

THE ROLE OF ICT REGULATIONS IN AGRIBUSINESS AND RURAL DEVELOPMENT

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Abstract

Information and Communication Technology (ICT) supports farmers by facilitating access to markets through real-time data on market prices, weather forecasts, information on pests, seed varieties and planting techniques (Ogotu et al., 2014). Ultimately, the use of ICT-enabled solutions stimulates improvements in agricultural productivity and growth in farmers' income (Lio and Liu, 2006). A major impediment for smallholder farmers to fully exploit the benefits of ICT is the lack of sufficient infrastructure and mobile networks in rural areas. A reason for this persisting network coverage gap stems from the significant capital investments required for providing widespread ICT access, which mobile operators have often little incentive to make since the potential profit margins in rural areas are relatively low (Kendal and Singh, 2012).

On one hand, carefully designed government policies and regulations can promote greater ICT penetration and the provision of ICT services by private sector actors including mobile operators. On the other hand, cumbersome regulation of the ICT sector can hinder competition and inhibit the creation of innovative solutions that are responsive to users' needs.

This paper explores the relationship between regulations and ICT development indicators. The data on ICT regulations across 62 countries is part of a larger primary data set collected in 2016, which focuses on legal barriers for businesses that are relevant to and operate within agricultural value chains.

The results suggest that higher quality regulatory frameworks for ICT are associated with higher mobile internet market penetration and better developed ICT infrastructure. Countries with few regulatory incentives to improve mobile connectivity show significantly weaker performance on ICT development metrics. The type of licensing regime and the efficiency of spectrum allocation can play an important role in encouraging the private sector to invest and roll out mobile networks in rural areas. As experienced by European Union (EU) countries, greater liberalization of the ICT sector promotes ubiquitous connectivity.

Introduction

Agriculture plays a vital role in the development of many countries. Access to markets, finance and information are cornerstones for agricultural growth. Increased incomes can only be sustained by linking farmers to markets (Magesa et al., 2014). Being imperative to rural development, information and communication technology (ICT) has immense potential to reduce poverty by integrating isolated rural populations into economies and markets (Duncombe, 2016; Qiang et al., 2012). For example, the expansion of ICT network coverage led to an 11% increase in household real consumption in rural Peru (Beuermann et al., 2012). Efficient use of ICT services help farmers to improve their commercial viability by increasing their agricultural productivity and profitability (Chatterjee and Nath, 2015; Saleminck et al., 2015).

ICT facilitates farmers' access to real-time data on agricultural practices, seed varieties, pest management, diseases outbreaks, market prices, and weather information (Ajani, 2014; Ogotu et al., 2014). This information is important for farmers to sustain and diversify their production, take well informed decisions on sale activities and negotiate better prices for agricultural products, all of which ultimately contribute to greater market participation and potentially higher incomes (Kiiza et al., 2011). In Uganda, for example, an increase in mobile network coverage from 46 to 70 percent of the population between 2003 and 2005 positively influenced market participation of farmers producing perishable crops and located in remote areas as evidenced by 20 percent increase in banana sales (Muto and Yamano, 2009).

Improved connectivity also stimulates better coordination among actors across agricultural value chains, as well as market integration and transparency of market prices (Duncombe, 2016; Trienekens, 2011). In Niger ICT-enabled access to market price information was found to reduce agricultural price dispersion across markets by 10 percent improving farmers' relative bargaining position and incomes (Magesa et al., 2014). Furthermore, ICT services improve communication of farmers with traders, suppliers, extension agents and among each other (Furuholt and Matotay, 2011).

ICT has also been linked to reduced transaction costs and inefficiencies for agribusinesses in the context of accessing agricultural input and output markets (Ajani, 2014). In particular, mobile technologies can have an even greater impact on transaction costs in remotely located markets with poorly developed transport infrastructure (Duncombe, 2016).

Despite the clear benefits of ICT to farmers and agribusinesses who are predominantly located in rural areas, access to communications is significantly more restricted in those remote communities. Only 67% of the rural population worldwide is covered by 3G signal (ITU, 2016). GSMA (2016) estimates that 1.6 billion people in rural areas do not have access to any mobile network. The most significant impediment to mobile access in rural areas is the lack of sufficient infrastructure (Sangwan and Komal, 2016; Saleminik et al., 2015). A reason for this persisting network coverage gap stems from the significant capital investments required for providing widespread ICT access, which private sector actors have often little incentive to make. The potential profit margins in rural areas are relatively low because of lower population densities (Kendal and Singh, 2012; Glass and Stefanova, 2012). This implies lower return on investment and higher costs of service provision, which might not be affordable to end-users in remote locations (Samarajiva and Zainudeen, 2010).

