, Mexico from 2013, Philippines, Russia, South Africa Turkey, and Brazil. The average efficiency score for output-orientation is 52% with minimum of 0.5% for South Africa in 2011, Indonesia 2016 & 2017 and maximum of 100%. The lowest scores are for South Africa, Indonesia, Egypt from 2016, Morocco 2011, 2015: 2019, Mexico from 2014, Malaysia from 2015, Philippines, Russia from 2015, South Africa, Turkey, Thailand, Brazil until 2018, and Qatar from 2012 to 2019 except 2017.

Table 3.a FDI Efficiency scores for 13 countries

```
+----------------------------------------------------------------------+
| Data Envelopment Analysis                                            |
| Output Variables:   FDI                                              |
| Input Variables:    ASSET    RESERVES EXRESERV ATM      BRANCH       |
| Underlying Technology assumes VARIABLE Returns to Scale.             |
+----------------------------------------------------------------------+
| Estimated Efficiencies:     Mean     Std.Deviation   Minimum  Maximum|
| Technical Efficiency       =======   =============   =======  =======|
|      Input Oriented         .6922        .2231        .2559   1.0000 |
|      Output Oriented        .5297        .3128        .0054   1.0000 |
| Sample Size:          117 Observations.       117 Complete observations |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E      |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE      |
| Incomplete observations are filled with zeros for efficiency values. |
+----------------------------------------------------------------------+
| Kernel Density Estimator for DEAEFF_I || Kernel Density Estimator for DEAEFF_O |
| Observations        =       117       || Observations        =       117     |
| Points plotted      =       117       || Points plotted      =       117     |
| Bandwidth           =    .077475      || Bandwidth           =   .108604     |
| Statistics for abscissa values-----   || Statistics for abscissa values----- |
| Mean                =    .692247      || Mean                =   .529729     |
| Standard Deviation  =    .223129      || Standard Deviation  =   .312781     |
| Minimum             =    .255901      || Minimum             =   .005358     |
| Maximum             =   1.000000      || Maximum             =  1.000000     |
| ------------------------------------  || ----------------------------------- |
| Kernel Function     =     Logistic    || Kernel Function     =   Logistic    |
| Cross val. M.S.E.   =     .000000     || Cross val. M.S.E.   =   .000000     |
| Results matrix      =     KERNEL      || Results matrix      =   KERNEL      |
```


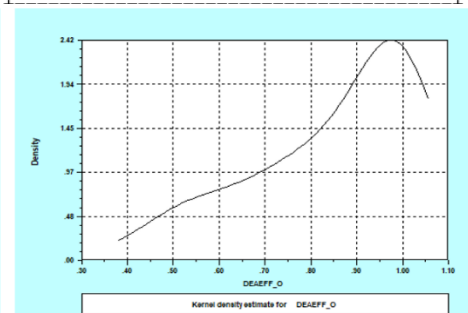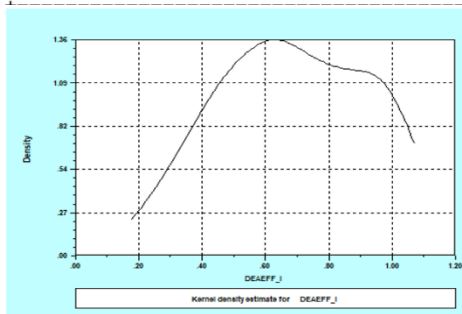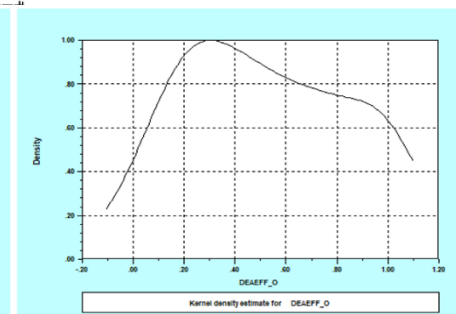Figure3a.a: efficiency scores for FDI input-oriented

Figure3a.b: efficiency scores for FDI output-oriented

Ibrahim Mosaad Elatroush

3.b FDI and Efficiency scores for 9 countries

Table 3.b exhibits FDI efficiency scores for banking sector for 9 countries. The average efficiency score for input-orientation is 77% with minimum about 27% for Indonesia in 2016 and maximum of 100%. The major inefficiency scores in countries of Indonesia, Mexico from 2013, Philippines except 2014, Russia except 2011,2013, South Africa except 2014, 2017 Turkey except 2012, 2013, and Thailand except 2018. The average efficiency score for output-orientation is 64% with minimum of 0.9% for South Africa in 2011, Indonesia 2016 & 2017 and maximum of 100%. The lowest scores are for South Africa except 2014, 2018, Indonesia except 2011, Egypt from 2016, Morocco from 2013, Mexico except 2011, Philippines except 2014, Russia except 2011, 2013, Turkey except 2012, 2013, and Thailand except 2018.

Table 3.b FDI Efficiency scores for 9 countries

```
+------------------------------------------------------------------------+
| Data Envelopment Analysis                                              |
| Output Variables:  FDI                                                 |
| Input Variables:  ASSET   RESERVES EXRESERV ATM     BRANCH   DEBT      |
| Underlying Technology assumes VARIABLE Returns to Scale.               |
+------------------------------------------------------------------------+
| Estimated Efficiencies:     Mean     Std.Deviation    Minimum  Maximum |
| Technical Efficiency       =======   =============    =======  ======= |
|       Input Oriented        .7716        .2032         .2672   1.0000  |
|       Output Oriented       .6436        .2827         .0088   1.0000  |
| Sample Size:        81 Observations.       81 Complete observations    |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E        |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE        |
| Incomplete observations are filled with zeros for efficiency values.   |
+------------------------------------------------------------------------+
| Kernel Density Estimator for DEAEFF_I | Kernel Density Estimator for DEAEFF_O |
| Observations          =        81     | Observations          =        81     |
| Points plotted        =        81     | Points plotted        =        81     |
| Bandwidth             =   .075940     | Bandwidth             =   .105651     |
| Statistics for abscissa values----    | Statistics for abscissa values----    |
| Mean                  =   .771595     | Mean                  =   .643596     |
| Standard Deviation    =   .203200     | Standard Deviation =      .282700     |
| Minimum               =   .267220     | Minimum               =   .008761     |
| Maximum               =  1.000000     | Maximum               =  1.000000     |
| ------------------------------------  | ------------------------------------  |
| Kernel Function       =  Logistic     | Kernel Function       =  Logistic     |
| Cross val. M.S.E.     =   .000000     | Cross val. M.S.E.     =   .000000     |
| Results matrix        =    KERNEL     | Results matrix        =    KERNEL     |
```
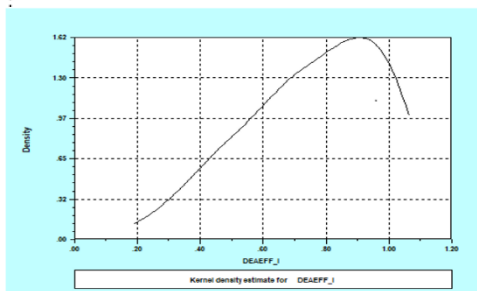
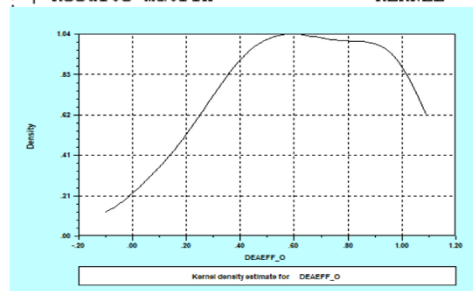Figure3b.a: efficiency scores for FDI input-oriented   Figure3b.b: efficiency scores for FDI output-oriented

Ibrahim Mosaad Elatroush

4.a Remittances and Efficiency scores for 13 countries

Table 4.a shows remittances efficiency scores for13 countries' banking sector. Average efficiency for input-orientation is 51% with minimum 12% for Russia 2013 and maximum of 100%. The major inefficiency scores are for Russia, Japan, Brazil, Indonesia, Thailand, Malaysia, South Africa, and Turkey. The average efficiency score for output-orientation is 36% with minimum of 3% for Qatar in 2018, South Africa 2016 and maximum of 100%. The lowest scores are for Qatar, South Africa, Turkey, Malaysia, Japan, Brazil, Thailand, Russia, Indonesia, Egypt from 2016, Morocco from 2015. It is remarkable that remittances have a positive impact on Egypt for both input and output–orientation.

