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EVALUATING THE EFFICIENCY OF COUNTRIES' DIGITALIZATION IN TERMS OF FINANCIAL INCLUSION BY USING DEA

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Abstract

The aim of the study is to evaluate the efficiency of countries in digitalization in terms of financial inclusion, in other words, their success in digitalization. Within the scope of the study, 117 countries were grouped as high, upper-middle, lower middle and low income and subjected to Data Envelopment Analysis. In the study conducted for the year 2021, four input variables related to the utilization and access of digital financial services were identified, along with ten corresponding output variables. Efficient countries were determined in the study based on the constant and variable return scale model for output. Digital efficiency has been identified in financial inclusion was detected in 25 countries based on variable returns and 18 countries based on constant returns in high-income countries. In upper-middle-income countries, digital efficiency in financial inclusion was identified in 12 countries based on variable returns and 9 countries based on constant returns. 16 countries in the lower middle and low income categories demonstrated digital efficiency in financial inclusion using variable returns, while 9 countries detected digital efficiency using constant returns. In the study, the comprehensive analysis of the success of digitalization in financial inclusion at the level of countries divided into income groups by using data envelopment analysis reveals the originality of the study.

Keywords: Financial Inclusion, Digitalization, Efficiency

JEL Codes: G20, G29

ÜLKELERİN FİNANSAL KAPSAYICILIK AÇISINDAN DİJİTALLEŞMEDEKİ ETKİNLİKLERİNİN VZA İLE DEĞERLENDİRİLMESİ

Öz

Çalışmanın amacı, ülkelerin finansal kapsayıcılık açısından dijitalleşmedeki etkinliklerinin diğer bir ifadeyle dijitalleşmedeki başarılarının değerlendirilmesidir. Çalışma kapsamında 117 ülke yüksek, üst-orta, düşük ve düşük-orta gelirli olmak üzere gruplandırılarak Veri Zarflama Analizi'ne tabi tutulmuştur. 2021 yılı için yapılan çalışmada, ilgili ülkelerde dijital finansal hizmetlerin erişimi ve kullanımı kapsamında 4 girdi ve 10 çıktı değişkeni belirlenmiştir. Çıktıya yönelik sabit ve değişken getiri modeline dayalı olarak yapılan çalışmada etkin ülkeler belirlenmiştir. Yüksek gelir grubunda yer alan ülkelerde değişken getiriye göre 25, sabit getiriye göre 18 ülkede finansal kapsayıcılıkta dijital etkinlik tespit edilmiştir. Üst-orta gelirli ülkelerde değişken getiriye göre 12, sabit getiriye göre 9; düşük ve düşük-orta gelirli ülkelerde değişken getiriye göre 16, sabit getiriye göre 9 ülkede finansal kapsayıcılık açısından dijitalleşme sürecinde etkinlik saptanmıştır. Çalışmada, gelir gruplarına ayrılmış olan ülkeler düzeyinde finansal kapsayıcılıkta dijitalleşme başarısının veri zarflama analizi ile kapsamlı olarak ele alınması çalışmanın özgün tarafını ortaya koymaktadır.

Anahtar Kelimeler Finansal Kapsayıcılık, Dijitalleşme, Etkinlik

JEL Kodları: G20, G29

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INTRODUCTION

As per the World Bank's definition, financial inclusion requires the ability of individuals and businesses to access a wide array of responsible and sustainable financial products and services. These encompass operations, payments, savings, credit, and assurance, all of which are specifically tailored to fulfill the requirements of individuals and businesses in a manner that is both convenient and affordable.

The digitalization process, facilitated by internet connectivity and mobile applications, has emerged as a vital conduit for delivering a broad spectrum of financial solutions. The extensive adoption of digital channels has played a pivotal role in the proliferation of diverse financial offerings. Expediting the provision of digital financial services primarily relies on leveraging technological advancements to establish seamless connections (Koh, Phoon, and Ha, 2018, p. 391). Technology is the most important driving force for financial inclusion, as it ensures people with the ability to access financial services regardless of their location (Fanta and Makina, 2019, p. 226). Technology enables the easy management of connections between service providers and customers. Furthermore, it helps financial service providers expand their reach. In this context, technology benefits banks, one of the most important service providers in the financial system, in reducing their costs, providing customers with easy access, and managing job-related risks (Bansal, 2014, p. 472).

Affordable provision of financial services is important for poverty reduction and economic growth. Digitalization allows for a reduction in the costs of financial transactions, increased transparency, and security (Pazarbasioglu et al., 2020, p. 5). The impact of digitalization on financial product and service processes allows individuals and institutions to easily and cost-effectively control financial transactions, providing ease in making financial decisions. Digitized financial services provide affordable access to financial solutions for underserved individuals, expanding their reach to a broader demographic. Particularly for individuals with low income or limited resources, facilitating entry to essential financial services enhances the grade of financial inclusion. Furthermore, it grants financial access to individuals facing challenges in utilizing traditional banking services. Additionally, it offers convenient platform services to facilitate essential financial transactions like bill payments and fund transfers for individuals (Ozili, 2018, p. 333).

Although digital advancements have predominantly been associated with positive impacts on financial inclusion, it is necessary to acknowledge the existence of barriers that hinder access to these services and impede the enhancement of quality of life. Infrastructure problems, providing appropriate services, and increasing individuals' economic status are among the obstacles (Koh et al., 2018, p. 390). In addition, while digitalization facilitates physical access to financial services and connections, low financial

literacy and awareness among individuals prevent these services from being used (Aziz and Naima, 2021, p. 1). Nevertheless, the correlation among the utilization of digital financial services and achieving financial inclusion is more pronounced among individuals with higher incomes. This is because individuals from economically marginalized backgrounds, including those with limited financial resources, may be reluctant to embrace the use of digital financial services (Ozili, 2018, p. 333). Additionally, problems with internet connectivity and access continue to be a barrier to financial inclusion. Especially in rural areas, users experience problems accessing the internet due to weak connectivity (Aziz and Naima, 2021, p. 6).

Studies have shown that individuals and institutions can easily participate in the financial system, in other words, financial inclusion plays an important role in the development of the financial system. (Rasheed et al., 2016; Lenka, 2021; Evans; 2015). It can be stated that the digitalization process is an intermediary function of financial inclusion in the development of the financial system. Yartey (2008) found in his study that financial development is related to the use of information and communication technologies. According to Yartey (2008), especially the development of stock markets and banks, the widespread use of information communication technologies and the development of financial markets facilitate the financing of information communication technologies. In this context, when the role of financial inclusion in financial development is considered, the importance of the digitalization process in financial inclusion becomes an undeniable reality. Accordingly, the motivation for the study is to investigate the success of digitalization at the level of financial inclusion of countries, in other words, its efficiency. In the study, a detailed evaluation of the success of digitalization in financial inclusion at the level of countries divided into income groups, with comprehensive data envelopment analysis and fixed and variable return models, reveals the originality of the study. In addition, the output variables used to examine the study in detail - obtained from the Global Findex Database, which is a global set - are expected to contribute to the literature in this respect.

The study's research question examines the efficiency of digitalization practices in facilitating financial inclusion through the delivery period of financial offerings. The study analyzes the efficiency of the digital infrastructure and services provided, and the usage of these services, in other words, the efficiency of digitalization in financial inclusion. Data Envelopment Analysis was utilized in the evaluation of the efficiency of decision-making units, which can assess a large number of inputs and outputs simultaneously and allows to determine the efficiency scores of the units relative to each other instead of evaluating them alone (İşbilen Yücel, 2017, p. 3 & p. 15).

In the study, decision-making units classified according to income groups according to the output-oriented BCC and CCR model were subjected to an efficiency measurement as part of the data envelopment analysis. In the study, examining 2021, effective countries were identified within the framework of both

models. Finally, target and improvement values were calculated for the inputs and outputs of all decision-making units were calculated.

The plan of the study consists of an introduction chapter, followed by literature reviews, a methodology section, and conclusions and policy recommendations.

LITERATURE REVIEW

When examining the studies in the literature, it is determined that the connection of inclusive finance and internet usage, mobile bank solutions, and digital technologies is generally investigated, and indexation techniques are frequently used in measuring digitalization and financial inclusion.

In their study, Korynski and Pytkowska (2016) investigated the level of financial inclusion in European Union countries using data envelopment analysis. In the study, the authors used variables related to the use of financial services (such as accounts, loans, life insurance) as output variables. In access to financial services, variables related to the infrastructure, quality of products and services, and policy dimension related to the supply of financial services are considered as input variables. In the study, they calculated the financial inclusion scores of countries with data envelopment analysis and produced a composite index. As a result of the study, they concluded that there are significant differences in the level of financial inclusion among the member countries of the European Union, but there is an increase in efforts at this point.

Some studies in the literature have examined mobile banking services and their relationship with financial inclusion within the scope of digital finance (Klein and Mayer, 2011; Singh, 2014; Durai and Stella,2019; Coffie, Zhao, and Mensah, 2020;). The provision of financial services through mobile networks can provide financial access to unbanked households. In this context, international mobile remittance features represent an important innovation for rural households to access banking services (Nyanhete, 2017, p. 256). In addition, Nyanhete (2017) examined the role of mobile technologies in improving human life and emphasized the importance of their further use. According to Ouma, Odongo and Were (2017), the availability of mobile phones and the use of mobile phones increase the probability of households saving as individuals who cannot access financial services can access affordable, accessible and sustainable financial services through mobile phones. While increased internet and mobile phone use is the cause of financial inclusion, increased internet and mobile phone use is positive for financial inclusion (Evans, 2018, p. 576). Coffie, Zhao, and Mensah (2020) investigated the relationship between mobile transactions and financial inclusion in a study using the total number of mobile payment transactions per year and variables related to

financial inclusion. The study emphasizes that the level of financial inclusion increases with the increase in mobile payment transactions.

In examining the literature on digitalization practices in financial services, the concept of digital finance is mostly encountered. According to Ozili (2018), digital finance positively affects financial inclusion in developed and developing economies. In this context, Fintech providers have an important role in intermediation. Especially for individuals with low and variable incomes, the conveniences offered by digital finance are becoming more important.