This paper examines the role of regulations in facilitating ICT access and ultimately rural development. The remainder of this paper is organized as follows. The next section discusses the role of an enabling environment and ICT regulations that are critical for expanding access to rural areas. The third section presents the new data set on the quality of regulations followed by the analysis of the relationship between regulations and key ICT development indicators. The final section draws some concluding remarks.

The Role of Regulations

An enabling agribusiness environment encompasses a set of laws, policies, regulations which support agricultural activities, commercialization, pro-poor growth and rural development (Konig et al., 2013). Effective regulations improve coordination along the agricultural value chain, market access, and thus, positively influence profitability of agribusinesses and agricultural productivity (Diaz-Bonilla et al., 2014; Divanbeigi and Saliola, 2017).

Agricultural value chains are complex and involve a variety of components beyond traditional inputs such as seeds or fertilizers. Agribusiness enablers, including finance, transport services, and efficient and affordable ICT, are widely understood to be important prerequisites for farmers and other agribusinesses to secure market access. Since the quality of these enablers is to a great extent determined by regulatory frameworks, it is important that applicable regulations enable relevant businesses to operate competitively and in a manner that serves social welfare goals. The impact of ICT regulations on mobile operators, and the consequent impact on rural development and economic performance is fairly underexplored in the literature. A comparative assessment of the quality of regulations has also not been possible to-date due to the lack of data (Jalilian et al., 2007). This paper contributes to the existing literature by employing a new data set that covers ICT regulatory issues specifically relevant for rural and remote areas.

ICT Regulations and Rural Development

ICT proliferation in rural areas depends on a number of factors, one of which is the enabling regulatory environment (Ajani, 2014). Regulatory stimuli can trigger telecommunication operators to accelerate network roll-outs. Thus, improving ICT infrastructure in rural areas requires policy interventions that incentivize, facilitate and potentially aggregate investments by mobile operators (Galloway and Mochrie, 2005).

Cumbersome ICT regulations can hinder competition and inhibit the creation of innovative solutions that are responsive to farmers' needs. In many developing countries legal prescriptions are ultimately constraining ICT use. The reasons for poor ICT connectivity in rural areas lie in regulatory shortcomings that prevent private sector from rural roll out of networks. Suboptimal regulatory mechanisms often restrict the expansion of ICT services to undeserved areas and limit the positive impact of ICT on agribusinesses. High transaction costs and arbitrary regulatory charges are reflected in the prohibitively high prices for end-users in rural areas (Samarajiva and Zainudeen, 2010).

On the other hand, carefully designed government policies and regulations can promote greater ICT penetration and the provision of ICT services by the private sector, even in remote areas. In order to achieve close to ubiquitous connectivity along with broader rural development objectives, it becomes important for governments to create an enabling environment which

encourages operators to roll-out networks to less profitable geographic areas, particularly rural communities that remain underdeveloped (Salemink et al., 2015).

When it comes to rural areas the deployment of fixed broadband access networks using copper or fiber is particularly difficult due to prohibitive cost (GSMA, 2016). Compared to fixed broadband mobile communication technologies are easier to access. Thus, they are considered more important for rural development (Chatterjee and Nath, 2015). Indeed, in the past few years the use of ICT in agriculture in both developed and developing countries became possible because of the proliferation of mobile technologies (Ajani, 2014; Qiang et al., 2012). Furthermore, mobile communication technologies allow for internet access via mobile phones that are more affordable for rural populations than larger electronic devices (Samarajiva and Zainudeen, 2010). As a result, mobile internet market penetration generates more substantial economic and social benefits (Buttkereit et al., 2009). For example, a 1% growth in mobile network coverage has been found to boost GDP per-capita by 5% (Chatterjee and Nath, 2015). In this respect, ICT regulations and government incentives that affect the business strategies of mobile operators deserve particular attention.