Table 4.a Remittances Efficiency scores for 13 countries

```
+----------------------------------------------------------------------+
| Data Envelopment Analysis                                            |
| Output Variables:  REMITTEN                                          |
| Input Variables:   ASSET    RESERVES EXRESERV ATM      BRANCH        |
| Underlying Technology assumes VARIABLE Returns to Scale.             |
+----------------------------------------------------------------------+
| Estimated Efficiencies:    Mean     Std.Deviation   Minimum  Maximum |
| Technical Efficiency       =======  =============   =======  ======= |
|     Input Oriented          .5128         .3015      .1184   1.0000  |
|     Output Oriented         .3569         .3637      .0254   1.0000  |
| Sample Size:     117 Observations.     117 Complete observations     |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E      |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE      |
| Incomplete observations are filled with zeros for efficiency values. |
+----------------------------------------------------------------------+
| Kernel Density Estimator for DEAEFF_I || Kernel Density Estimator for DEAEFF_O |
| Observations        =        117      || Observations        =        117     |
| Points plotted      =        117      || Points plotted      =        117     |
| Bandwidth           =    .102035      || Bandwidth           =    .112795     |
| Statistics for abscissa values----    || Statistics for abscissa values----   |
| Mean                =    .512808      || Mean                =    .356906     |
| Standard Deviation  =    .301500      || Standard Deviation  =    .363730     |
| Minimum             =    .118413      || Minimum             =    .025449     |
| Maximum             =   1.000000      || Maximum             =   1.000000     |
|---------------------------------------||-------------------------------------- |
| Kernel Function     =    Logistic     || Kernel Function     =    Logistic    |
| Cross val. M.S.E.   =    .000000      || Cross val. M.S.E.   =    .000000     |
| Results matrix      =      KERNEL     || Results matrix      =      KERNEL    |
+----------------------------------------------------------------------+
```


Figure4a.a: efficiency scores for remittances input-oriented Figure4a.b: efficiency scores for remittances output-oriented

4.b Remittances and Efficiency scores for 9 countries

Table 4.b exhibits remittances efficiency scores for banking sector for 9 countries. The average efficiency score for input-orientation is 58% with minimum of 12% for Russia 2013 and maximum of 100%. The major inefficiency scores are for Russia, Indonesia, Mexico except 2019, Thailand, South Africa, and Turkey. The average efficiency score for output-orientation is 47% with minimum of 4% for South Africa 2016, Turkey 2019, and maximum of 100%. The lowest scores are for South Africa, Turkey, Qatar, Russia, Indonesia, and Morocco from 2015.

Table 4.b Remittances Efficiency scores for 9 countries

```
+------------------------------------------------------------------------+
| Data Envelopment Analysis                                              |
| Output Variables:  REMITTEN                                            |
| Input Variables:   ASSET    RESERVES EXRESERV ATM    BRANCH   DEBT     |
| Underlying Technology assumes VARIABLE Returns to Scale.               |
+------------------------------------------------------------------------+
| Estimated Efficiencies:     Mean     Std.Deviation    Minimum  Maximum |
| Technical Efficiency      =======    =============    =======  ======= |
|      Input Oriented         .5789        .3057          .1184   1.0000 |
|      Output Oriented        .4692        .3791          .0369   1.0000 |
| Sample Size:          81 Observations.       81 Complete observations  |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E        |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE        |
| Incomplete observations are filled with zeros for efficiency values.   |
+------------------------------------------------------------------------+
| Kernel Density Estimator for DEAEFF_I || Kernel Density Estimator for DEAEFF_O |
| Observations         =         81     || Observations         =         81    |
| Points plotted       =         81     || Points plotted       =         81    |
| Bandwidth            =    .109822     || Bandwidth            =    .119982    |
| Statistics for abscissa values----    || Statistics for abscissa values----   |
| Mean                 =    .578866     || Mean                 =    .469183    |
| Standard Deviation = .305654          || Standard Deviation = .379065         |
| Minimum              =    .118413     || Minimum              =    .036852    |
| Maximum              =   1.000000     || Maximum              =   1.000000    |
| -------------------------------       || -------------------------------      |
| Kernel Function     =    Logistic     || Kernel Function     =    Logistic    |
| Cross val. M.S.E.   =     .000000     || Cross val. M.S.E.   =     .000000    |
| Results matrix      =      KERNEL     || Results matrix      =      KERNEL    |
+------------------------------------------------------------------------+
```
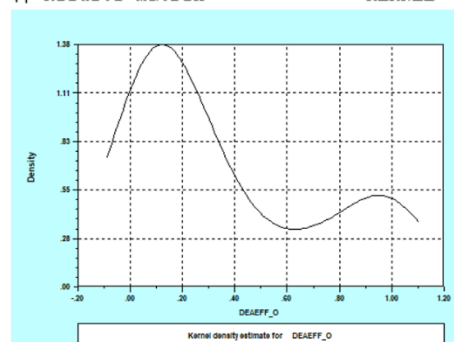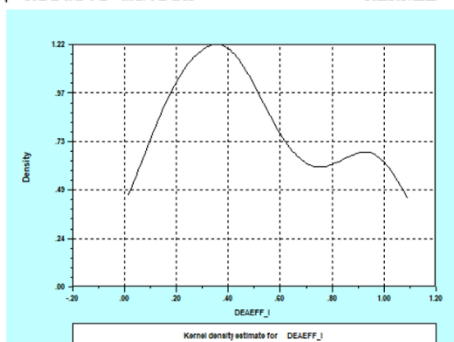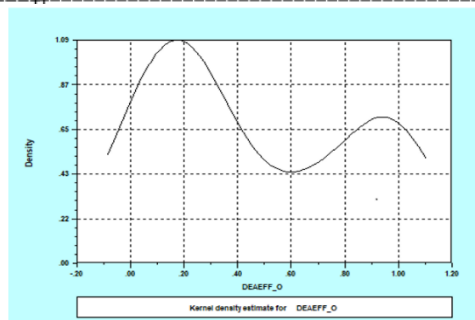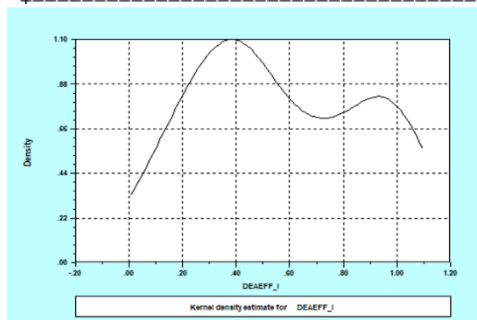

Figure4b.a: efficiency scores for remittances input-oriented Figure4b.b: efficiency scores for remittances output-oriented

Ibrahim Mosaad Elatroush

5.a Money supply and Efficiency scores for 13 countries

Table 5.a displays the efficiency scores of money supply for banking sector for 13 countries. The average efficiency score for input-orientation is 59% with minimum of 14% for Russia 2013 and maximum of 100%. The major inefficiency scores are for Russia, Brazil, Mexico, Thailand, Malaysia, South Africa, and Turkey. Average efficiency score for output-orientation is 47% with minimum of 9 % for Philippines 2011, Russia 2011, and maximum of 100%. The lowest scores are for Philippines, Russia, Mexico, Malaysia, Thailand, Brazil, South Africa, Turkey except 2013, Qatar except 2017, and Morocco except 2013 and 2015.

Table 5.a Money supply Efficiency scores for 13 countries

```
+---------------------------------------------------------------------+
| Data Envelopment Analysis                                           |
| Output Variables:  MSUPPLY                                          |
| Input Variables:   ASSET     RESERVES EXRESERV ATM       BRANCH     |
| Underlying Technology assumes VARIABLE Returns to Scale.            |
+---------------------------------------------------------------------+
| Estimated Efficiencies:     Mean     Std.Deviation   Minimum  Maximum |
| Technical Efficiency       =======   =============   =======  ======= |
|      Input Oriented         .5891        .2858         .1390   1.0000 |
|      Output Oriented        .4676        .3290         .0930   1.0000 |
| Sample Size:            117 Observations.     117 Complete observations |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E     |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE     |
| Incomplete observations are filled with zeros for efficiency values. |
+-----------------------------------+---------------------------------+
| Kernel Density Estimator for DEAEFF_I || Kernel Density Estimator for DEAEFF_O |
| Observations       =        117   || Observations       =        117 |
| Points plotted     =        117   || Points plotted     =        117 |
| Bandwidth          =     .099230  || Bandwidth          =     .104975 |
| Statistics for abscissa values----|| Statistics for abscissa values----|
| Mean               =     .589149  || Mean               =     .467605 |
| Standard Deviation =     .285785  || Standard Deviation =     .329017 |
| Minimum            =     .139027  || Minimum            =     .093015 |
| Maximum            =    1.000000  || Maximum            =    1.000000 |
| -----------------------------------|| -----------------------------------|
| Kernel Function    =    Logistic  || Kernel Function    =    Logistic |
| Cross val. M.S.E.  =     .000000  || Cross val. M.S.E.  =     .000000 |
| Results matrix     =     KERNEL   || Results matrix     =     KERNEL  |
+-----------------------------------+---------------------------------+
```
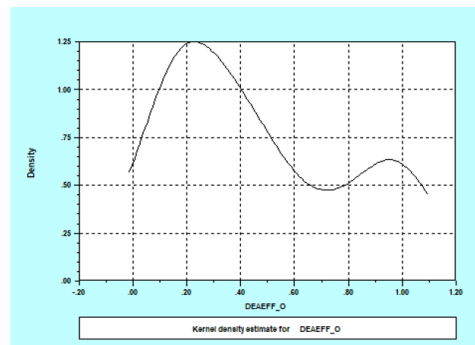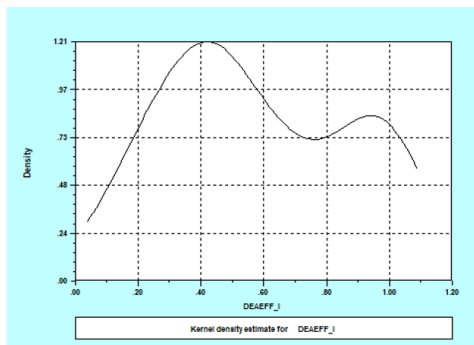