Digital finance plays a vital role in people's daily activities. For individuals, usability, convenience, timeliness and ease of interbank accounts are important and effective aspects of mobile banking. Low service fees and good timing also have a significant impact on mobile applications. Low service fees are effective in credit card usage (Durai and Stella, 2019, p. 126). In South Asian Association for Regional Cooperation (SAARC) countries, the increase in mobile phone and internet usage positively affects the level of financial inclusion (Lenka and Barik, 2018, p. 17). In the Middle East and North Africa (MENA) region, digital finance increases access to financial services and the availability and utilization of financial services (Al-Smadi, 2022, p. 8).

The contribution of digital applications to businesses' availability of financial outcomes and facilities is among the topics examined in the literature. In this context, Gosavi (2018) investigated whether the utilize of mobile money was effective in solving firms' access to finance problem. According to Gosavi (2018), companies using mobile money in Eastern Sub-Saharan Africa are likely to receive credit limits and loans. According to Chen, Gong, Chu, and Cao (2018), access to the internet plays an important role in reducing the dependence of small and micro businesses on physical branches of banks and thus accessing finance.

Technology promotes access to and use of financial services and there is a positive interaction between technology and financial inclusion (Fanta and Makine, 2019, p. 227). According to Kouladoum, Wirajing and Nchofoung (2022), digital technologies play an important role in increasing the level of financial inclusion in Sub-Saharan African countries. The increase in digital technologies increases the level of financial inclusion.

The studies in the literature generally indicate a positive nexus the utilize of digital applications such as internet and mobile services and financial inclusivity for individuals and enterprises (Evans, 2018; Lenka and Barik, 2018; Chen, Gong, Chu, and Cao, 2018; Fanta and Makine, 2019; Coffie, Zhao, and Mensah, 2020; Kouladoum, Wirajing, and Nchofoung, 2022; Al-Smadi, 2022) At this point, the efficiency of digitalization practices in financial inclusion is the motivation for this study.

The utilization of Data Envelopment Analysis to gauge the grade of digitalization in financial inclusion and the comprehensive classification of countries according to their income groups constitutes a unique aspect of the study. In addition, it is expected that the study will contribute to the literature in terms of the variables used in the study, which are different from the literature, in order to discuss the use of digital services in detail.

METHODOLOGY

In this section, the purpose and methods of the study are presented, followed by a discussion of the inputs and outputs used in the analysis, and an overview of the decision-making units involved in the study.

Purpose and Method

The study aims to evaluate the digital efficiency in financial accessibility using country-level data. In other words, it aims to determine the efficiency of digital applications in accessing and using financial services and their use. For this purpose, 117 countries (decision-making units) were classified according to their income groups and subjected to a DEA utilizing a set of four inputs and ten outputs identified in the literature.

In this context, countries are classified according to their income to ensure similarity. In addition, this classification was preferred to determine whether the' income level of the countries' is important in investigating the success of countries in digitalization in terms of financial inclusion. The World Bank's classification of countries according to their gross domestic product per capita was taken into consideration in the study's classification. According to income level, the World Bank has categorized countries into four groups: low income, lower middle income, high middle income and high income. Since DEA is used in the study and the number of decision-making units is important in this analysis method, the appropriate number of decision-making units was reached by considering low-income and lower-middle-income countries together while determining the country groups.

In this study, BCC and CCR models are used to determine aggregate (economic), technical and scale efficiency for output. Technical efficiency is defined as the ability to obtain the maximum output with a given amount of input, while scale efficiency is defined as the ability to use the appropriate proportion of inputs, taking into account costs. With the combination of technical and scale efficiency, total efficiency, also known as economic efficiency, is obtained (Demirci, 2018, p. 20). The CCR model focuses on total efficiency, assuming that decision-making units operate with constant returns to scale. Calculating efficient and inefficient scores, it reveals the amount of inputs and outputs that cause inefficiency. The BCC model

also provides a more detailed efficiency measurement than the CCR model with the assumption of variable returns to scale. It also calculates technical efficiency and scale efficiency values in the case of variable returns to scale, both increasing and decreasing (İşbilen Yücel, 2017, p. 20). In addition to technical efficiency, another performance indicator, the proximity to the most efficient scale size, should be examined. This is called scale efficiency. Scale efficiency is calculated as the ratio of technical efficiency under constant returns to scale to technical efficiency under variable returns to scale (Demirci, 2018, p. 20).

In the study, the efficiency of digital applications in financial inclusion, in other word, their success, is discussed in detail; It was examined in the context of both technical, total and scale efficiency, and therefore both BCC and CCR models were used.

In the application phase of DEA, appropriate decision-making units must first be selected. Then appropriate inputs and outputs must be determined within the framework of the variables of the study, and finally the efficiency of decision-making units must be evaluated in line with appropriate models. In this context, three stages can be generally mentioned in DEA (Okursoy and Tezsürücü, 2014, p. 7).

Decision-Making Units

In DEA, the choice of decision-making units and the determination of their number were important issues. In the selection of decision-making units, homogeneity and the number of decision-making units were important. In this study, the view that the number of decision-making units should be further than the number of inputs and outputs, and at least 2 or 3 times the sum of the input and output numbers was taken into account when determining the number of decision-making units (Demirci, 2018, p.75).

In the study, countries were classified into income groups in order to obtain reliable results and ensure homogeneity among decision-making units. In this context, countries were classified into three groups: high-income, upper-middle-income, and low and lower-middle-income countries. The countries considered as decision-making units are presented in Table 1.

Table 1 shows that there are 41 decision-making units for high-income countries, 32 for upper-middle-income countries, and 44 for low- and lower-middle-income countries. In this context, there are a total of 117 decision-making units in the study.

Table 1: Decision-making units and symbols

High Income Countries	Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), Croatia (HRV), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hong Kong (HKG), Hungary (HUN), Iceland (ISL), Israel (ISR), Italy (ITA), Ireland (IRL), Japan (JPN), Korea Rep. (KOR), Latvia (LVA), Lithuania (LTU), Malta (MLT), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Portugal (PRT), Poland (POL), Saudi Arabia (SAU), Singapore (SGP), Slovak Republic (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), United Arab Emirates (ARE), United Kingdom (GBR), United States (USA), Uruguay (URY)
Upper Middle Income Countries	Albania (ALB), Argentina (ARG), Armenia (ARM), Bosnia and Herzegovina (BIH), Brazil (BRA), Bulgaria (BGR), China (CHN), Costa Rica (CRI), Dominican Rep. (DOM), Ecuador (ECU), Gabon (GAB), Georgia (GEO), Iraq (IRQ), Jamaica (JAM), Jordan (JOR), Kazakhstan (KAZ), Lebanon (LBN), Malaysia (MYS), Mauritius (MUS), Moldova (MDA), Namibia (NAM), North Macedonia (MKD), Panama (PAN), Paraguay (PRY), Peru (PER), Romania (ROU), Russian Federation (RUS), Serbia (SRB), South Africa (ZAF), Thailand (THA), Türkiye (TUR)
Low and Lower Middle Income Countries	Algeria (DZA), Bangladesh (BGD), Benin (BEN), Bolivia (BOL), Burkina Faso (BFA),Cambodia (KHM), Cameroon (CMR), Congo Rep. (COG), Coted'Ivoire (CIV), Egypt (EGY), El Salvador (SLV), Ghana (GHA), Guinea (GIN), Honduras (HND), India (IND), Indonesia (IDN), Iran (IRN), Kenya (KEN), Kyrgyz Republic (KGZ), Lao PDR (LAO), Liberia (LBR), Malawi (MWI), Mali (MLI), Mongolia (MNG), Morocco (MAR), Mozambique (MOZ), Myanmar (MMR), Nepal (NPL), Nicaragua (NIC), Nigeria (NGA), Pakistan (PAK), Philippines (PHL), Senegal (SEN), Sierra Leone (SLE), Sri Lanka (LKA), Tajikistan (TJK), Tanzania (TZA), Togo (TGO), Tunisia (TUN), Uganda (UGA), Ukraine (UKR), Uzbekistan (UZB), Zambia (ZMB), Zimbabwe (ZWE)

Inputs and Outputs

In determining the inputs and outputs utilized to measure digital efficiency in financial inclusion, "access" and "usage" criteria were used. In their study, Khera, Ng, Ogawa and Sahay (2021) calculated a digital financial inclusion index and used access and usage variables related to digital financial solutions in the calculation of this index. In this context, the inputs used in the analysis of the study represent availability of digital monetary solutions, while the outputs represent the utilize of digital financial services. Details of the input and resulting factors utilized in the research are presented in Table 2.

Given that financial services should be accessible to individuals from all segments of society, including disadvantaged groups, it is also important to determine the level of access of the targeted users to the devices they need to use digital financial services (Demirgüç-Kunt, Klapper, Singer, and Ansar, 2021, p. 126). Access is primarily measured by accessibility indicators related to the availability of means of access to payment services (such as internet and mobile phones) (Khera et al., 2021, p. 3). The input represented by the symbol INP1 in Table 2 shows the rate of individuals aged 15 and above with internet access. Since internet access is one of the most important intermediary indicators of access to digital finance applications, it was considered as an input variable. In his study, Evans (2018) discussed the number of

people using the internet in the context of digital technologies. INP2 represents the rate of individuals aged 15 and above who own a mobile phone to the total population. Evans (2018) analyzed data on mobile cellular subscriptions within the scope of digital technologies. In this context, mobile phone ownership is also considered as an input variable since it mediates access to digital financial applications. INP3 represents the rate of individuals covered by a mobile-cellular network, while INP4 represents the rate of the population covered with a minimum of 3G capability. Khera at al. (20221) used the number of mobile subscriptions per 100 people as an indicator of access to digital infrastructure in their study. In this context, INP3 and INP4 variables were considered as input variables since they were indicative variables that measure access to mobile infrastructure services.