Certain telecommunication policy options can trigger higher mobile internet market penetration in rural areas. For example, the European Union (EU) regulations safeguard a free market for telecommunications to stimulate investments in less attractive geographic areas (Cambini and Jiang, 2009). Competition in the telecommunication sector is promoted through a general authorization regime which allows mobile operators to start a business with license exempt entry or a simple notification submitted to the regulatory authority as opposed to obtaining an individual operating license. These simplified entry requirements to start operations reduce regulatory barriers that could otherwise relate to discretionary, additional administrative charges or uncertainties over renewal of an operating license term.

The expansion of mobile networks to remote areas is also influenced by spectrum management regulations and policies. Spectrum type and availability have a direct impact on the maximum coverage and capacity of mobile base stations and, therefore, are determinative of the investments required to cover a certain area. Lower radio frequencies significantly reduce the capital expenditures

for base stations and provide greater coverage in rural areas. For instance, a 700 MHz spectrum decreases the number of base stations required to ensure certain network coverage by up to 65%, as compared to the 2.1 GHz spectrum (Buttkereit et al., 2009). Thus, spectrum regulations that allow mobile operators to use lower radio frequencies—which includes digital dividend previously deployed by analogue television—promote ICT development in rural areas. In addition, practices such as spectrum trading and infrastructure sharing foster efficiency by significantly reducing capital expenditures required for the provision of mobile services in rural locations. The simulation results modelled by Buttkereit et al. (2009) based on good practices with the strongest predictable impact on rural areas show that an effective ICT regulatory framework could lower a monthly per-subscriber cost for mobile services by up to 75%.

Benchmarking ICT Regulations

A new data set produced by the World Bank Group's *Enabling the Business of Agriculture (EBA)* project allows benchmarking of regulations that impact firms along the agricultural value chain. This includes agricultural input regulations such as on seeds, fertilizers, machinery and water as well as business enabling regulations covering markets, transport, finance, and ICT.

The EBA 2017 report covers 62 countries in various regions around the world (see *Annex*). Primary data is collected through a series of questionnaires completed by private and public sector experts in each country. In the ICT field this includes mobile operators, telecommunication lawyers and regulatory authorities. The data is further validated through an analysis of the relevant legislation and regulations.

The EBA ICT data set features laws and regulations that promote an enabling environment for the provision and use of ICT services, with a particular focus on rural areas. It covers information related to the licensing framework for mobile operators, spectrum management and infrastructure sharing. A complete list of issues covered by the EBA ICT indicator is presented in Table 1 below.

Table 1. Regulatory areas covered by EBA ICT indicator

Type of licensing regime
Technology and service neutrality
Validity of operating license
Transparency of operating license costs

Predictability of renewal conditions for operating and spectrum licenses
Allocation of low frequency spectrum and digital dividend
Voluntary spectrum trading
Infrastructure sharing

Individual questions on ICT regulations are assigned numerical scores ranging from 0 to 1. The scoring reflects the quality of the regulations, and is based on internationally recognized good regulatory practices that enable access to ICT in rural areas. Individual components are then normalized to a “distance to frontier” score, which captures the gap between a country’s performance and a measure of best practice across the entire sample of 62 countries. An aggregate EBA ICT score for each country is expressed on a scale from 0 to 100, where 0 represents the worst performanceⁱ.

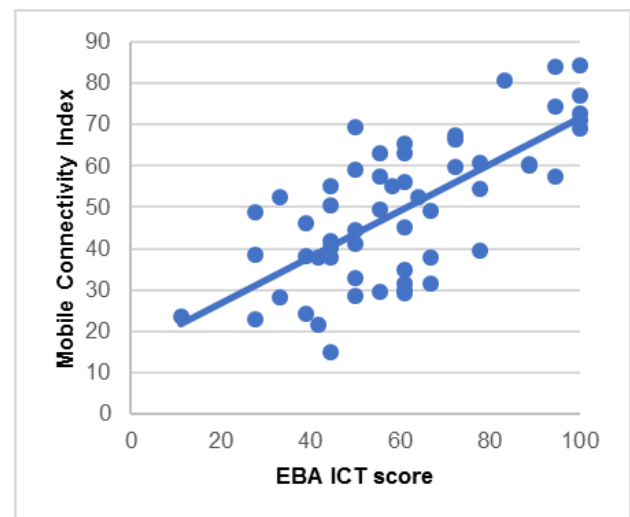
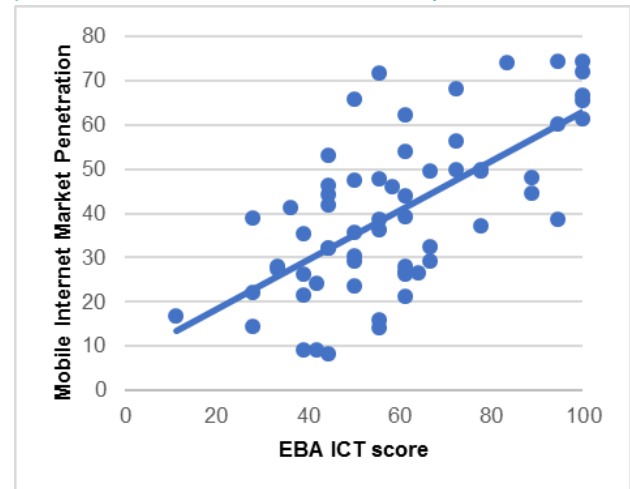
Results