Figure5a.a: efficiency scores for money supply input-oriented Figure5a.b: efficiency scores for money supply output-oriented

Ibrahim Mosaad Elatroush

Table 5.b displays the efficiency scores of money supply for banking sector for 9 countries. The average efficiency score for input-orientation is 79% with minimum of 36% for Turkey 2017, Thailand 2017, and maximum of 100%. The major inefficiency scores are for Turkey except 2013, 2019, Thailand, Philippines, South Africa, Mexico except 2019, and Morocco except 2011, 2012, 2014. The average efficiency score for output-orientation is 79% with minimum of 38 % for Philippines 2011, and maximum of 100%. The lowest scores are for Philippines, Thailand, Turkey except 2013, Russia except 2015, 2016, Mexico except 2019, South Africa except 2018,2019, and Morocco except 2011, 2012 and 2014.

Table 5.b Money supply Efficiency scores for 9 countries

```
+----------------------------------------------------------------------------+
| Data Envelopment Analysis                                                  |
| Output Variables:  MSUPPLY                                                 |
| Input Variables:   ASSET      RESERVES EXRESERV ATM      BRANCH    DEBT     |
| Underlying Technology assumes VARIABLE Returns to Scale.                    |
+----------------------------------------------------------------------------+
| Estimated Efficiencies:     Mean       Std.Deviation    Minimum   Maximum  |
| Technical Efficiency      =======      =============    =======   =======  |
|      Input Oriented        .7923           .1810          .3592   1.0000   |
|      Output Oriented       .7914           .1819          .3772   1.0000   |
| Sample Size:          81 Observations.        81 Complete observations     |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E            |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE            |
| Incomplete observations are filled with zeros for efficiency values.       |
+----------------------------------------+-----------------------------------+
| Kernel Density Estimator for DEAEFF_I  || Kernel Density Estimator for DEAEFF_O |
| Observations         =           81    || Observations         =          81    |
| Points plotted       =           81    || Points plotted       =          81    |
| Bandwidth            =      .067659    || Bandwidth            =     .067992    |
| Statistics for abscissa values----     || Statistics for abscissa values----    |
| Mean                 =      .792269    || Mean                 =     .791381    |
| Standard Deviation   =      .181043    || Standard Deviation   =     .181932    |
| Minimum              =      .359152    || Minimum              =     .377243    |
| Maximum              =     1.000000    || Maximum              =    1.000000    |
| -------------------------------------  || -----------------------------------   |
| Kernel Function      =      Logistic   || Kernel Function      =     Logistic   |
| Cross val. M.S.E.    =      .000000    || Cross val. M.S.E.    =     .000000    |
| Results matrix       =       KERNEL    || Results matrix       =      KERNEL    |
+----------------------------------------+-----------------------------------+
```
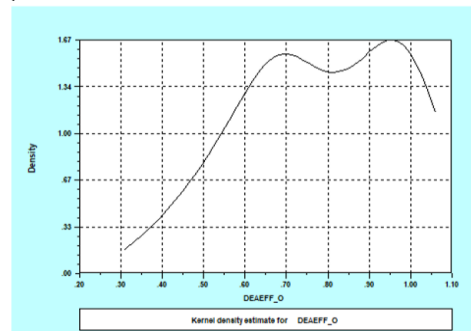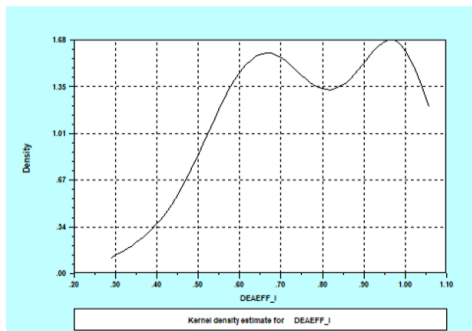
Figure5b.a: efficiency scores for money supply input-oriented   Figure5b.b: efficiency scores for money supply output–oriented

Ibrahim Mosaad Elatroush

Part Two: Joint efficiency scores

In this part efficiency scores are measured with joint independent variables.
6.a Loans and FDI efficiency scores for 13 countries

Table 6.a illustrates efficiency scores for banking sector for 13 countries. The average efficiency scores for input-orientation are 78% with minimum 27 % for Brazil 2018 and maximum of 100% The lower efficiency countries are Brazil except 2014 and 2019, Thailand, Russia except 2013 then efficiency has declined sharply, Philippines, Mexico, Morocco, and Malaysia except 2011, 2014. The performance of Indonesia has improved from 2015 and performance of Egypt is good until 2018 then have dropped to about 70% in 2019.Turkey efficiency scores have fluctuated but improved in 2018 and 2019. The average efficiency scores for output-orientation are 69% with minimum of 15% for Philippines in 2016 and maximum of 100%. The lowest scores are for Philippines, Mexico, Malaysia, Russia, Morocco, and Thailand. Egypt is performed well from 2011 to 2015 then efficiency scores have dropped dramatically to be 25% in 2019 and this may be due to the reduction of the levels of FDI.

Table 6. a Loans & FDI Efficiency scores for 13 countries

```
+-----------------------------------------------------------------------+
| Data Envelopment Analysis                                             |
| Output Variables:  LOANS     FDI                                      |
| Input Variables:    ASSET     RESERVES EXRESERV BRANCH                |
| Underlying Technology assumes VARIABLE Returns to Scale.              |
+-----------------------------------------------------------------------+
| Estimated Efficiencies:     Mean      Std.Deviation    Minimum   Maximum |
| Technical Efficiency       =======   =============    =======   ======= |
|      Input Oriented         .7767         .2060         .2668    1.0000 |
|      Output Oriented        .6904         .2801         .1485    1.0000 |
| Sample Size:           117 Observations.     117 Complete observations |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E       |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE       |
| Incomplete observations are filled with zeros for efficiency values.  |
+-------------------------------------+---------------------------------+
| Kernel Density Estimator for DEAEFF_I | Kernel Density Estimator for DEAEFF_O |
| Observations         =        117   | Observations         =        117 |
| Points plotted       =        117   | Points plotted       =        117 |
| Bandwidth            =     .071542  | Bandwidth            =     .097264 |
| Statistics for abscissa values----  | Statistics for abscissa values---- |
| Mean                 =     .776672  | Mean                 =     .690350 |
| Standard Deviation = .206041        | Standard Deviation = .280121       |
| Minimum              =     .266799  | Minimum              =     .148494 |
| Maximum              =    1.000000  | Maximum              =    1.000000 |
| ----------------------------------- | ---------------------------------- |
| Kernel Function      =    Logistic  | Kernel Function      =    Logistic |
| Cross val. M.S.E.    =     .000000  | Cross val. M.S.E.    =     .000000 |
| Results matrix       =      KERNEL  | Results matrix       =      KERNEL |
+-------------------------------------+---------------------------------+
```
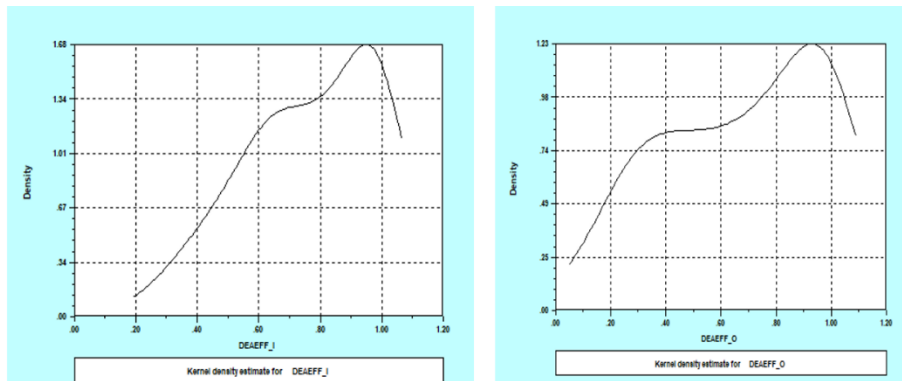
Ibrahim Mosaad Elatroush

Figure6a.a: efficiency scores for Loans &FDI input-oriented   Figure 6a.b: efficiency scores for Loans &FDI output-oriented

6.b Loans and FDI efficiency scores for 9 countries

Table 6.b illustrates efficiency scores for banking sector for 9 countries. The average efficiency scores for input-orientation are 88% with minimum 55 % for Mexico 2014 and maximum of 100% The lower efficiency countries are Mexico except 2012, Russia except 2013, Philippines, Thailand except 2018 and 2019 which performed well. The performance of Egypt is good until 2015 then have dropped to about 70% in 2019.Turkey efficiency scores have fluctuated but improved in 2018 and 2019. The average efficiency scores for output-orientation are 84% with minimum of 39% for Egypt 2019 and maximum of 100%. The lowest scores are for Morocco except 2011,2012, and 2014, Mexico except 2013, Philippines performed bad, Russia except 2013, and Thailand. Turkey performed well in 2018 and 2019. Egypt is performed well from 2011 to 2014 then efficiency scores have dropped dramatically to poor performance of 39% in 2019 and this may be due to a drop in FDI levels.