In general, the output variables used in the study indicate the proportion of individuals who use digital tools such as the internet and mobile services to check their financial account balance, make payments, transfer money, use credit cards, make payments and make all kinds of purchases. The output variable represented by symbol OUT1 is the proportion of adults who use a cellular device or online connectivity to control the account balance at a monetary institution. OUT2 represents the proportion of adult individuals who utilize their mobile phone or the internet to make payments, purchase something, transfer or accept funds with an account of monetary institution. OUT3 represents the proportion of adult individuals that loan from a bank or other financial institution used a credit card, or a mobile money account in the last year. OUT4 represents the percentage of adult individuals who used their mobile phone, bank card, or credit card to make payments from an account, or who utilized the internet to pay bills or make purchases in-store within the past year. Moreover, it comprises adult individuals who paid bills or transferred money straightly from a financial institution account or owing to a mobile money account. OUT5 represents the proportion of adult individuals who received payments into their account with a mobile money account, bank card, credit card, or mobile phone for payments.OUT6 represents the ratio of individuals who utilize a mobile phone or the internet to make any online purchases; OUT7 represents the ratio of individuals who use a mobile phone or the internet to pay bills; OUT8 represents the ratio of individuals who use a mobile phone or the internet to send money; OUT9 represents the ratio of individuals who use a mobile phone to shop in a store; and OUT10 represents the ratio of individuals who make orderly payments for water, electricity, or garbage collection utilizing a mobile phone. INP1, INP2, INP3, and INP4 constitute the inputs of the study, while OUT1, OUT2, OUT3, OUT4, OUT5, OUT6, OUT7, OUT8, OUT9, and OUT10 represent the outputs of the study.

In their study, Petrikova and Kocisova (2024) discussed the use of financial services from a digital perspective by using the OUT4 and OUT5 variables. The Global Findex Database published by the World

Bank in 2021 has become a definitive source of data on how adults worldwide use financial services (Demirgüç-Kunt et al., 2021, p. 17). In this context, related variables obtained from the Global Findex Database, which is an important data source for measuring individuals' use of digital services, were used as output variables in the study. From this point of view, the variables OUT1, OUT2, OUT3, OUT6, OUT7, OUT8, OUT9, OUT10 in the relevant data set are included in the study to detail the use of digital applications in the use of financial services. In this context, it is expected to contribute to the literature due to the use of these output variables - obtained from the Global Findex Database, which is a global set - used differently from the literature to discuss the study in detail.

Table 2: Inputs and outputs

Inputs/Outputs	Symbol
Individuals with internet connectivity (% aged 15+)	**INP1**
Possess a mobile phone (% aged 15+)	**INP2**
Population contained by a mobile-cellular network (%)	**INP3**
Population contained by at least a 3G mobile network (%)	**INP4**
Used a cell phone or online connectivity to verify the status of one's account balance (% aged 15+).	**OUT1**
Utilize a mobile phone or the internet to conduct transactions, purchase items, or to send or receive money using an account at a monetary institution (% aged 15+)	**OUT2**
Obtained funds from an official monetary establishment or employed a mobile money account to borrow money (% age 15+)	**OUT3**
Accomplished an electronic payment (% aged 15+)	**OUT4**
Accepted electronic transactions (% aged 15+)	**OUT5**
Utilized a smartphone or online connectivity to make purchases on the internet (% aged 15+)	**OUT6**
Utilized a cellphone or internet access to make bill payments using digital means (% age 15+)	**OUT7**
Utilized a mobile device or online connectivity to transfer money electronically (% aged 15+)	**OUT8**
Accomplished a mobile phone-based digital payment at a physical store (% aged 15+)	**OUT9**
Successfully made a utility payment using a mobile device (% age 15+)	**OUT10**

Results

This part of the study includes efficiency measurement results and potential improvement values based on output-oriented BCC and CCR models of decision-making units.

Efficiency Measurement Results

In the study, efficiency values were calculated according to the output-oriented BCC and CCR models in order to compare the digital efficiency scores in financial inclusion of countries in different income

groups. The efficiency measurement results according to the BCC and CCR models of high-income countries are presented in Table 3.

Table 3 presents the efficiency measurement results of 41 countries in the high-income group, based on the output-oriented CCR and BCC models. Accordingly, 18 countries were found to be relatively efficient according to the CCR model, while 25 countries were found to be relatively efficient according to the BCC model. In addition, scale efficiency was found in 25 countries. A total of 23 countries were unable to achieve full efficiency according to the CCR model, while 16 countries were unable to achieve full efficiency according to the BCC model. Thus, 43.9% of the high-income countries examined were efficient according to the CCR model, and 60.9% were efficient according to the BCC model. The scale efficiency ratio was also 60.9%.

As shown in Table 3, Uruguay has the lowest efficiency value among high-income countries according to the CCR model (0.66), while Malta has the lowest efficiency value according to the BCC model (0.88). In addition, it is observed that the efficiency values of the majority of countries examined are above 0.85 for both models, and the average efficiency value is quite high (above 0.95).

In general, it is possible to state that the level of inclusive finance is remarkably high in countries with a high income bracket for 2021.

Table 3: Efficiency measurement results of high income countries regarding BCC and CCR models

Countries	CCR	BCC	Scale Effeciency	Countries	CCR	BCC	Scale Effeciency
Australia	0.99	**1.00**	0.99	Korea Rep.	**1.00**	**1.00**	**1.00**
Austria	**1.00**	**1.00**	**1.00**	Latvia	0.95	0.95	**1.00**
Belgium	0.99	**1.00**	0.99	Lithuania	0.89	**1.00**	0.89
Canada	**1.00**	**1.00**	**1.00**	Malta	0.88	0.88	**1.00**
Chile	0.87	**1.00**	0.87	Netherlands	**1.00**	**1.00**	**1.00**
Croatia	0.87	0.89	0.98	New Zealand	**1.00**	**1.00**	**1.00**
Cyprus	0.86	**1.00**	0.86	Norway	**1.00**	**1.00**	**1.00**
Czechia	0.95	0.95	0.99	Poland	0.93	0.93	**1.00**
Denmark	**1.00**	**1.00**	**1.00**	Portugal	0.92	0.96	0.96
Estonia	**1.00**	**1.00**	**1.00**	Saudi Arabia	0.92	0.98	0.94
Finland	**1.00**	**1.00**	**1.00**	Singapore	0.92	0.92	**1.00**
France	**1.00**	**1.00**	**1.00**	Slovak Republic	0.94	0.95	0.99
Germany	**1.00**	**1.00**	**1.00**	Slovenia	**1.00**	**1.00**	**1.00**

Greece	0.90	0.90	**1.00**	Spain	0.98	0.98	0.99
Hong Kong	**1.00**	**1.00**	**1.00**	Sweden	**1.00**	**1.00**	**1.00**
Hungary	0.86	0.88	0.97	Switzerland	0.99	0.99	0.99
Iceland	**1.00**	**1.00**	**1.00**	United Ara.Emir.	0.89	**1.00**	0.89
Ireland	**1.00**	**1.00**	**1.00**	United Kingdom	0.99	0.99	**1.00**
Israel	**1.00**	**1.00**	**1.00**	United States	0.93	0.93	**1.00**
Italy	0.94	0.94	0.99	Uruguay	0.66	**1.00**	0.66
Japan	**1.00**	**1.00**	**1.00**				
Average Efficiency Value					**0.95**	**0.98**	**0.97**

Secondly, the efficiency measurement results regarding BCC and CCR models regarding the nations in the upper-middle income group are presented in Table 4.

As indicated in Table 4, the efficiency measurement results of 32 countries in the upper-middle income group are presented according to the CCR and BCC models constructed for output orientation. Accordingly, 9 countries were discovered to be relatively efficient according to the CCR model, and 12 countries considering to the BCC model. However, it was concluded that 9 countries also had scale efficiency. It was determined that 23 countries were relatively inefficient according to the CCR model, and 20 countries by the BCC model. Thus, in the upper-middle income group countries examined, 28.1% were efficient according to the CCR model, and 37.5% were efficient according to the BCC model. The scale efficiency rate is also 28.1%. However, Lebanon has the lowest efficiency value in terms of digitalization according to CCR and BCC models.

As shown in Table 4, for the upper-middle-income group, the majority of countries had efficiency values above 0.55 according to the CCR model (excluding 5 countries) and above 0.90 according to the BCC model (excluding 2 countries). The average efficiency value for this group was calculated as 0.74 according to the BCC model and 0.96 according to the CCR model. The average scale efficiency value was also observed to be 0.77.

It has been observed that the number of countries identified as efficient in the upper-middle-income category is comparatively lower in comparison to the high-income group, according to BCC and CCR models and scale efficiency. When the average efficiency values of high and upper-middle-income countries are compared (especially for BCC model), it has been found that the average efficiency values in the upper-middle-income group are lower. In this context, it is possible to state that the relative digital efficiency scores in financial inclusion in upper-middle-income nations are lower in comparison to those in high-

income nations. Finally, efficiency measurement results regarding countries' BCC and CCR models in the low- and low-middle-income group are presented in Table 5.

Table 4: Efficiency values of upper middle income countries by BCC and CCR models

Countries	CCR	BCC	Scale Effeciency	Countries	CCR	BCC	Scale Effeciency
Albania	0.40	0.92	0.44	Kazakhstan	**1.00**	**1.00**	**1.00**
Argentina	0.77	0.93	0.83	Lebanon	0.13	0.89	0.14
Armenia	0.65	0.90	0.72	Malaysia	0.98	**1.00**	0.98
Bosnia-Herz.	0.70	0.94	0.75	Mauritius	0.87	0.97	0.90
Brazil	**1.00**	**1.00**	**1.00**	Moldova	0.64	0.91	0.70
Bulgaria	0.86	0.92	0.93	Namibia	**1.00**	**1.00**	**1.00**
China	**1.00**	**1.00**	**1.00**	North Mace.	0.83	0.90	0.92
Colombia	0.65	0.95	0.68	Panama	0.53	**1.00**	0.53
Costa Rica	0.68	0.95	0.71	Paraguay	0.56	0.94	0.60
Dominician R.	0.58	0.97	0.60	Peru	0.67	**1.00**	0.67
Ecuador	0.63	0.95	0.67	Romania	0.70	0.91	0.77
Gabon	0.98	0.99	0.98	Russia	**1.00**	**1.00**	**1.00**
Georgia	0.70	0.92	0.77	Serbia	**1.00**	**1.00**	**1.00**
Iraq	0.31	0.96	0.33	South Africa	**1.00**	**1.00**	**1.00**
Jamaica	0.58	0.95	0.60	Thailand	**1.00**	**1.00**	**1.00**
Jordan	0.32	0.89	0.37	Türkiye	**1.00**	**1.00**	**1.00**
Average Efficiency Value					**0.74**	**0.96**	**0.77**

Table 5 presents the efficiency measurement results based on CCR and BCC models for 44 countries in the low and low-middle income group. According to the CCR model, 9 countries are relatively efficient, while according to the BCC model, 16 countries are relatively efficient. Additionally, 9 countries were found to have scale efficiency. On the other hand, 35 countries are relatively inefficient according to the CCR model, and 28 countries are relatively inefficient according to the BCC model. Therefore, in the examined low and low-middle income group, 20.4% of countries are efficient according to the CCR model, and 36.3% of countries are efficient according to the BCC model. The efficiency at scale ratio is also 20.4%. Moreover, according to the CCR model, Pakistan has the lowest value of efficiency, while according to BCC model, it is Egypt. The average efficiency level of the countries in this group was calculated as 0.71 according to the BCC model and 0.92 wih respect to CCR model. The average scale efficiency value is found to be 0.76.