The literature generally supports the idea that effective regulations of the ICT sector can trigger mobile infrastructure development and improved internet access in rural areas. In order to investigate this relationship further the correlation between the quality of ICT regulations as measured by EBA and mobile internet market penetration is explored. As expected, stronger ICT regulations conforming to global good practices are positively associated with mobile internet market penetration (Figure 1). This relationship suggests that the total number of unique mobile internet subscribers expressed as a percentage share of the total market population is higher when the regulatory framework is more effective.

A similar relationship is observed when correlating the quality of ICT regulations and the Mobile Connectivity Index. Countries with stronger ICT regulations perform better on the Mobile Connectivity Index (Figure 1). The Mobile Connectivity Index developed by GSMA measures the key enablers of universal adoption of the mobile internet across infrastructure, affordability, consumer readiness and content dimensions (GSMA, 2016). The Mobile Connectivity Index offers an aggregate measure of physical prerequisites necessary for the population to be able to access and use the mobile internet. Its positive and significant correlation (0.70) with the EBA ICT score indicates the importance of the enabling regulatory environment for the development of adequate

infrastructure and conditions promoting ubiquitous mobile connectivity.

Figure 1. ICT regulations, mobile internet market penetration, and Mobile Connectivity Index

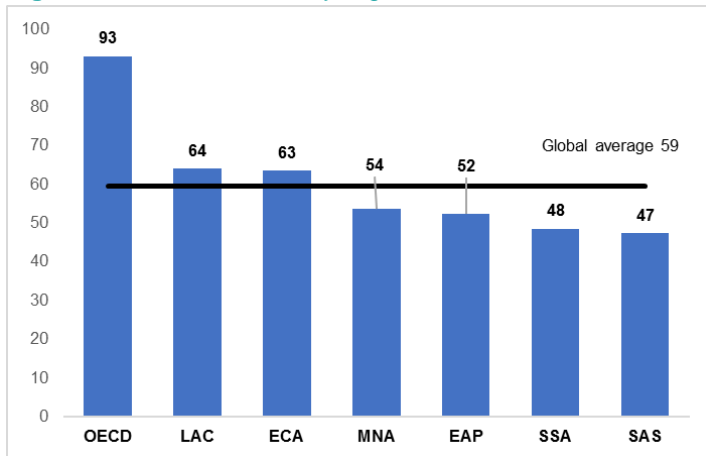


Notes: The correlation between the mobile internet market penetration and the EBA ICT score is 0.66. The correlation between the Mobile Connectivity Index (GSMA) and the EBA ICT score is 0.70. The correlations are significant at 1% after controlling for income per capita.
Source: World Bank (2017), GSMA Intelligence.

The assessment of ICT regulations in the 62 countries covered reveals certain regional trends (Figure 2). Sub-Saharan Africa, South and East Asia have the greatest potential for improvement of their regulatory environments. These regions face particular barriers related to ICT sector liberalization. None of the countries in Sub-Saharan Africa, South and East Asia adopted a general authorization regime for mobile operators to enter respective telecommunication markets. General authorization regimes incentivize competition and pose fewer administrative barriers to market entry for

telecommunication providers by reducing the regulatory burden associated with obtaining an individual operating license.