Table 6. b Loans & FDI Efficiency scores for 9 countries

```
+------------------------------------------------------------------------+
| Data Envelopment Analysis                                              |
| Output Variables:  LOANS    FDI                                        |
| Input Variables:   ASSET    RESERVES EXRESERV BRANCH   DEBT            |
| Underlying Technology assumes VARIABLE Returns to Scale.               |
+------------------------------------------------------------------------+
| Estimated Efficiencies:     Mean    Std.Deviation    Minimum   Maximum |
| Technical Efficiency      =======   =============    =======   ======= |
|     Input Oriented         .8844        .1293         .5498    1.0000  |
|     Output Oriented        .8352        .1822         .3937    1.0000  |
| Sample Size:          81 Observations.      81 Complete observations   |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E        |
| Efficiencies saved as matrices  DEA EFFO, DEA EFFI and DEA EFFE        |
+----+----------------------------------+---------------------------------+
| Inc| Kernel Density Estimator for DEAEFF_I || Kernel Density Estimator for DEAEFF_O |
+----| Observations          =        81 || Observations          =        81 |
     | Points plotted        =        81 || Points plotted        =        81 |
     | Bandwidth             =   .048327 || Bandwidth             =   .068078 |
     | Statistics for abscissa values---- || Statistics for abscissa values---- |
     | Mean                  =   .884413 || Mean                  =   .835195 |
     | Standard Deviation    =   .129313 || Standard Deviation =      .182164 |
     | Minimum               =   .549773 || Minimum               =   .393714 |
     | Maximum               =  1.000000 || Maximum               =  1.000000 |
     | -------------------------------- || -------------------------------- |
     | Kernel Function       =  Logistic || Kernel Function       =  Logistic |
     | Cross val. M.S.E.     =   .000000 || Cross val. M.S.E.     =   .000000 |
     | Results matrix        =    KERNEL || Results matrix        =    KERNEL |
     +----------------------------------++---------------------------------+
```
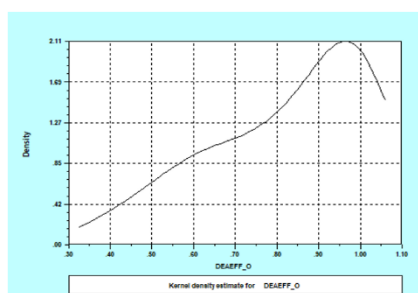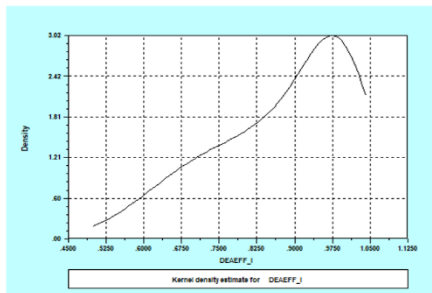
Figure6b.a: efficiency scores for Loans &FDI input-oriented   Figure 6b.b: efficiency scores for Loans &FDI output-oriented

7.a Remittances and FDI efficiency scores for 13 countries

Table 7.a illustrates efficiency for banking sector for 13 countries. The average efficiency for input-orientation is 72% with minimum 26 % for Brazil 2012 and maximum of 100%. Lower efficiency countries are Brazil except 2014 and 2019, Indonesia, Russia except 2013 then efficiency has declined sharply, Turkey except 2013, Thailand, Morocco, South Africa, and Malaysia except 2011, 2014. The performance of Philippines has improved from 2014. The performance of Egypt is pretty well, and this may be due to the increment of remittances. The average efficiency for output-orientation is 67% with minimum of 6% for South Africa 2011 and maximum of 100%. The lowest scores are for Brazil except 2013 and 2019,

Ibrahim Mosaad Elatroush

Turkey except 2013, Thailand, Indonesia, Malaysia except 2011 and 2014, Russia except 2013, and Morocco. Egypt performed well except the years of 2013 and 2016 and this may be due to the increment of remittances.

Table 7. a Remittances & FDI Efficiency scores for 12 countries

```
+-----------------------------------------------------------------+
| Data Envelopment Analysis                                       |
| Output Variables:  REMITTEN FDI                                 |
| Input Variables:   ASSET    RESERVES EXRESERV BRANCH            |
| Underlying Technology assumes VARIABLE Returns to Scale.        |
+-----------------------------------------------------------------+
| Estimated Efficiencies:    Mean    Std.Deviation   Minimum   Maximum |
| Technical Efficiency      =======  =============   =======   ======= |
|      Input Oriented        .7209       .2282        .2559    1.0000  |
|      Output Oriented       .6666       .2676        .0595    1.0000  |
| Sample Size:          117 Observations.     117 Complete observations |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE |
| Incomplete observations are filled with zeros for efficiency values. |
+-----------------------------------------------------------------+
| Kernel Density Estimator for DEAEFF_I || Kernel Density Estimator for DEAEFF_O |
| Observations          =        117    || Observations          =        117    |
| Points plotted        =        117    || Points plotted        =        117    |
| Bandwidth             =    .079229    || Bandwidth             =    .092900    |
| Statistics for abscissa values----    || Statistics for abscissa values----    |
| Mean                  =    .720856    || Mean                  =    .666638    |
| Standard Deviation    =    .228180    || Standard Deviation    =    .267553    |
| Minimum               =    .255901    || Minimum               =    .059487    |
| Maximum               =   1.000000    || Maximum               =   1.000000    |
| -----------------------------------   || -----------------------------------   |
| Kernel Function       =   Logistic    || Kernel Function       =   Logistic    |
| Cross val. M.S.E.     =    .000000    || Cross val. M.S.E.     =    .000000    |
|                                       || Results matrix        =     KERNEL    |
```
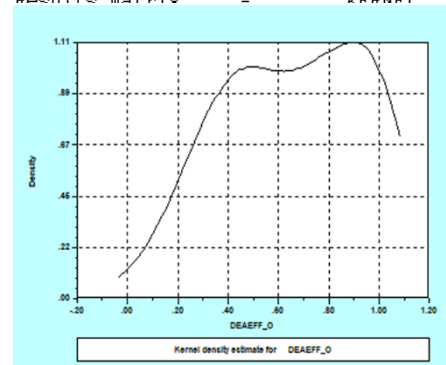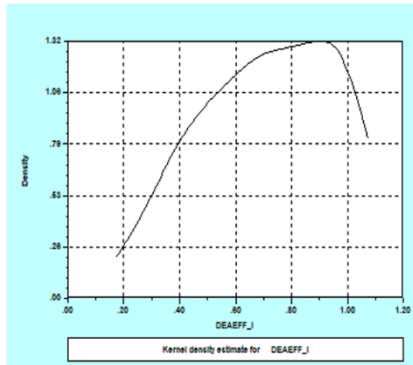

Figure7a.a: efficiency scores for Remittances &FDI input-oriented Figure 7a.b: efficiency scores for Remittances &FDI output-oriented

7.b Remittances and FDI efficiency scores for 9 countries

Table 7.b illustrates efficiency scores for banking sector for 9 countries. The average efficiency scores for input-orientation are 82% with minimum 27 % for Indonesia 2016 and maximum of 100% The lower efficiency countries are Indonesia, Mexico except 2012, Russia except 2011 and 2013, South Africa except 2014 and 2017, Turkey except 2012, 2013, and Thailand except 2018. The performance of Egypt is pretty well. The average efficiency scores for output-orientation are 78% with

minimum of 6% for South Africa 2011 and maximum of 100%. The lowest scores are for South Africa except 2014 and 2017, Thailand, Turkey except 2012, 2013, Russia except 2011 and 2013, Indonesia except 2011, Morocco is performed well from 2011 to 2015 except then has a decline in efficiency scores to reach 70% in 2017. Egypt is performed well from 2011 to 2015 then efficiency scores have dropped to be 87% in 2016 and then recovered to 100% from 2016 to 2019.