In general, it has been found that the calculated relative efficiency values for the countries in this group are inferior to those of high and upper-middle income nations. However, the mean efficiency values calculated for both models and scale efficiency support this result. As a result, it can be stated that the relative digital efficiency score for financial inclusion is lower in low and lower-middle income countries compared to high and upper-middle income countries.

Table 5: Efficiency values of low and lower-middle income nations regarding BCC and CCR model

Countries	CCR	BCC	Scale Effeciency	Countries	CCR	BCC	Scale Effeciency
Algeria	0.33	0.79	0.42	Mali	0.85	**1.00**	0.85
Bangladesh	0.79	0.85	0.93	Mongolia	**1.00**	**1.00**	**1.00**
Benin	0.77	0.90	0.86	Morocco	0.28	0.76	0.37
Bolivia	0.59	0.80	0.74	Mozambique	**1.00**	**1.00**	**1.00**
Burkina Faso	0.77	**1.00**	0.77	Myanmar	0.52	0.86	0.60
Cambodia	0.81	0.92	0.88	Nepal	0.65	0.88	0.74
Cameroon	**1.00**	**1.00**	**1.00**	Nicaragu	0.43	**1.00**	0.43
Congo	0.76	0.93	0.82	Nigeria	0.97	**1.00**	0.97
Cote d'Ivoire	0.76	0.87	0.88	Pakistan	0.28	0.94	0.30
Egypt	0.35	0.77	0.45	Philippines	0.91	0.99	0.92
El Salvador	0.31	0.78	0.39	Senegal	0.68	0.86	0.79
Ghana	**1.00**	**1.00**	**1.00**	Sierra Leone	0.59	0.99	0.60
Guinea	0.59	**1.00**	0.59	Sri Lanka	0.57	0.82	0.69
Honduras	0.40	0.88	0.46	Tajikistan	0.43	0.84	0.51
India	0.74	0.93	0.80	Tanzania	**1.00**	**1.00**	**1.00**
Indonesia	0.70	0.96	0.73	Togo	0.82	0.91	0.90
Iran	**1.00**	**1.00**	**1.00**	Tunisia	0.53	0.84	0.63
Kenya	**1.00**	**1.00**	**1.00**	Uganda	0.91	0.98	0.93
Kyrgyzstan	0.49	0.79	0.62	Ukraine	**1.00**	**1.00**	**1.00**
Lao PDR	0.41	0.81	0.50	Uzbekistan	0.57	0.86	0.66
Liberia	0.92	**1.00**	0.92	Zambia	0.99	**1.00**	0.99
Malawi	0.85	0.99	0.86	Zimbabwe	**1.00**	**1.00**	**1.00**
Average Efficiency Value					**0.71**	**0.92**	**0.76**

When Table 3, Table 4 and Table 5 were analyzed in general, according to the BCC model, the efficiency of digital applications in financial inclusion was determined in 25 countries in the high-income country group, 12 countries in the upper-middle-income country group, and 16 countries in the low and

lower-middle-income country group. According to the CCR model, the efficiency of digital applications in financial inclusion was determined in 18 countries in the high-income country group, 9 countries in the upper-middle-income country group and 9 countries in the low and low-middle-income country group. The scale efficiency of digital applications in financial inclusion was determined in 25 countries in the high-income country group, 9 countries in the upper-middle income country group, and 9 countries in the low and lower-middle income country group.

According to the BCC model, average efficiency values were calculated as 98% in high-income countries, 96% in upper-middle-income countries, and 92% in low- and lower-middle-income countries. According to the CRR model, average efficiency values were calculated as 95% in high-income countries, 74% in upper-middle-income countries, and 71% in low and low-middle-income countries. In terms of scale efficiency, average efficiency values were calculated as 97% in high-income countries, 77% in upper-middle-income countries, and 76% in low and low-middle-income countries. When the findings are analyzed in terms of average efficiency values, it is possible to state that income is an important factor in the success of digital applications in financial inclusion for country groups.

In the study, the efficiency analysis findings in Table 3, Table 4 and Table 5 are summarized for all countries and models and presented in Table 6.

When Table 6 is examined, it can be observed that the number of countries identified with a level of efficiency as determined by BCC model is more than the CCR model for all three country groups. Consequently, the proportion of efficient countries calculated by the BCC model is also more than that of the CCR model. Additionally, when analyzed under both models, the proportion of efficient countries is supreme for high-income countries and least for low and lower-middle income countries. The number of inefficient countries is supreme for the low and lower-middle income group (under the CCR model) and lowest for the high-income group (under the BCC model). The average of ineffective countries is higher according to the CCR model compared to the BCC model. The mean level of efficiency is the highest for high-income nations and the lowest for low and lower-middle-income nations, regardless of the model used. The upper-middle-income group is found to have the lowest efficiency value for both models.

Table 6: Summary results

Criteria	CCR Summary Statistics			BCC Summary Statistics		
	High Income	Upper Middle Income	Low and Lower Middle	High Income	Upper Middle Income	Low and Lower Middle
Total Number of Countries	41	32	44	41	32	44
Number of Efficient Countries	18	9	9	25	12	16
Proportion of Efficient Countries	0.44	0.28	0.20	0.61	0.37	0.36
Average Efficiency	0.95	0.74	0.71	0.97	0.96	0.92
Minimum Efficiency	0.66	0.13	0.28	0.88	0.89	0.78
Number of Inefficient Countries	23	23	35	16	20	28
Average of Inefficient Countries	0.92	0.64	0.64	0.94	0.93	0.87

In the study, financial inclusion was discussed in terms of access and usage, and the success of digitalization in individuals' access to financial services was investigated. In the analysis of the study, output-oriented BCC and CCR models were used and effective, in other words successful, countries were identified. The input variables used in the analysis represent access to digital services in financial inclusion, while the output variables represent the use of digital financial services. In this context, it is concluded that access to digital services is an important factor in the financial inclusion level of countries. It is possible to state that internet access, mobile phone ownership, access to digital channels, including the coverage of mobile networks, and the existence and inclusiveness of digital infrastructures are the determining factors at this point.

Potential Improvement Values

After determining the efficiency values of the decision-making units in the study, the improvement values for the inputs and outputs of the decision-making units whose efficiency was not determined were calculated based on the BCC model, expressing the total efficiency. Accordingly, the targeted, actual and improvement values regarding the inputs and outputs of decision-making units are presented in Table 7, Table 8 and Table 9. In the relevant tables, I1, I2, I3 and I4 represent the inputs used in the study; O1, O2, O3, O4, O5, O6, O7, O8, O9 and O10 represent the output variables, respectively. Also, the symbol A is actual; T stands for targeted; I stands for improvement values.

Targeted, actual and improvement values for the inputs and outputs included in the study in high-income countries are presented in Table 7. When Table 7 is examined, it can be seen that there is no difference between the actual and targeted values according to the inputs of AUS, which represents the Australian decision-making unit, in other words, there is no residual value within the scope of the inputs. In terms of outputs, it was revealed that the target was not achieved in the output variables O1, O2, O3, O7, O8 and O9 and in this context, they should be increased by 0.01, 0.03, 0.05, 0.01, 0.13, 0.05 units, respectively.

Table 7: Actual, targeted and improvement values of inputs and outputs in high-income countries