Figure 2. EBA ICT score by region



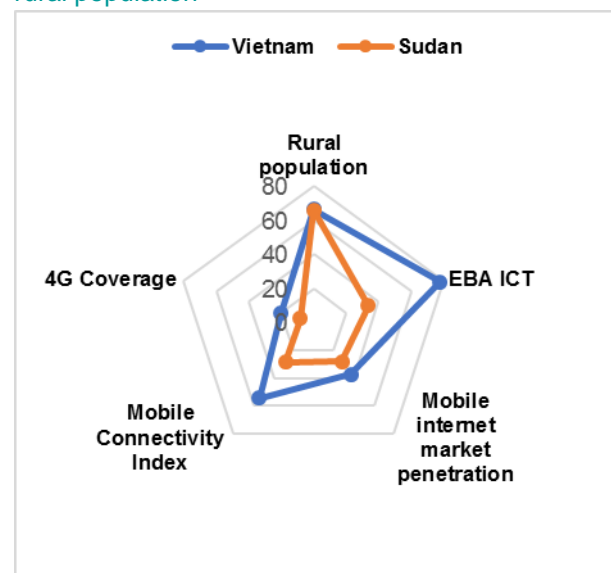
Notes: OECD- High income OECD countries, LAC - Latin America & Caribbean, ECA- Europe & Central Asia, MNA- Middle East & North Africa, EAP - East Asia & Pacific, SSA-Sub-Saharan Africa, SAS- South Asia.
Source: World Bank (2017).

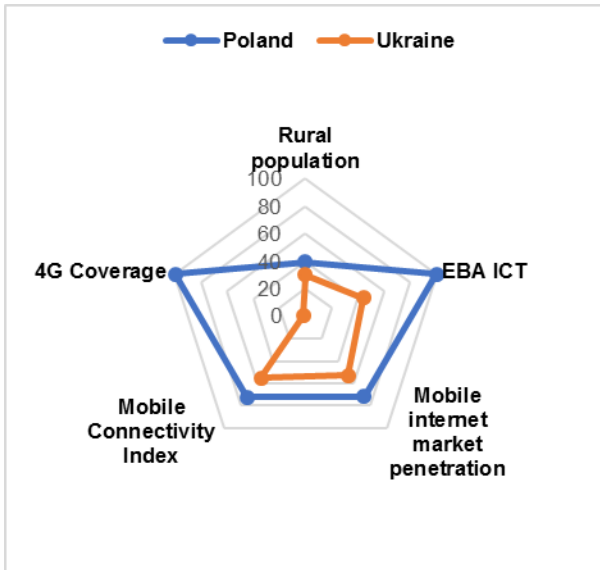
With respect to spectrum management, no country in Sub-Saharan Africa allows voluntary spectrum trading between mobile operators. As such, this prevents the efficient allocation of scarce spectrum resource, price reductions and the proliferation of new technologies. In South and East Asia the digital dividend spectrum has not been licensed to mobile operators implying that the network coverage potential in rural areas is yet to be fully realized. Indeed, countries such as Ethiopia, Burkina Faso, and Lao PDR have one of the lowest mobile internet market penetration levels - on average below 20%.

In contrast, OECD high income countries display stronger regulatory frameworks. Most of these countries have moved towards a general authorization regime reflecting more competitive and open telecommunication markets. All OECD high income countries license digital dividend frequencies to mobile operators and allow voluntary spectrum trading. The EU policy framework involves simplified and inclusive rules that promote competition. As a result, EU countries are among the top performers on the EBA ICT indicator. Countries like Denmark, the Netherlands, Spain and Poland have in place the majority of good regulatory practices, boosting ubiquitous connectivity beyond urban areas. This is also reflected in mobile internet market penetration levels, which are above 60% in these countries.

Comparing countries that have similar proportions of their population located in rural areas, it is worth noting how differences in ICT regulatory frameworks as per the EBA indicator are reflected in the varied performance on ICT development metrics (Figure 3). For example, both Vietnam and Sudan (both lower middle income countries) have approximately 66% of their population living in rural areas. However, they show a difference of around 10 percentage points when it comes to 4G coverage (20% in Vietnam vs. 8% in Sudan) and mobile internet market penetration (37% in Vietnam vs. 28% in Sudan). There is also a notable difference in the level of mobile development as reflected by the Mobile Connectivity Index (with a score of 54.42 for Vietnam as opposed to 28.38 for Sudan). Significant variance in the quality of the regulatory framework could be one explanation for these differences, given the similarities in income levels and the proportion of the rural population in each country. The EBA ICT score for Vietnam is 77.78 whereas Sudan reaches only 33.33 points. Although both countries impose individual licenses on mobile operators, the licensing framework in Sudan is not transparent: operating license costs are not publicly available, which undermines regulatory certainty and increases investment risks. With regard to spectrum management, Vietnam allows voluntary spectrum trading thereby promoting efficiency and flexibility on the use of radio frequencies. By contrast, spectrum trading is not permitted in Sudan.