Table 7. b Remittances & FDI Efficiency scores for 9 countries

```
+------------------------------------------------------------------------+
| Data Envelopment Analysis                                              |
| Output Variables:  REMITTEN FDI                                        |
| Input Variables:   ASSET    RESERVES EXRESERV ATM      BRANCH   DEBT   |
| Underlying Technology assumes VARIABLE Returns to Scale.               |
+------------------------------------------------------------------------+
| Estimated Efficiencies:     Mean    Std.Deviation   Minimum   Maximum  |
| Technical Efficiency      =======   =============   =======   =======  |
|      Input Oriented        .8170        .2029        .2672    1.0000   |
|      Output Oriented       .7759        .2421        .0595    1.0000   |
| Sample Size:             81 Observations.       81 Complete observations|
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E        |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE        |
| Incomplete observations are filled with zeros for efficiency values.   |
+------------------------------------------------------------------------+
+-------------------------------------+  +-------------------------------------+
| Kernel Density Estimator for DEAEFF_I| | Kernel Density Estimator for DEAEFF_O|
| Observations        =          81   | | Observations        =          81   |
| Points plotted      =          81   | | Points plotted      =          81   |
| Bandwidth           =      .075840  | | Bandwidth           =      .090483  |
| Statistics for abscissa values----  | | Statistics for abscissa values----  |
| Mean                =      .817042  | | Mean                =      .775885  |
| Standard Deviation  =      .202934  | | Standard Deviation  =      .242114  |
| Minimum             =      .267220  | | Minimum             =      .059487  |
| Maximum             =     1.000000  | | Maximum             =     1.000000  |
| ----------------------------------- | | ----------------------------------- |
| Kernel Function     =     Logistic  | | Kernel Function     =     Logistic  |
| Cross val. M.S.E.   =      .000000  | | Cross val. M.S.E.   =      .000000  |
| Results matrix      =      KERNEL   | | Results matrix      =      KERNEL   |
```
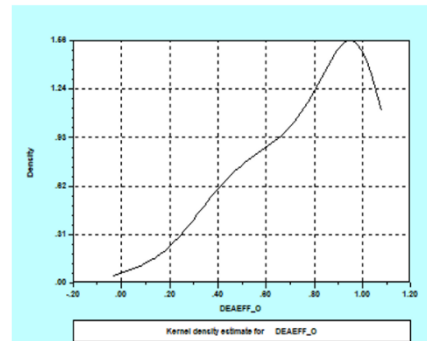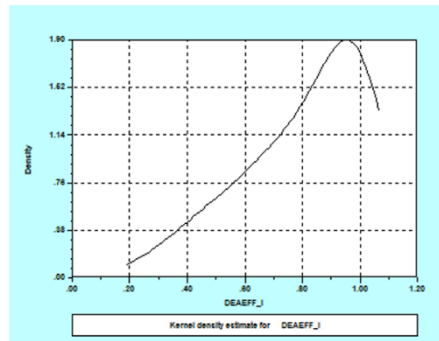

Figure7b.a: efficiency scores for Remittances &FDI input-oriented   Figure 7.b.b: efficiency scores for Remittances &FDI output-oriented

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8.a Deposits and FDI efficiency scores for 13 countries

Table 8.a demonstrates efficiency scores for banking sector for 13 countries. The average efficiency scores for input-orientation are 86% with minimum 50 % for Thailand 2015 and maximum of 100% The lower efficiency countries are Thailand, Russia except 2011, 2013 and 2014 then efficiency has declined sharply, South Africa, Brazil efficiency scores are fluctuated from 100% in 2011 and 2014 then have dropped sharply to 57% in 2018 then recovered to 100% in 2019, Philippines, Malaysia except 2011, 2014 and Morocco except 2012 and 2014. The performance of Egypt is pretty well from 2011 to 2015 then witnessed a decline from 2016 to reach 71% in 2019. The average efficiency scores for output-orientation are 81% with minimum of 41% for Morocco 2016 and maximum of 100%. The lowest scores are for Morocco, South Africa, Thailand, Brazil efficiency scores are also fluctuated from 100% in 2011 and 2014 then have dropped sharply to 57% in 2018 then recovered to 100% in 2019, Russia performed well from 2011 to 2014 then efficiency scores have dropped to 56% in 2019, Philippines, Malaysia except 2011 and 2014, and Mexico except 2011 and 2012. Egypt performed well from 2011 to 2015 then witnessed a decline from 2016 to reach 51% in 2019.

Table 8. a Deposits & FDI Efficiency scores for 13 countries

```
+-----------------------------------------------------------------------+
| Data Envelopment Analysis                                             |
| Output Variables:  FDI       DEPOSITS                                 |
| Input Variables:   ASSET     RESERVES ATM      BRANCH    EXRESERV     |
| Underlying Technology assumes VARIABLE Returns to Scale.              |
+-----------------------------------------------------------------------+
| Estimated Efficiencies:    Mean    Std.Deviation   Minimum   Maximum  |
| Technical Efficiency       =======  =============  =======   =======  |
|     Input Oriented         .8579        .1461       .5041    1.0000   |
|     Output Oriented        .8097        .1942       .4119    1.0000   |
| Sample Size:          117 Observations.    117 Complete observations  |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E       |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE       |
| Incomplete observations are filled with zeros for efficiency values.  |
+-----------------------------------+-----------------------------------+
| Kernel Density Estimator for      | Kernel Density Estimator for      |
|                    DEAEFF_I       |                    DEAEFF_O       |
| Observations       =        117   | Observations       =        117   |
| Points plotted     =        117   | Points plotted     =        117   |
| Bandwidth          =    .050741   | Bandwidth          =    .067433   |
| Statistics for abscissa values----| Statistics for abscissa values----|
| Mean               =    .857943   | Mean               =    .809661   |
| Standard Deviation =    .146135   | Standard Deviation =    .194209   |
| Minimum            =    .504097   | Minimum            =    .411907   |
| Maximum            =   1.000000   | Maximum            =   1.000000   |
| --------------------------------- | --------------------------------- |
| Kernel Function    =    Logistic  | Kernel Function    =    Logistic  |
| Cross val. M.S.E.  =    .000000   | Cross val. M.S.E.  =    .000000   |
| Results matrix     =     KERNEL   | Results matrix     =     KERNEL   |
+-----------------------------------+-----------------------------------+
```
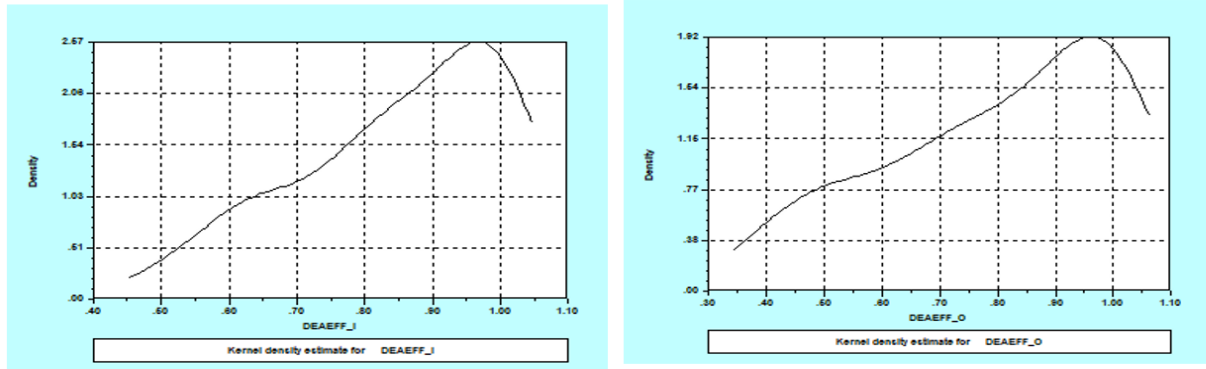
Figure8a.a: efficiency scores for Deposits &FDI input oriented Figure 8a.b: efficiency scores for Deposits &FDI output-oriented

8.bDeposits and FDI efficiency scores for 9 countries

Table 8.b confirms efficiency scores for banking sector for 9 countries. The average efficiency scores for input-orientation are 92% with minimum 59 % for Russia 2016 and maximum of 100%. Russia has performed well from 2011 to 2014 then efficiency scores has dropped to the lowest score in 2016 then recovered from 2017 to reach 100% in 2018 and 2019. The lower efficiency countries are Thailand efficiency scores are poor from 2011 to 2015 then start to recover from to 2015 to be efficient from 2018, South Africa except 2014 and 2017. Morocco performed well from 2011to 2014 then efficiency scores have dropped. The performance of Egypt is pretty well from 2011 to 2015 then witnessed a decline from 2016 to reach 71% in 2019. The average efficiency scores for output-orientation are 91% with minimum of 51% for Egypt 2017 and maximum of 100%. The lowest scores are for Egypt despite it has performed from 2011 to 2015 its scores have dropped sharply, South Africa except 2014 and 2017, Thailand efficiency scores are poor from 2011 to 2015 then start to recover from to 2015 to be efficient from 2018, Russia has performed well from 2011 to 2014 then efficiency scores have dropped to the lowest score in 2016 then recovered from 2017 to reach 100% in 2018 and 2019. Morocco performed well from 2011to 2014 then efficiency scores have dropped.