		I1	I2	I3	I4	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
AUS	**A**	0.94	0.96	1.00	1.00	0.88	0.83	0.57	0.98	0.87	0.77	0.77	0.63	0.44	0.40
	T	0.94	0.96	1.00	1.00	0.89	0.86	0.62	0.98	0.87	0.78	0.78	0.76	0.49	0.40
	İ	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.00	0.00	0.00	0.01	0.13	0.05	0.00
BEL	**A**	0.94	0.95	1.00	1.00	0.83	0.78	0.48	0.97	0.77	0.68	0.78	0.57	0.33	0.34
	T	0.94	0.95	0.99	0.99	0.88	0.85	0.53	0.97	0.87	0.75	0.78	0.72	0.49	0.43
	İ	0.00	0.00	-0.01	-0.01	0.05	0.07	0.05	0.00	0.10	0.07	0.00	0.15	0.16	0.09
CHL	**A**	0.85	0.96	0.99	0.95	0.59	0.56	0.24	0.78	0.72	0.49	0.52	0.43	0.41	0.30
	T	0.85	0.90	0.93	0.93	0.77	0.76	0.51	0.90	0.83	0.69	0.65	0.64	0.51	0.35
	İ	0.00	-0.05	-0.07	-0.03	0.17	0.20	0.27	0.12	0.11	0.21	0.14	0.21	0.10	0.05
HRV	**A**	0.91	0.98	1.00	1.00	0.56	0.42	0.33	0.75	0.77	0.44	0.43	0.27	0.20	0.33
	T	0.91	0.96	0.99	0.99	0.80	0.79	0.51	0.95	0.89	0.72	0.70	0.63	0.52	0.39
	İ	0.00	-0.02	-0.01	-0.01	0.24	0.37	0.18	0.20	0.12	0.28	0.27	0.37	0.32	0.05
CYP	**A**	0.85	0.94	1.00	1.00	0.60	0.56	0.31	0.79	0.64	0.46	0.50	0.35	0.28	0.28
	T	0.85	0.92	0.94	0.94	0.81	0.81	0.56	0.91	0.83	0.73	0.66	0.70	0.55	0.33
	İ	0.00	-0.02	-0.06	-0.06	0.21	0.24	0.25	0.13	0.19	0.27	0.16	0.35	0.27	0.05
CZE	**A**	0.08	0.09	0.28	0.05	0.06	0.04	0.04	0.18	0.15	0.10	0.08	0.09	0.28	0.05
	T	0.08	0.09	0.28	0.05	0.06	0.04	0.04	0.18	0.15	0.10	0.08	0.09	0.28	0.05
	İ	0.08	0.09	0.28	0.05	0.06	0.04	0.04	0.18	0.15	0.10	0.08	0.09	0.28	0.05
ITA	**A**	0.91	0.98	1.00	1.00	0.72	0.59	0.55	0.93	0.55	0.56	0.33	0.26	0.19	0.12
	T	0.20	0.91	0.96	1.00	0.77	0.73	0.59	0.99	0.71	0.70	0.64	0.52	0.34	0.20
	İ	0.00	-0.03	0.00	-0.02	0.05	0.14	0.04	0.06	0.16	0.14	0.31	0.26	0.15	0.08
LVA	**A**	0.95	1.00	0.99	0.99	0.79	0.76	0.23	0.93	0.83	0.58	0.77	0.62	0.26	0.33
	T	0.95	0.98	0.99	0.99	0.91	0.87	0.57	0.98	0.87	0.78	0.81	0.69	0.41	0.42
	İ	0.00	-0.03	0.00	0.00	0.12	0.11	0.34	0.05	0.05	0.20	0.04	0.07	0.14	0.08
LTU	**A**	0.87	0.94	1.00	1.00	0.72	0.67	0.12	0.83	0.65	0.53	0.61	0.47	0.31	0.14
	T	0.87	0.94	0.96	0.96	0.83	0.83	0.57	0.94	0.85	0.75	0.68	0.72	0.56	0.35
	İ	0.00	0.00	-0.04	-0.04	0.11	0.16	0.45	0.10	0.21	0.23	0.07	0.25	0.26	0.21

	A	0.89	0.96	1.00	1.00	0.65	0.61	0.39	0.86	0.69	0.52	0.51	0.44	0.31	0.24
MLT	**T**	0.89	0.96	1.00	1.00	0.82	0.80	0.61	0.97	0.82	0.74	0.63	0.66	0.52	0.28
	İ	0.00	0.00	0.00	0.00	0.17	0.20	0.22	0.11	0.12	0.22	0.11	0.22	0.21	0.03
	A	0.94	0.96	1.00	1.00	0.77	0.72	0.32	0.91	0.67	0.68	0.70	0.48	0.42	0.32
POL	**T**	0.94	0.96	1.00	1.00	0.86	0.83	0.53	0.99	0.85	0.74	0.76	0.68	0.45	0.39
	İ	0.00	0.00	0.00	0.00	0.08	0.11	0.21	0.07	0.18	0.06	0.06	0.20	0.03	0.06
	A	0.86	0.93	1.00	1.00	0.54	0.50	0.30	0.88	0.66	0.41	0.45	0.33	0.26	0.18
PRT	**T**	0.86	0.93	0.98	0.98	0.75	0.73	0.61	0.96	0.75	0.69	0.56	0.56	0.42	0.20
	İ	0.00	0.00	-0.02	-0.02	0.21	0.23	0.30	0.08	0.09	0.28	0.11	0.23	0.16	0.02
	A	0.92	0.99	1.00	1.00	0.60	0.59	0.32	0.72	0.57	0.62	0.62	0.57	0.52	0.43
SAU	**T**	0.92	0.95	0.97	0.97	0.89	0.86	0.49	0.95	0.88	0.75	0.79	0.76	0.56	0.46
	İ	0.00	-0.04	-0.03	-0.03	0.29	0.27	0.17	0.23	0.31	0.13	0.17	0.19	0.05	0.04
	A	0.94	0.97	1.00	1.00	0.69	0.68	0.44	0.91	0.78	0.58	0.58	0.54	0.50	0.18
SGP	**T**	0.94	0.97	1.00	1.00	0.86	0.84	0.59	0.99	0.84	0.78	0.73	0.73	0.54	0.24
	İ	0.00	0.00	0.00	0.00	0.17	0.17	0.15	0.08	0.07	0.20	0.15	0.19	0.04	0.07
	A	0.95	0.99	1.00	0.99	0.79	0.71	0.34	0.93	0.83	0.68	0.72	0.58	0.32	0.27
SVK	**T**	0.95	0.97	1.00	0.99	0.91	0.87	0.51	0.98	0.88	0.77	0.79	0.74	0.54	0.43
	İ	0.00	-0.02	-0.01	0.00	0.11	0.16	0.17	0.06	0.05	0.09	0.07	0.17	0.22	0.16
	A	0.92	0.93	1.00	1.00	0.75	0.64	0.52	0.97	0.55	0.58	0.48	0.53	0.36	0.08
ESP	**T**	0.92	0.93	1.00	1.00	0.77	0.73	0.56	0.99	0.72	0.69	0.62	0.54	0.36	0.16
	İ	0.00	0.00	0.00	0.00	0.02	0.09	0.04	0.02	0.17	0.11	0.14	0.01	0.01	0.08
	A	0.89	0.93	1.00	1.00	0.64	0.60	0.61	0.98	0.46	0.51	0.54	0.33	0.18	0.18
CHE	**T**	0.89	0.93	1.00	1.00	0.72	0.70	0.62	0.98	0.72	0.67	0.60	0.49	0.29	0.18
	İ	0.00	0.00	0.00	0.00	0.08	0.10	0.00	0.00	0.25	0.17	0.06	0.16	0.12	0.00
	A	0.76	1.00	1.00	1.00	0.47	0.41	0.24	0.75	0.18	0.25	0.16	0.12	0.16	0.10
ARE	**T**	0.76	0.80	0.86	0.86	0.58	0.57	0.50	0.85	0.58	0.55	0.50	0.36	0.18	0.12
	İ	0.00	-0.20	-0.14	-0.14	0.10	0.16	0.26	0.10	0.41	0.30	0.34	0.24	0.02	0.02
	A	0.92	0.92	1.00	1.00	0.72	0.64	0.55	0.99	0.67	0.64	0.52	0.51	0.26	0.11
GBR	**T**	0.92	0.92	1.00	1.00	0.75	0.72	0.62	0.99	0.73	0.68	0.67	0.52	0.27	0.18
	İ	0.00	0.00	0.00	0.00	0.03	0.08	0.07	0.01	0.06	0.03	0.15	0.00	0.00	0.07
	A	0.95	0.97	1.00	1.00	0.79	0.74	0.66	0.91	0.69	0.75	0.66	0.46	0.32	0.31
USA	**T**	0.95	0.96	1.00	1.00	0.90	0.87	0.71	0.98	0.87	0.80	0.77	0.79	0.45	0.37
	İ	0.00	-0.01	0.00	0.00	0.11	0.13	0.05	0.07	0.17	0.06	0.12	0.33	0.13	0.06
	A	0.87	0.93	0.93	0.93	0.38	0.34	0.42	0.60	0.44	0.32	0.32	0.18	0.28	0.19
URY	**T**	0.87	0.90	0.93	0.93	0.80	0.78	0.64	0.91	0.77	0.71	0.68	0.66	0.42	0.29
	İ	0.00	0.00	-0.03	0.00	0.41	0.44	0.22	0.31	0.34	0.40	0.36	0.48	0.14	0.10

Targeted, actual and improvement values for inputs and outputs used in upper- middle income countries are presented in Table 8. For example, when ALB, which represents the Albenia decision unit, is

examined, it is seen that there should be a decrease in inputs and an increase in outputs. While the targeted value for the I1 variable is 0.31 units, the actual value is 0.78. In this context, 0.47 units of surplus value emerged. Based on this, it is necessary to reduce the I1, I2, I3 and I4 variables by 0.47, 0.54, 0.63 and 0.62 units, respectively. It is necessary to increase the O1 variable by 0.10 units, the 02 variable by 0.15 units, the O4 variable by 0.12 units, the O7 variable by 0.13 units, the O8 variable by 0.15 units, and the O9 and O10 variables by 0.08 units.

Table 8: Actual, targeted and improvement values of inputs and outputs in upper-middle income countries