Figure 3. ICT indicators in countries with comparable rural population





Source: World Bank (2017), GSMA Intelligence, World Development Indicators.

Similarly, neighboring countries Poland and Ukraine, both with approximately 30% of their populations located in rural areas, also differ in their levels of ICT development. Whereas almost universal 4G coverage has been achieved in Poland, Ukraine is just starting to roll-out 4G networks. Similarly, Poland's mobile internet market penetration is almost 20% higher than Ukraine. These differences are also reflected in the Mobile Connectivity Index where Ukraine scores 55.11, with ICT infrastructure being the weakest component, and Poland 72.71. Under EBA's ICT indicator, Poland's regulatory environment performs better than that of Ukraine (100 vs. 44.44). In line with EU regulations, Poland operates under a simple notification regime for mobile operators to enter the telecommunication market. General authorization frameworks assure greater transparency and regulatory certainty. Indeed, the requirements to complete simple notification are publicly available online and there is no time limitation on the subsequent right to operate. By contrast, Ukraine requires mobile operators to obtain an individual operating license, and that license must be renewed every 5 years. Such a short validity creates uncertainties regarding renewal and undermines long-

term planning by mobile operators. The absence of technology and service neutrality in Ukraine coupled with restrictions on spectrum trading between mobile operators is further constraining the development of advanced communication systems.

Stronger, more supportive regulatory environments for mobile operators thus are associated with more developed ICT sectors. As such, predictable legal environments and effective regulations can be understood to enable ICT proliferation and have a positive influence on rural development.

Conclusions

ICT-enabled agricultural services have proven to bring significant benefits to farmers ranging from the provision of relevant information to an increase in incomes through greater access to markets. Despite this, and despite the widespread proliferation of mobile technologies around the world, rural populations in general and farmers in particular continue to face restricted access to the internet and ICT services. The main barrier to fully realize the benefits of ICT for rural development is the network coverage gap, whereby poor infrastructure limits ICT access. ICT regulations have an important role to play in bridging this gap and improving connectivity.

The strength or weakness of ICT regulation is clearly associated with performance on key ICT metrics, including network development and mobile connectivity. The significant positive correlation between the quality of ICT regulations and mobile internet market penetration suggests that legal frameworks are an important element of an enabling environment for ICT services. Countries with weak regulatory frameworks that do not foster competition display significantly weaker performances on ICT development metrics. As a result, further improvements in access to ICT and resulting positive effects for agribusinesses as well as rural development in general are conditional, among other factors, on an enabling regulatory environment.

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Annex: List of Countries Covered by EBA

High income	Upper middle income	Lower middle income	Low income
Chile	Bosnia and Herzegovina	Armenia	Benin
Denmark	Colombia	Bangladesh	Burkina Faso
Greece	Georgia	Bolivia	Burundi
Italy	Jordan	Cambodia	Ethiopia
Korea, Rep.	Kazakhstan	Cameroon	Haiti
Netherlands	Malaysia	Côte d'Ivoire	Liberia
Poland	Mexico	Egypt, Arab Rep.	Malawi
Spain	Peru	Ghana	Mali
Uruguay	Romania	Guatemala	Mozambique
	Russian Federation	India	Nepal
	Serbia	Kenya	Niger
	Thailand	Kyrgyz Republic	Rwanda
	Turkey	Lao PDR	Senegal
		Morocco	Tanzania
		Myanmar	Uganda
		Nicaragua	Zimbabwe
		Nigeria	
		Philippines	
		Sri Lanka	
		Sudan	
		Tajikistan	
		Ukraine	
		Vietnam	
		Zambia	

ⁱ For more detailed information on the EBA methodology and details of the calculation please refer to www.eba.worldbank.org.