Ibrahim Mosaad Elatroush

Table 8. b Deposits & FDI Efficiency scores for 9 countries

```
+------------------------------------------------------------------------+
| Data Envelopment Analysis                                              |
| Output Variables:  FDI        DEPOSITS                                 |
| Input Variables:   ASSET    RESERVES BRANCH   EXRESERV DEBT            |
| Underlying Technology assumes VARIABLE Returns to Scale.               |
+------------------------------------------------------------------------+
| Estimated Efficiencies:     Mean    Std.Deviation   Minimum   Maximum  |
| Technical Efficiency       =======  =============   =======   ======== |
|     Input Oriented          .9246       .1002        .5934    1.0000   |
|     Output Oriented         .9058       .1264        .5078    1.0000   |
| Sample Size:         81 Observations.       81 Complete observations   |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E        |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE        |
| Incomplete observations are filled with zeros for efficiency values.   |
+------------------------------------------------------------------------+ +
| Kernel Density Estimator for DEAEFF_I | | Kernel Density Estimator for DEAEFF_O |
| Observations          =         81 | | Observations          =         81 |
| Points plotted        =         81 | | Points plotted        =         81 |
| Bandwidth             =    .037464 | | Bandwidth             =    .047251 |
| Statistics for abscissa values---- | | Statistics for abscissa values---- |
| Mean                  =    .924594 | | Mean                  =    .905814 |
| Standard Deviation =       .100246 | | Standard Deviation =       .126435 |
| Minimum               =    .593383 | | Minimum               =    .507781 |
| Maximum               =   1.000000 | | Maximum               =   1.000000 |
| ----------------------------------- | | ----------------------------------- |
| Kernel Function      =    Logistic | | Kernel Function      =    Logistic |
| Cross val. M.S.E.    =    .000000  | | Cross val. M.S.E.    =    .000000  |
| Results matrix       =     KERNEL  | | Results matrix       =     KERNEL  |
+---------------------------------------+ +---------------------------------------+
```
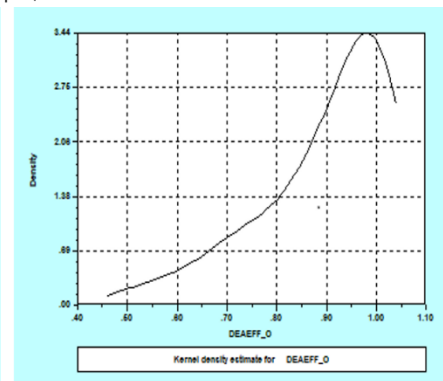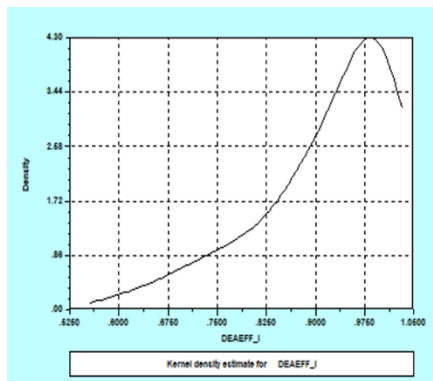

Figure8b.a: efficiency scores for Deposits &FDI input oriented Figure 8b.b: efficiency scores for Deposits &FDI output-oriented

9.a Deposits, FDI and Remittances efficiency scores for 13 countries

Table 9.a demonstrates efficiency for banking sector for 13 countries. The average efficiency for input-orientation is 88% with minimum 50 % for Thailand 2015 and maximum of 100%. Lower efficiency countries are Thailand, South Africa, Russia except 2011, 2013 and 2014 then efficiency has declined sharply, Brazil efficiency scores are fluctuated from 100% in 2011 and 2014 then have dropped sharply to 57% in 2018 then recovered

Ibrahim Mosaad Elatroush

to 100% in 2019, Philippines, Malaysia except 2011, 2014 and Morocco except 2012 and 2014. The performance of Egypt is pretty well during the period, and it may be due to the impact of the increment of remittances that compensate the impact of a decline in FDI in recent years. The average efficiency scores for output-orientation are 85% with minimum of 42% for South Africa 2019 and maximum of 100%. The lowest scores are for South Africa, Thailand, Brazil efficiency scores are also fluctuated from 100% in 2011 and 2014 then have dropped sharply to 57% in 2018 then recovered to 100% in 2019, Russia performed well from 2011 to 2014 then efficiency scores have dropped to 56% in 2019, Philippines, Malaysia except 2011 and 2014, and Mexico except 2011 and 2012. Morocco performed well in 2011 and 2014 then efficiency scores have dropped to be 49% in 2019.

Table 9. a Deposits, FDI & Remittances Efficiency for 13 countries

```
+-----------------------------------------------------------------------+
| Data Envelopment Analysis                                             |
| Output Variables:  FDI     DEPOSITS REMITTEN                          |
| Input Variables:   ASSET    RESERVES ATM      BRANCH   EXRESERV       |
| Underlying Technology assumes VARIABLE Returns to Scale.              |
+-----------------------------------------------------------------------+
| Estimated Efficiencies:    Mean     Std.Deviation    Minimum   Maximum |
| Technical Efficiency      =======   =============    =======   ======= |
|     Input Oriented         .8775        .1491         .5041    1.0000  |
|     Output Oriented        .8450        .1914         .4184    1.0000  |
| Sample Size:          117 Observations.     117 Complete observations |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E        |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE        |
| Incomplete observations are filled with zeros for efficiency values.   |
+-----------------------------------------------------------------------+
+---------------------------------+ +---------------------------------+
| Kernel Density Estimator for DEAEFF_I | | Kernel Density Estimator for DEAEFF_O |
| Observations       =        117 | | Observations       =        117 |
| Points plotted     =        117 | | Points plotted     =        117 |
| Bandwidth          =    .051784 | | Bandwidth          =    .066470 |
| Statistics for abscissa values---- | | Statistics for abscissa values---- |
| Mean               =    .877462 | | Mean               =    .844959 |
| Standard Deviation =    .149139 | | Standard Deviation =    .191433 |
| Minimum            =    .504097 | | Minimum            =    .418405 |
| Maximum            =   1.000000 | | Maximum            =   1.000000 |
| ------------------------------- | | ------------------------------- |
| Kernel Function    =   Logistic | | Kernel Function    =   Logistic |
| Cross val. M.S.E.  =    .000000 | | Cross val. M.S.E.  =    .000000 |
| Results matrix     =     KERNEL | | Results matrix     =     KERNEL |
+---------------------------------+ +---------------------------------+
```
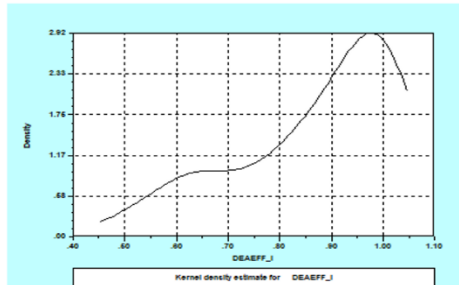
Ibrahim Mosaad Elatroush

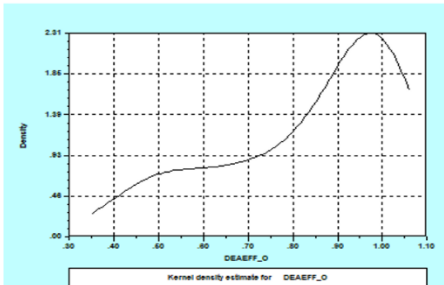| Figure9a.a: efficiency scores for Deposits, Remittance & FDI input oriented | Figure 9a.b: efficiency scores for Deposits, Remittance & FDI output-oriented |

9.b Deposits, FDI and Remittances efficiency scores for 9 countries

Table 9.b confirms efficiency scores for banking sector for 9 countries. The average efficiency scores for input-orientation are 93% with minimum 59 % for Russia 2016 and maximum of 100%. Russia has performed well from 2011 to 2014 then efficiency scores has dropped to the lowest score in 2016 then recovered from 2017 to reach 100% in 2018 and 2019. The lower efficiency countries are Thailand efficiency scores are poor from 2011 to 2015 then start to recover from to 2015 to be efficient from 2018, South Africa except 2014 and 2017. Morocco performed well from 2011to 2014 then efficiency scores have dropped. The performance of Egypt is pretty well during the period, and it may be due to the impact of the increment of remittances that compensate the impact of a decline in FDI in recent years. The average efficiency scores for output-orientation are 93% with minimum of 58% for South Africa 2019 and maximum of 100%. The lowest scores are for South Africa except 2014 and 2017, Thailand efficiency scores are poor from 2011 to 2015 then start to recover from to 2016 to be efficient from 2018, Russia has performed well from 2011 to 2014 then efficiency scores have dropped to the lowest score in 2016 then recovered from 2017 to reach 100% in 2018 and 2019. Morocco performed well from 2011to 2014 then efficiency scores have dropped. Egypt performed well during the whole period except 2016 87%. Both input-orientation and output – orientation techniques are matched.