		I1	I2	I3	I4	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
ALB	**A**	0.78	0.91	1.00	0.99	0.13	0.08	0.13	0.18	0.28	0.17	0.05	0.04	0.09	0.02
	T	0.31	0.37	0.37	0.37	0.23	0.22	0.13	0.30	0.28	0.18	0.18	0.19	0.17	0.10
	İ	-0.47	-0.54	-0.63	-0.62	0.10	0.15	0.00	0.12	0.00	0.00	0.13	0.15	0.08	0.08
ARG	**A**	0.85	0.92	0.99	0.99	0.31	0.34	0.32	0.59	0.37	0.32	0.32	0.28	0.27	0.17
	T	0.64	0.71	0.74	0.74	0.43	0.38	0.33	0.59	0.41	0.35	0.37	0.32	0.28	0.17
	İ	-0.21	-0.22	-0.25	-0.24	0.12	0.05	0.01	0.00	0.03	0.03	0.05	0.04	0.00	0.00
ARM	**A**	0.82	0.94	1.00	1.00	0.22	0.16	0.28	0.40	0.31	0.16	0.20	0.15	0.07	0.17
	T	0.53	0.60	0.64	0.64	0.34	0.29	0.28	0.47	0.34	0.23	0.29	0.23	0.15	0.17
	İ	-0.29	-0.34	-0.36	-0.36	0.13	0.13	0.00	0.07	0.03	0.08	0.10	0.08	0.08	0.00
BIH	**A**	0.92	0.95	1.00	1.00	0.35	0.18	0.21	0.51	0.55	0.31	0.13	0.07	0.07	0.10
	T	0.54	0.67	0.67	0.67	0.41	0.43	0.21	0.54	0.55	0.34	0.32	0.39	0.37	0.18
	İ	-0.38	-0.28	-0.33	-0.33	0.06	0.25	0.00	0.03	0.00	0.03	0.18	0.32	0.30	0.08
BGR	**A**	0.89	0.96	1.00	1.00	0.46	0.36	0.26	0.68	0.53	0.39	0.32	0.21	0.20	0.15
	T	0.73	0.82	0.82	0.80	0.54	0.52	0.28	0.68	0.53	0.50	0.49	0.54	0.48	0.18
	İ	-0.16	-0.14	-0.18	-0.20	0.09	0.17	0.02	0.00	0.00	0.11	0.17	0.33	0.28	0.03
COL	**A**	0.61	0.92	1.00	1.00	0.21	0.20	0.19	0.42	0.33	0.15	0.19	0.21	0.12	0.10
	T	0.40	0.55	0.64	0.59	0.31	0.25	0.19	0.42	0.34	0.17	0.19	0.27	0.17	0.10
	İ	-0.21	-0.37	-0.36	-0.41	0.10	0.05	0.00	0.00	0.01	0.02	0.00	0.07	0.05	0.00
CRI	**A**	0.83	0.95	0.98	0.94	0.37	0.36	0.18	0.53	0.38	0.23	0.33	0.33	0.22	0.20
	T	0.56	0.65	0.65	0.64	0.42	0.40	0.20	0.53	0.49	0.32	0.34	0.40	0.33	0.20
	İ	-0.27	-0.31	-0.33	-0.31	0.05	0.04	0.03	0.00	0.11	0.09	0.02	0.07	0.11	0.00
DOM	**A**	0.71	0.83	1.00	1.00	0.16	0.11	0.22	0.26	0.27	0.08	0.09	0.08	0.05	0.04
	T	0.41	0.48	0.51	0.51	0.27	0.22	0.22	0.37	0.27	0.18	0.23	0.19	0.11	0.13
	İ	-0.30	-0.35	-0.48	-0.49	0.12	0.12	0.00	0.11	0.00	0.10	0.14	0.11	0.07	0.10
ECU	**A**	0.70	0.89	0.96	0.95	0.20	0.17	0.23	0.40	0.25	0.13	0.17	0.14	0.08	0.07
	T	0.44	0.56	0.60	0.59	0.29	0.24	0.23	0.40	0.30	0.18	0.25	0.21	0.10	0.14
	İ	-0.26	-0.33	-0.36	-0.36	0.08	0.07	0.00	0.00	0.05	0.05	0.08	0.07	0.02	0.07
GAB	**A**	0.74	0.94	0.99	0.98	0.09	0.08	0.12	0.62	0.42	0.10	0.41	0.51	0.15	0.28

	T	0.72	0.83	0.82	0.81	0.54	0.52	0.25	0.68	0.65	0.40	0.44	0.51	0.41	0.28
	İ	-0.02	-0.11	-0.17	-0.17	0.45	0.44	0.13	0.05	0.23	0.30	0.03	0.00	0.26	0.00
	A	0.80	0.91	1.00	1.00	0.35	0.27	0.24	0.46	0.47	0.15	0.25	0.19	0.14	0.19
GEO	**T**	0.55	0.64	0.66	0.65	0.40	0.38	0.24	0.53	0.47	0.30	0.32	0.33	0.29	0.19
	İ	-0.25	-0.27	-0.34	-0.35	0.05	0.11	0.00	0.06	0.00	0.15	0.06	0.15	0.15	0.00
	A	0.73	0.85	1.00	0.97	0.02	0.01	0.04	0.10	0.08	0.21	0.06	0.06	0.05	0.01
IRQ	**T**	0.22	0.27	0.27	0.27	0.17	0.18	0.10	0.22	0.14	0.21	0.16	0.18	0.20	0.01
	İ	-0.50	-0.59	-0.73	-0.70	0.15	0.17	0.06	0.12	0.06	0.00	0.10	0.12	0.15	0.00
	A	0.71	0.85	1.00	0.99	0.22	0.19	0.12	0.40	0.32	0.16	0.12	0.11	0.10	0.08
JAM	**T**	0.41	0.49	0.49	0.48	0.31	0.32	0.17	0.40	0.32	0.31	0.27	0.32	0.31	0.08
	İ	-0.30	-0.36	-0.52	-0.51	0.10	0.13	0.05	0.00	0.00	0.15	0.15	0.21	0.22	0.00
	A	0.89	1.00	1.00	1.00	0.14	0.07	0.10	0.21	0.27	0.14	0.10	0.05	0.06	0.05
JOR	**T**	0.26	0.32	0.32	0.32	0.20	0.21	0.10	0.26	0.27	0.17	0.15	0.19	0.19	0.09
	İ	-0.63	-0.68	-0.68	-0.68	0.07	0.14	0.00	0.05	0.00	0.02	0.06	0.15	0.13	0.04
	A	0.97	0.99	1.00	1.00	0.06	0.01	0.03	0.06	0.10	0.07	0.01	0.01	0.00	0.00
LBN	**T**	0.10	0.13	0.13	0.13	0.08	0.08	0.04	0.10	0.10	0.07	0.06	0.08	0.08	0.03
	İ	-0.87	-0.86	-0.87	-0.87	0.02	0.07	0.01	0.05	0.00	0.00	0.06	0.07	0.07	0.03
	A	0.81	0.92	0.99	0.99	0.46	0.34	0.20	0.64	0.67	0.19	0.19	0.31	0.17	0.09
MUS	**T**	0.64	0.80	0.79	0.79	0.50	0.53	0.24	0.64	0.67	0.41	0.38	0.48	0.46	0.22
	İ	-0.17	-0.12	-0.20	-0.20	0.04	0.19	0.04	0.00	0.00	0.22	0.19	0.17	0.28	0.13
	A	0.84	0.92	1.00	1.00	0.34	0.25	0.13	0.48	0.49	0.25	0.21	0.11	0.08	0.12
MDA	**T**	0.48	0.59	0.59	0.58	0.37	0.39	0.18	0.48	0.49	0.30	0.28	0.35	0.34	0.17
	İ	-0.36	-0.33	-0.42	-0.42	0.03	0.14	0.05	0.00	0.00	0.05	0.07	0.24	0.26	0.04
	A	0.88	0.95	1.00	1.00	0.37	0.30	0.22	0.66	0.49	0.31	0.28	0.08	0.12	0.22
MKD	**T**	0.72	0.79	0.82	0.81	0.49	0.44	0.34	0.66	0.49	0.38	0.42	0.39	0.31	0.22
	İ	-0.17	-0.16	-0.18	-0.19	0.13	0.13	0.12	0.00	0.00	0.07	0.14	0.31	0.18	0.00
	A	0.57	0.80	0.96	0.95	0.20	0.17	0.10	0.29	0.24	0.14	0.18	0.19	0.13	0.11
PAN	**T**	0.30	0.36	0.36	0.35	0.23	0.23	0.11	0.29	0.29	0.18	0.18	0.22	0.19	0.11
	İ	-0.27	-0.44	-0.60	-0.60	0.03	0.06	0.01	0.00	0.05	0.04	0.00	0.03	0.06	0.00
	A	0.67	0.87	0.89	0.87	0.23	0.20	0.22	0.38	0.34	0.16	0.20	0.19	0.15	0.12
PER	**T**	0.45	0.54	0.59	0.58	0.32	0.27	0.22	0.43	0.34	0.19	0.23	0.24	0.17	0.14
	İ	-0.22	-0.33	-0.29	-0.29	0.09	0.07	0.00	0.06	0.00	0.03	0.04	0.05	0.01	0.03
	A	0.72	0.89	1.00	0.95	0.07	0.07	0.14	0.41	0.31	0.07	0.11	0.22	0.06	0.06
PRY	**T**	0.41	0.50	0.52	0.52	0.32	0.29	0.16	0.41	0.32	0.26	0.25	0.31	0.27	0.06
	İ	-0.32	-0.39	-0.47	-0.43	0.24	0.22	0.02	0.00	0.01	0.19	0.14	0.09	0.21	0.00
	A	0.86	0.96	1.00	1.00	0.40	0.33	0.19	0.56	0.46	0.37	0.34	0.17	0.23	0.18
ROU	**T**	0.60	0.67	0.67	0.66	0.45	0.43	0.23	0.56	0.46	0.38	0.39	0.44	0.37	0.18
	İ	-0.25	-0.28	-0.33	-0.34	0.05	0.09	0.03	0.00	0.00	0.01	0.05	0.27	0.14	0.01

Targeted, actual and improvement values for the inputs and outputs used in the study for low and lower-middle income countries are presented in Table 9. According to Table 9, DZA, which represents the Algenia decision unit, should decrease inputs and increase outputs. Because it appears that the actual values for the inputs are above the targeted values. While the targeted value for the I1 variable is 0.26 units, the actual value is 0.83 units. As a result, the variable I1 must be reduced by 0.57 units, the variable I2 by 0.64 units, and the variable I3 and I4 by 0.66 units. It is necessary to increase the O1 variable by 0.13 units, the O2 variable by 0.19 units, the O3 variable by 0.08 units, the O4 variable by 0.16 units, the O6 variable by 0.05 units, the O7 variable by 0.10 units, the O8 variable by 0.16 units, the O9 variable by 0.14 units, and the O10 variable by 0.09 units.