Ibrahim Mosaad Elatroush

Table 9. b Deposits, FDI & Remittances Efficiency scores for 9

```
+---------------------------------------------------------------------+
| Data Envelopment Analysis                                           |
| Output Variables:  FDI      DEPOSITS REMITTEN                        |
| Input Variables:   ASSET    RESERVES ATM      BRANCH   EXRESERV DEBT |
| Underlying Technology assumes VARIABLE Returns to Scale.             |
+---------------------------------------------------------------------+
| Estimated Efficiencies:    Mean    Std.Deviation   Minimum  Maximum  |
| Technical Efficiency       ======  =============   =======  =======  |
|      Input Oriented        .9339        .0983        .5934   1.0000  |
|      Output Oriented       .9279        .1081        .5782   1.0000  |
| Sample Size:          81 Observations.      81 Complete observations |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E      |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE      |
| Incomplete observations are filled with zeros for efficiency values. |
+----------------------------------------+----------------------------+
| Kernel Density Estimator for DEAEFF_I | Kernel Density Estimator for DEAEFF_O |
| Observations         =          81    | Observations         =          81    |
| Points plotted       =          81    | Points plotted       =          81    |
| Bandwidth            =     .036751    | Bandwidth            =     .040390    |
| Statistics for abscissa values----    | Statistics for abscissa values----    |
| Mean                 =     .933889    | Mean                 =     .927894    |
| Standard Deviation = .098339          | Standard Deviation = .108077          |
| Minimum              =     .593383    | Minimum              =     .578227    |
| Maximum              =    1.000000    | Maximum              =    1.000000    |
| -----------------------------------   | -----------------------------------   |
| Kernel Function      =    Logistic    | Kernel Function      =    Logistic    |
| Cross val. M.S.E.    =     .000000    | Cross val. M.S.E.    =     .000000    |
| Results matrix       =      KERNEL    | Results matrix       =      KERNEL    |
+----------------------------------------+----------------------------+
```
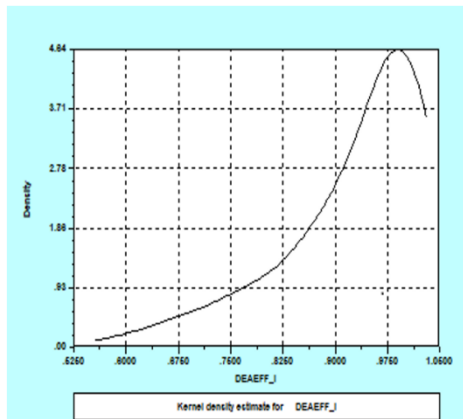

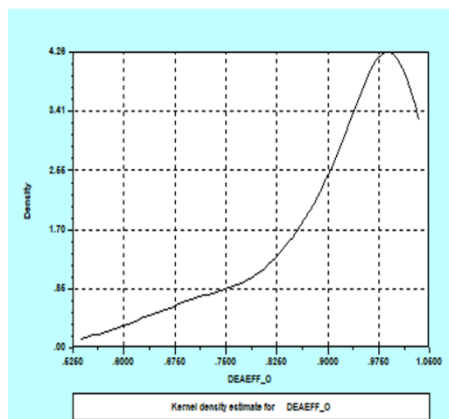| Figure9b.a: efficiency scores for Deposits, Remittance & FDI input oriented | Figure 9b.b: efficiency scores for Deposits, Remittance & FDI output-oriented |

Ibrahim Mosaad Elatroush

10.a Loans, FDI and Remittances efficiency scores for 13 countries

Table 10.a demonstrates efficiency scores for banking sector for 13 countries. The average efficiency for input-orientation is 83% with minimum 27 % for Brazil 2018 and maximum of 100% The lower efficiency countries are Brazil, Thailand, South Africa except 2017, Russia except 2013 then efficiency has declined sharply, Brazil efficiency scores are fluctuated from 100% in 2014 then have dropped sharply to 27% in 2018 then recovered to 100% in 2019, Turkey efficiency scores are 100% in 2013 then dropped to 73% in 2017 then recovered to 100% in 2018 and 2019. Philippines except 2014, 2017 and 2018, Malaysia except 2011, 2014 and Morocco except 2012 and 2014. The performance of Egypt is pretty well during the period, and it may be due to the impact of the increment of remittances that compensate the impact of a decline in FDI in recent years. The average efficiency scores for output-orientation are 82% with minimum of 25% for Brazil 2018 and maximum of 100%. The lowest scores are for Thailand, Brazil efficiency scores are fluctuated from 100% in 2014 then have dropped sharply to 27% in 2018 then recovered to 100% in 2019, Russia except 2013 then efficiency has declined sharply, Philippines except 2014,2018,2018, Malaysia except 2011 and 2014, and Mexico except 2012, 2018 and 2019. Morocco performed well in 2011 and 2014 then efficiency scores have dropped to be 55% in 2019. Turkey efficiency scores are 100% in 2013 then dropped to 73% in 2017 then recovered to 100% in 2018 and 2019.

Table10. a Loans, FDI & Remittances Efficiency scores for 13

```
+----------------------------------------------------------------------+
| Data Envelopment Analysis                                            |
| Output Variables:  LOANS    FDI      REMITTEN                         |
| Input Variables:   ASSET    RESERVES EXRESERV BRANCH                  |
| Underlying Technology assumes VARIABLE Returns to Scale.              |
+----------------------------------------------------------------------+
| Estimated Efficiencies:    Mean     Std.Deviation   Minimum  Maximum  |
| Technical Efficiency      =======   =============   =======  =======  |
|      Input Oriented        .8285        .1943        .2654   1.0000   |
|      Output Oriented       .8152        .2111        .2455   1.0000   |
| Sample Size:          117 Observations.     117 Complete observations |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E       |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE       |
| Incomplete observations are filled with zeros for efficiency values.  |
+----------------------------------+-----------------------------------+
| Kernel Density Estimator for DEAEFF_I | Kernel Density Estimator for DEAEFF_O |
| Observations        =          117 | Observations        =          117 |
| Points plotted      =          117 | Points plotted      =          117 |
| Bandwidth           =      .067451 | Bandwidth           =      .073291 |
| Statistics for abscissa values---- | Statistics for abscissa values---- |
| Mean                =      .828471 | Mean                =      .815243 |
| Standard Deviation  =      .194261 | Standard Deviation  =      .211078 |
| Minimum             =      .265369 | Minimum             =      .245520 |
| Maximum             =     1.000000 | Maximum             =     1.000000 |
|                                    |                                    |
| Kernel Function     =     Logistic | Kernel Function     =     Logistic |
| Cross val. M.S.E.   =      .000000 | Cross val. M.S.E.   =      .000000 |
| Results matrix      =       KERNEL | Results matrix      =       KERNEL |
+----------------------------------+-----------------------------------+
```
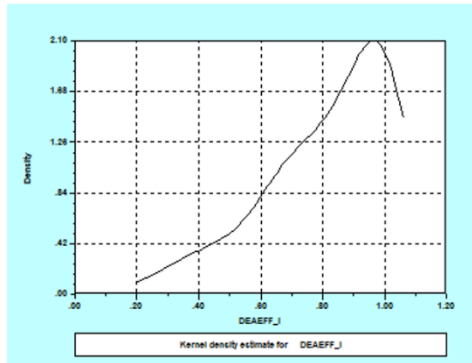
Ibrahim Mosaad Elatroush

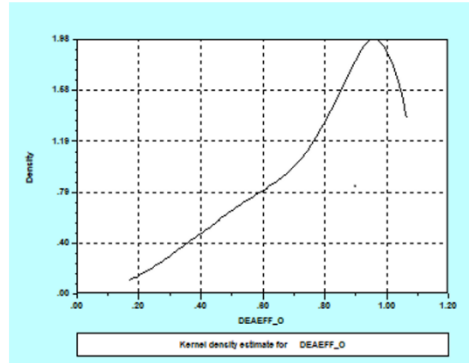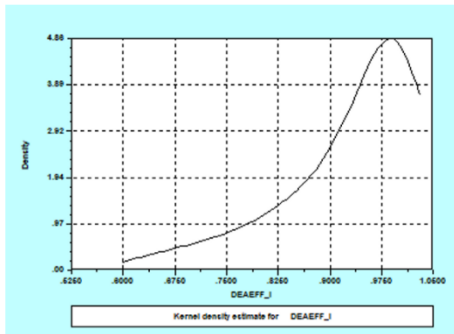Figure10a.a: efficiency scores for Loans, Remittance & & FDI input oriented

Figure 10a.b: efficiency scores for Loans, Remittances & FDI output-oriented

10.b Loans, FDI and Remittances efficiency scores for 9 countries

Table 10.b confirms efficiency for banking sector for 9 countries. The average efficiency for input-orientation is 94% with minimum 63 % for Russia 2019 and maximum of 100%. Russia has performed well in 2011 and 2013 then efficiency scores has dropped to the lowest score in 2019. The lower efficiency countries are Thailand efficiency scores are poor from 2011 to 2016 then start to recover to be efficient from 2018. Turkey efficiency scores performed well from 2011 to 2014 then dropped to 76% in 2017 and recovered to 100% in 2018 and 2019. Mexico efficiency scores have dropped to 71% in 2014 then starts to recover to reach 100% in 2018 and 2019. Morocco performed well from 2011 to 2014 then scores start to drop to be 86% in 2019. The performance of Egypt is pretty well during the whole period. Average efficiency scores for output-orientation are 93% with minimum of 64% for Morocco 2016 and maximum of 100%. The lowest scores are for Morocco despite it performs well from 2011 to 2014. Thailand efficiency scores are low from 2011 to 2016 then start to recover from to be efficient from 2018. Turkey performed well from 2011 to 2014 then dropped to 77% in 2017 and recovered to be 100% in 2018 and 2019. Russia has performed well in 2011 and 2013 then efficiency scores have dropped to its lowest score in 2019 65%. Mexico efficiency scores have dropped to 73% in 2014 then starts to recover to reach 100% in 2018 and 2019. Egypt performed well during the whole period except 2016 86%. Both input-orientation and output–orientation are matched.

Ibrahim Mosaad Elatroush

Table10. b Loans, FDI & Remittances Efficiency for 9 countries

```
+----------------------------------------------------------------------+
| Data Envelopment Analysis                                            |
| Output Variables:  LOANS      FDI       REMITTEN                      |
| Input Variables:   ASSET    RESERVES EXRESERV ATM       BRANCH  DEBT  |
| Underlying Technology assumes VARIABLE Returns to Scale.             |
+----------------------------------------------------------------------+
| Estimated Efficiencies:   Mean    Std.Deviation   Minimum   Maximum  |
| Technical Efficiency     ======   =============   =======   =======  |
|    Input Oriented         .9356        .0937        .6341   1.0000   |
|    Output Oriented        .9261        .1052        .6430   1.0000   |
| Sample Size:         81 Observations.      81 Complete observations  |
| Efficiencies saved as variables DEAEFF_O, DEAEFF_I and DEAEFF_E     |
| Efficiencies saved as matrices  DEA_EFFO, DEA_EFFI and DEA_EFFE     |
| Incomplete observations are filled with zeros for efficiency values. |
+----------------------------------------------------------------------+
```


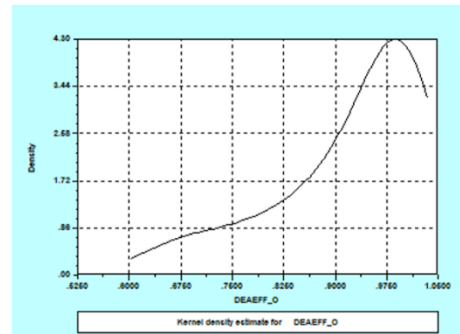| Figure10b.a: efficiency scores for Loans, Remittance & & FDI input oriented | Figure 10b.b: efficiency scores for Loans, Remittances & FDI output-oriented |

Ibrahim Mosaad Elatroush

Results Summary

Indicator For 9 or 13 countries	Efficiency score Input orientation				Efficiency score Output orientation			
	Mean	S.Dev	Min	Max	Mean	S.Dev	Min	Max
Loans 13	0.6524	0.2887	0.1482	1	0.5352	0.3409	0.0730	1
Loans 9	0.8120	0.1722	0.4980	1	0.7580	0.2238	0.2256	1
Deposits 13	0.8018	0.1744	0.4953	1	0.7492	0.2191	0.3840	1
Deposits 9	0.8808	0.1464	0.5390	1	0.8608	0.1708	0.4456	1
FDI 13	0.6922	0.2231	0.2559	1	0.5297	0.3128	0.0054	1
FDI 9	0.7716	0.2032	0.2672	1	0.6436	0.2827	0.0088	1
Remittances 13	0.5128	0.3015	0.1184	1	0.3596	0.3637	0.0254	1
Remittances 9	0.5789	0.3057	0.1184	1	0.4692	0.3791	0.0369	1
Money Supply 13	0.5891	0.2858	0.1390	1	0.4676	0.3290	0.0930	1
Money Supply 9	0.7923	0.1810	0.3592	1	0.7914	0.1819	0.3772	1
Loans & FDI 13	0.7767	0.2060	0.2668	1	0.6904	0.2801	0.1485	1
Loans & FDI 9	0.8844	0.1293	0.5498	1	0.8352	0.1822	0.3937	1
Remittances & FDI 13	0.7209	0.2282	0.2559	1	0.6666	0.2676	0.0595	1
Remittances & FDI 9	0.8170	0.2029	0.2672	1	0.7759	0.2421	0.0595	1
Deposits & FDI 13	0.8579	0.1461	0.5042	1	0.8097	0.1942	0.4119	1
Deposits & FDI 9	0.9246	0.1002	0.5934	1	0.9058	0.1264	0.5074	1
Deposits, FDI & Remit13	0.8775	0.1491	0.5041	1	0.8450	0.1914	0.4184	1
Deposits, FDI & Remit 9	0.9339	0.0983	0.5934	1	0.9279	0.1081	0.5782	1
Loans, FDI & Remit 13	0.8285	0.1943	0.2654	1	0.8152	0.2111	0.2455	1
Loans, FDI & Remit 9	0.9356	0.0937	0.6341	1	0.9251	0.1052	0.6430	1

Ibrahim Mosaad Elatroush

V. Conclusions

In this paper a sample of selected countries; developed, developing, and emerging countries is chosen to estimate efficiency scores for banking sector from 2011 to 2019. The input – orientation and output – orientation techniques are employed to detect whether banks can control their inputs, or outputs, or both. From preceding results, we can realize that banks in major countries tend to be input – oriented rather than output – oriented. In other words, banks have the ability to control their input or lower their operating cost since the majority of the sample are developing or emerging economies. For separate outputs, deposits have higher efficiency scores than other solitary outputs such as loans, remittances, money supply, and attracting FDI and this may be attributed to the variety of provided products recently.

On the other hand, efficiency scores for loans are lower than deposits and this may be ascribed to several reasons such as sophisticated and bureaucratic procedures in some countries in which banks in such countries prefer to provide loans to the government than investors or private sector. Their point of view is based on funding governmental bonds or securities is less risky than personal or private loans which raises the phenomenon of crowding out. The flow of FDI witnessed a decline in most countries after 2015. The efficiency for remittances witnessed a declined in most countries except Egypt and Philippines. The efficiency for money supply has increased for Japan and Indonesia whereas it has a sharp decline for Egypt from 2019.

The impact of Deposits and FDI are higher than the impact of loans and FDI and remittances and FDI. The efficiency scores for deposits, FDI and remittances and for loans, FDI and remittances are converged. Moreover, the gap between input – orientation and output – orientation tend to closer than some individual outputs. Efficiency scores for some outputs for the nine countries are higher than the thirteen countries in which banks in these countries witness lower remittances, inefficient procedures for providing loan, failing to attract additional FDI, or fail to attract new deposits. The forthcoming paper will employ to measure the total factor productivity for selected countries from 2011 to 2019.

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Ibrahim Mosaad Elatroush

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Ibrahim Mosaad Elatroush

قياس كفاءة القطاع المصرفي لعينة من الدول باستخدام التحليل الغلافي للبيانات

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ملخص

تهدف الورقة البحثية لقياس الكفاءة للقطاع المصرفي لعدد ثلاثة عشر دولة وكانت العينة الممثلة تشمل دول متقدمة ونامية واقتصاديات ناشئة. تم تقدير الكفاءة لعدد ١١٧ مشاهدة لبيانات مجمعة لتسع سنوات للفترة من ٢٠١١ إلى ٢٠١٩ شملت عدد من الدول وتم تقدير الكفاءة باستخدام طريقة التحليل الغلافي للبيانات وفقا لأسلوبي كفاءة المدخلات وكفاءة المخرجات لتحديد مدى قدرة وكفاءة البنوك بالتحكم بعناصر المدخلات وتدنية تكاليف الإنتاج أو تعظيم الإيرادات والأرباح وفقا لأسلوب وكفاءة المخرجات. وتمثلت المدخلات في الأصول، الاحتياطيات، الديون، عدد الفروع، عدد ماكينات الصراف الآلي. كما تمثلت المخرجات في القروض الممنوحة، الودائع، الاستثمار الأجنبي المباشر، المعروض النقدي، التحويلات من الخارج.

أظهرت النتائج وجود نوع من الاختلاف بين مؤشرات الكفاءة بين الدول وبين أنواع المخرجات وفقا لأنماط التنمية المختلفة بين الدول. كما أظهرت النتائج أن معظم دول الدراسة لديها قدرة أكبر على التحكم في المدخلات عن التحكم في المخرجات وذلك لكل مخرج على حدة ولكن في حالة المخرجات المشتركة أظهرت النتائج عدم وجود فجوة كبيرة أو اختلافات جوهرية بين أسلوبي التحكم في المدخلات والتحكم في المخرجات. كما أوصت النتائج بضرورة الحاجة لتطوير الأنظمة المصرفية بالدول النامية لكي تكون قادرة على التحكم بالمخرجات ومن ثم تعظيم إيراداتها وأرباحها.

الكلمات المفتاحية: مؤشرات الكفاءة – التحكم في المدخلات – التحكم في المخرجات – القروض – الودائع – التحويلات – عرض النقود – الاستثمار الأجنبي المباشر.