Table 9: Actual, targeted and improvement values of inputs and outputs in low and lower-middle income countries

		I1	I2	I3	I4	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
DZA	**A**	0.83	0.95	0.98	0.98	0.11	0.04	0.04	0.13	0.30	0.08	0.04	0.05	0.04	0.01
	T	0.26	0.31	0.32	0.32	0.24	0.23	0.11	0.29	0.30	0.14	0.14	0.21	0.18	0.10
	İ	-0.57	-0.64	-0.66	-0.66	0.13	0.19	0.08	0.16	0.00	0.05	0.10	0.16	0.14	0.09
BGD	**A**	0.27	0.79	1.00	0.98	0.06	0.04	0.16	0.41	0.26	0.03	0.11	0.18	0.02	0.11
	T	0.21	0.51	0.66	0.61	0.10	0.09	0.16	0.41	0.27	0.07	0.20	0.32	0.10	0.17
	İ	-0.06	-0.28	-0.34	-0.37	0.04	0.05	0.00	0.00	0.01	0.04	0.10	0.14	0.08	0.06
BEM	**A**	0.29	0.72	0.98	0.80	0.06	0.06	0.11	0.42	0.25	0.04	0.07	0.31	0.04	0.05
	T	0.22	0.56	0.72	0.62	0.09	0.08	0.15	0.42	0.27	0.06	0.19	0.31	0.08	0.16
	İ	-0.07	-0.17	-0.26	-0.18	0.03	0.03	0.04	0.00	0.02	0.02	0.12	0.00	0.04	0.11
BOL	**A**	0.81	1.00	1.00	0.88	0.18	0.17	0.20	0.48	0.32	0.12	0.14	0.15	0.08	0.08
	T	0.39	0.56	0.59	0.52	0.28	0.27	0.20	0.48	0.43	0.16	0.23	0.38	0.25	0.17
	İ	-0.43	-0.45	-0.41	-0.36	0.10	0.10	0.00	0.00	0.11	0.04	0.10	0.23	0.17	0.09
BFA	**A**	0.24	0.76	0.93	0.53	0.06	0.07	0.09	0.31	0.17	0.05	0.1	0.23	0.04	0.06
	T	0.24	0.76	0.93	0.53	0.06	0.07	0.09	0.31	0.17	0.05	0.10	0.23	0.04	0.06
	İ	0.18	0.41	0.50	0.41	0.07	0.07	0.12	0.31	0.21	0.05	0.14	0.24	0.07	0.11
KHM	**A**	-0.06	-0.35	-0.42	-0.12	0.02	0.00	0.03	0.00	0.04	0.00	0.04	0.01	0.03	0.05
	T	0.69	0.81	1.00	0.96	0.10	0.05	0.31	0.19	0.15	0.04	0.03	0.04	0.01	0.01
	İ	0.37	0.66	0.76	0.74	0.21	0.20	0.31	0.59	0.44	0.13	0.35	0.54	0.27	0.24
COG	**A**	-0.32	-0.16	-0.24	-0.22	0.11	0.15	0.00	0.40	0.29	0.08	0.33	0.50	0.26	0.22
	T	0.30	0.71	0.88	0.87	0.04	0.05	0.10	0.43	0.23	0.05	0.10	0.30	0.06	0.03
	İ	0.23	0.53	0.67	0.63	0.11	0.10	0.18	0.43	0.29	0.08	0.22	0.34	0.12	0.17
CIV	**A**	-0.07	-0.18	-0.21	-0.25	0.07	0.05	0.08	0.00	0.06	0.03	0.12	0.04	0.05	0.14
	T	0.31	0.83	0.98	0.96	0.07	0.07	0.08	0.46	0.28	0.06	0.19	0.26	0.04	0.14

	İ	0.24	0.58	0.75	0.69	0.11	0.10	0.18	0.46	0.31	0.08	0.23	0.36	0.11	0.19
EGY	**A**	-0.07	-0.25	-0.23	-0.27	0.04	0.04	0.11	0.00	0.03	0.02	0.03	0.10	0.07	0.05
	T	0.38	0.81	1.00	1.00	0.03	0.02	0.08	0.08	0.17	0.03	0.01	0.03	0.01	0.00
	İ	0.13	0.28	0.34	0.33	0.06	0.06	0.08	0.22	0.17	0.03	0.07	0.18	0.05	0.06
SLV	**A**	-0.24	-0.53	-0.66	-0.67	0.03	0.04	0.00	0.14	0.00	0.01	0.06	0.15	0.04	0.06
	T	0.63	0.85	0.98	0.92	0.08	0.07	0.11	0.19	0.20	0.09	0.08	0.09	0.07	0.05
	İ	0.19	0.26	0.28	0.28	0.15	0.14	0.11	0.24	0.22	0.09	0.13	0.19	0.13	0.09
GIN	**A**	-0.44	-0.59	-0.70	-0.64	0.06	0.07	0.00	0.05	0.02	0.00	0.05	0.11	0.06	0.04
	T	0.30	0.80	0.88	0.40	0.03	0.03	0.08	0.25	0.17	0.04	0.04	0.16	0.05	0.03
	İ	0.18	0.34	0.38	0.24	0.06	0.06	0.09	0.25	0.18	0.04	0.10	0.21	0.07	0.07
HND	**A**	-0.12	-0.46	-0.50	-0.16	0.03	0.03	0.02	0.00	0.02	0.00	0.06	0.05	0.02	0.05
	T	0.55	0.77	0.89	0.82	0.06	0.05	0.11	0.28	0.15	0.08	0.11	0.13	0.04	0.07
	İ	0.22	0.31	0.33	0.33	0.17	0.16	0.13	0.28	0.25	0.10	0.15	0.22	0.15	0.11
IND	**A**	-0.33	-0.46	-0.56	-0.49	0.11	0.11	0.02	0.00	0.10	0.02	0.04	0.09	0.11	0.03
	T	0.28	0.66	0.99	0.99	0.16	0.12	0.13	0.25	0.19	0.08	0.10	0.10	0.08	0.05
	İ	0.20	0.34	0.41	0.40	0.16	0.15	0.13	0.29	0.24	0.08	0.15	0.23	0.14	0.11
IDN	**A**	-0.07	-0.32	-0.59	-0.59	0.00	0.03	0.00	0.04	0.04	0.00	0.05	0.12	0.06	0.06
	T	0.51	0.73	0.98	0.94	0.09	0.12	0.13	0.29	0.23	0.18	0.08	0.08	0.06	0.06
	İ	0.35	0.42	0.43	0.43	0.33	0.31	0.15	0.39	0.40	0.18	0.19	0.28	0.25	0.14
KGZ	**A**	-0.15	-0.31	-0.55	-0.51	0.24	0.19	0.02	0.10	0.17	0.00	0.11	0.20	0.18	0.08
	T	0.85	0.91	0.99	0.91	0.15	0.11	0.18	0.26	0.25	0.10	0.09	0.12	0.06	0.06
	İ	0.27	0.44	0.49	0.44	0.15	0.15	0.18	0.37	0.28	0.10	0.21	0.31	0.16	0.14
LAO	**A**	-0.57	-0.48	-0.51	-0.47	0.00	0.03	0.00	0.11	0.03	0.00	0.13	0.19	0.10	0.08
	T	0.48	0.83	0.95	0.85	0.12	0.09	0.09	0.16	0.13	0.10	0.09	0.08	0.06	0.03
	İ	0.20	0.24	0.25	0.25	0.17	0.16	0.09	0.22	0.22	0.10	0.11	0.17	0.14	0.08
LBR	**A**	-0.29	-0.58	-0.70	-0.60	0.05	0.07	0.00	0.07	0.09	0.00	0.02	0.09	0.07	0.05
	T	0.27	0.64	0.76	0.63	0.08	0.08	0.17	0.43	0.28	0.07	0.07	0.22	0.05	0.04
	İ	0.25	0.55	0.69	0.58	0.11	0.10	0.17	0.43	0.29	0.07	0.20	0.34	0.11	0.16
MWI	**A**	-0.02	-0.09	-0.07	-0.05	0.03	0.02	0.00	0.00	0.02	0.00	0.13	0.12	0.06	0.12
	T	0.21	0.62	0.86	0.84	0.07	0.07	0.10	0.37	0.23	0.02	0.10	0.25	0.07	0.08
	İ	0.18	0.50	0.67	0.61	0.08	0.07	0.12	0.38	0.23	0.05	0.17	0.26	0.07	0.15
MLI	**A**	-0.03	-0.11	-0.20	-0.24	0.01	0.00	0.02	0.01	0.00	0.04	0.07	0.01	0.00	0.07
	T	0.26	0.71	1.00	0.68	0.09	0.10	0.13	0.34	0.28	0.03	0.09	0.26	0.09	0.06
	İ	0.22	0.49	0.61	0.58	0.10	0.10	0.14	0.39	0.28	0.06	0.16	0.30	0.09	0.13
MAR	**A**	-0.04	-0.21	-0.39	-0.10	0.01	0.00	0.01	0.05	0.00	0.03	0.06	0.04	0.00	0.07
	T	0.67	1.00	1.00	0.99	0.12	0.10	0.05	0.20	0.21	0.10	0.07	0.06	0.04	0.03
	İ	0.19	0.23	0.24	0.24	0.17	0.16	0.08	0.21	0.21	0.10	0.10	0.15	0.13	0.08
MMR	**A**	-0.48	-0.77	-0.76	-0.76	0.06	0.06	0.03	0.01	0.00	0.00	0.03	0.09	0.09	0.05
	T	0.74	0.96	0.96	0.94	0.19	0.17	0.10	0.37	0.21	0.20	0.17	0.26	0.10	0.03

	İ	0.38	0.46	0.46	0.46	0.35	0.33	0.17	0.42	0.43	0.20	0.20	0.31	0.27	0.15
	A	-0.36	-0.50	-0.50	-0.48	0.16	0.16	0.07	0.05	0.22	0.00	0.04	0.05	0.17	0.12
NPL	T	0.40	0.80	0.93	0.54	0.09	0.07	0.15	0.19	0.19	0.04	0.06	0.09	0.04	0.03
	İ	0.26	0.47	0.52	0.35	0.10	0.10	0.15	0.36	0.27	0.06	0.16	0.31	0.12	0.11
	A	-0.14	-0.32	-0.41	-0.19	0.01	0.03	0.00	0.18	0.07	0.02	0.10	0.23	0.09	0.08
NIC	T	0.50	0.70	0.73	0.72	0.04	0.04	0.12	0.18	0.10	0.07	0.07	0.05	0.04	0.03
	İ	0.17	0.28	0.31	0.31	0.12	0.11	0.12	0.25	0.20	0.07	0.14	0.22	0.13	0.10
	A	-0.33	-0.42	-0.42	-0.41	0.07	0.07	0.00	0.07	0.10	0.00	0.07	0.17	0.08	0.07
NGA	T	0.25	0.73	0.93	0.85	0.22	0.15	0.07	0.29	0.25	0.03	0.08	0.17	0.06	0.04
	İ	0.24	0.34	0.40	0.40	0.22	0.20	0.11	0.29	0.27	0.11	0.14	0.21	0.16	0.11
	A	-0.01	-0.39	-0.53	-0.45	0.00	0.06	0.04	0.00	0.02	0.08	0.06	0.04	0.10	0.07
PAK	T	0.30	0.63	0.89	0.78	0.02	0.02	0.04	0.15	0.08	0.01	0.06	0.06	0.00	0.03
	İ	0.09	0.18	0.22	0.21	0.04	0.04	0.07	0.15	0.11	0.03	0.08	0.13	0.05	0.06
	A	-0.22	-0.45	-0.67	-0.57	0.02	0.02	0.03	0.00	0.02	0.02	0.02	0.07	0.05	0.03
PHL	T	0.77	0.92	0.99	0.96	0.19	0.18	0.19	0.39	0.29	0.36	0.21	0.27	0.12	0.12
	İ	-0.07	-0.09	-0.14	-0.11	0.45	0.42	0.11	0.38	0.5	0	0.2	0.29	0.36	0.16
	A	0.51	0.83	0.99	0.99	0.1	0.11	0.13	0.51	0.35	0.12	0.2	0.4	0.08	0.14
SEN	T	0.70	0.83	0.85	0.85	0.64	0.60	0.30	0.77	0.79	0.36	0.37	0.56	0.48	0.28
	İ	-0.07	-0.09	-0.14	-0.11	0.45	0.42	0.11	0.38	0.50	0.00	0.16	0.29	0.36	0.16
	A	0.51	0.83	0.99	0.99	0.10	0.11	0.13	0.51	0.35	0.12	0.20	0.40	0.08	0.14
SLE	T	0.34	0.56	0.63	0.62	0.22	0.22	0.25	0.51	0.41	0.13	0.29	0.44	0.25	0.20
	İ	-0.16	-0.27	-0.36	-0.38	0.12	0.10	0.12	0.00	0.05	0.02	0.09	0.04	0.17	0.06
	A	0.22	0.59	0.93	0.80	0.03	0.03	0.06	0.25	0.15	0.01	0.04	0.20	0.03	0.04
LKA	T	0.13	0.35	0.46	0.42	0.06	0.05	0.10	0.27	0.17	0.04	0.12	0.20	0.05	0.11
	İ	-0.09	-0.24	-0.47	-0.38	0.03	0.02	0.04	0.02	0.02	0.03	0.08	0.00	0.02	0.07
	A	0.53	0.96	0.99	0.96	0.20	0.13	0.22	0.44	0.30	0.11	0.09	0.07	0.05	0.03
TJK	T	0.30	0.49	0.55	0.54	0.20	0.19	0.22	0.44	0.35	0.12	0.25	0.38	0.22	0.17
	İ	-0.23	-0.47	-0.44	-0.42	0.00	0.06	0.00	0.00	0.06	0.01	0.16	0.31	0.17	0.14
	A	0.38	0.82	0.90	0.90	0.06	0.03	0.13	0.23	0.20	0.01	0.04	0.04	0.01	0.02
TGO	T	0.16	0.32	0.38	0.37	0.09	0.08	0.13	0.27	0.20	0.05	0.14	0.23	0.10	0.10
	İ	-0.22	-0.50	-0.52	-0.53	0.03	0.05	0.00	0.05	0.00	0.04	0.10	0.20	0.09	0.08
	A	0.27	0.68	0.98	0.97	0.06	0.05	0.08	0.42	0.25	0.02	0.12	0.33	0.02	0.07
TUN	T	0.22	0.56	0.74	0.68	0.10	0.09	0.17	0.44	0.28	0.07	0.21	0.33	0.09	0.18
	İ	-0.05	-0.12	-0.24	-0.29	0.05	0.04	0.08	0.02	0.03	0.06	0.09	0.00	0.07	0.11
	A	0.62	0.88	0.99	0.99	0.10	0.06	0.10	0.16	0.20	0.17	0.03	0.05	0.03	0.01
UGA	T	0.33	0.39	0.40	0.40	0.30	0.28	0.14	0.36	0.37	0.17	0.17	0.26	0.23	0.13
	İ	-0.30	-0.48	-0.59	-0.59	0.20	0.23	0.04	0.21	0.17	0.00	0.14	0.21	0.20	0.12
	A	0.41	0.76	0.98	0.85	0.15	0.15	0.29	0.61	0.43	0.09	0.25	0.48	0.08	0.21
UZB	T	0.37	0.69	0.81	0.77	0.20	0.20	0.31	0.61	0.45	0.13	0.35	0.54	0.26	0.24

	İ	-0.04	-0.07	-0.18	-0.08	0.05	0.05	0.02	0.00	0.02	0.04	0.10	0.06	0.19	0.04
	A	0.59	0.75	0.99	0.95	0.24	0.20	0.08	0.39	0.25	0.06	0.16	0.10	0.11	0.13
ZMB	**T**	0.34	0.43	0.45	0.45	0.29	0.27	0.16	0.39	0.38	0.16	0.20	0.30	0.24	0.15
	İ	-0.25	-0.33	-0.55	-0.51	0.05	0.08	0.09	0.00	0.14	0.11	0.04	0.20	0.13	0.02

CONCLUSION AND POLICY IMPLICATIONS

The distribution of financial offerings and solutions through internet and mobile applications within virtual environments offers opportunities to reduce physical and cost barriers to accessing these products and services. Assessing the success of this opportunity at the inclusion level of the financial system is the subject of this study. In this respect, the study aims to determine the success, in other words, the efficiency of digitalization practices offered with the advancing technological infrastructure at the inclusion level of the financial system at the country level. In the other words, it was investigated whether the digital applications of countries, which are seen as an important element in the development of the financial system, are successful in financial inclusion. In this context, the study is important because it examines digital technologies, which are increasingly important in today's conditions, in terms of financial inclusion.

DEA was used in the study covering 2021. In the analysis process of the study, decision-making units were first identified. Since the study has been analyzed at the country level, the decision-making units consist of countries. Considering that income level might be a significant factor, countries were analyzed by dividing them into groups according to the World Bank's classification criteria. This classification was made in accordance with the nature of DEA (in terms of the number of decision-making units) according to three different groups: high, upper-middle, low and low-middle income. Secondly, input and output variables were determined. Global Findex Database was used to obtain data regarding the variables. Finally, in measuring the efficiency of countries in terms of financial inclusion, in other words their success, they were analyzed using variable return (BCC) and fixed return (CCR) models for output, in the context of evaluating digital services usage indicators. Efficient countries were identified for three different country groups, determined within the framework of both models. Then, the improvement values for the inputs and outputs of all decision-making units for the inefficient countries were calculated and evaluated.

Based on the findings of efficiency analysis, digital efficiency in financial inclusion was detected in 25 countries based on variable returns and 18 countries based on constant returns in high-income countries. In upper-middle-income countries, digital efficiency in financial inclusion was identified in 12 countries based on variable returns and 9 countries based on constant returns. In low and low-middle-income countries, digital efficiency in financial inclusion was detected in 16 countries based on variable returns and 9 countries based on constant returns. The group of countries with the highest number of effective countries

was the high-income country group. In this context, it was concluded that the reason for inefficiency in inefficient countries may be optimal scale, or in other words, the underutilization of capacity. For countries where efficiency could not be determined, potential improvement values were determined by calculating the targeted and actual values within the scope of the inputs and outputs used in the study. At this point, the calculated values can contribute to the point of accessing efficiency for countries that are not fully efficient.

It is concluded that increasing the output variables related to the use of digital financial services in high-income countries stands out within the scope of potential improvement values. The issue of reducing input variables related to access to digital financial services was found to be prominent in the group of upper-middle-income and low and lower-middle-income countries.

Looking at the proportion of the number of countries in the class and the number of countries identified as efficient, it has been concluded that in the high-income group, 60.9% based on variable returns and 43.9% based on constant returns, in the upper-middle-income group, 37.5% based on variable returns and 28.1% based on constant returns, and in the low and lower-middle-income group, 36.3% based on variable returns and 20.4% based on constant returns were identified as active. The group of countries possessing the greatest overall efficiency rate for inefficient countries is also high-income nations.

The findings derived from the analysis point out that digital efficiency in financial inclusion is connected to the income level of nations. In other words, adoption and utilization of digital financial offerings and solutions has the potential to be related to the income group of the nations. Therefore, specifically for countries in the low-income group, it is seen as an important issue for policymakers to first identify the obstacles to financial inclusion and develop strategies accordingly. At this point, it is very important to develop digital infrastructure such as internet and telecommunications. The internet and telecommunication infrastructure regarding digitalization should be at a level that covers low-income individuals and households, and financial products and services should be developed for these individuals. Raising awareness about digital literacy is also an issue that should be taken into account in improving the level of financial inclusion.

This study was conducted in the context of countries where input and output variables are accessible. For the countries discussed according to income groups, the World Bank classification was used. However, in the data envelopment analysis used in the study, countries were considered as three groups: high, upper-middle, low and lower-middle income, rather than four groups, in the context of the importance of the number of inputs and outputs in relation to the number of decision-making units. In addition, the results of the study cover the resources and outcomes of the examined decision-crafting entities for the year 2021.

Therefore, it is possible that the efficiency results may vary for different inputs and outputs and different years. These are reveal the limitations of this study.

In future studies, efficiency measurement can be conducted for countries based on their level of development or different inputs, outputs and years.

In this respect, the study differs from the study of Korynski and Pytkowska (2016), which obtained financial inclusion scores by using DEA to explain the differences among European Union countries. It is also similar to the study of Korynski and Pytkowska (2016) in addressing the transformation of inputs into the use of financial services within the scope of efficiency analysis.

AUTHOR STATEMENT / YAZAR BEYANI

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