



HOW TECHNOLOGY CREATES MARKETS

Trends and Examples for Private Investors
in Emerging Markets



Creating Markets, Creating Opportunities

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EXECUTIVE SUMMARY

Technological progress is often associated with the creation of novel and useful products through innovation and ingenuity. Yet in several emerging markets, including low-income economies, it is often more common to adopt, adapt, and scale technologies created elsewhere. By doing so, private enterprises in these countries could use technology to create markets and expand their product and service offerings to unserved and underserved residents, a process that produces new customers, buyers, sellers, and employees. This transforms the pursuit of profits into a driver of economic growth, as well as higher productivity and living standards, and gives technology a central role in emerging market development.

Examples of technology-driven market creation range from Peru, where partnerships between telecom providers and banks bring financial services to unbanked populations, to Tanzania where solar and energy storage technologies create business opportunities in remote areas, to India, where advanced farming technologies drive agribusiness opportunities for smallholder farmers. There are several examples where private enterprises in emerging economies leverage technologies to create markets and accelerate growth and development.

Adopting new technologies can also allow emerging economies to “leapfrog” steps in the traditional development ladder. For example, low-income nations that never established a telecommunications landline infrastructure or a retail banking system could bypass those development stages due to the profusion of mobile phones and the innovative financial services now available through them.

Yet the path from technology adoption to market creation and eventual fruition is not obstacle free. The penetration and diffusion of adopted technologies in developing countries is often too low to sustain new markets that depend on them.

Moreover, technology alone is not sufficient to create fully functioning markets. It must be complemented by appropriate government and regulatory policies. And it is highly dependent on infrastructure improvements, especially in energy and telecommunications.

Of course, none of these obstacles are insurmountable, and most will give way to cooperation between the private sector, governments, and outside actors such as development finance institutions.

IFC and other development finance institutions aim to use technology to help accomplish the United Nations 2030 Sustainable Development Goals. The general strategy entails clearing a path to allow private capital to be allocated at a sufficient scale to address development gaps in emerging markets.

Each emerging market intervention has the potential to alter the dynamics of markets by promoting one or several of five distinct attributes. These include **Competitiveness**, in which markets allow firms to enter and compete while incentivizing innovation and efficiencies; **Resilience**, with markets less vulnerable to shocks, volatility, and instability; **Integration**, with enhanced connectivity within and across markets; **Inclusiveness**, with markets accessible to groups still unserved or underserved; and **Sustainability**, with firms and individuals adopting environmentally and socially sustainable technologies and practices. Technology is critical to each of these attributes.

The second half of this report describes particular instances where technology is creating markets and driving development. They are grouped according to the five attributes described above, and together they paint a picture of technology’s ability to expand access to products, services, and job opportunities for individuals; access to markets, finance, and competition for businesses; and greater efficiency and responsiveness for governments.

COMPETITIVENESS

CHAPTER 1. Productivity and the Role of Technology Adoption in Emerging Markets

There are ample opportunities for developing countries to generate growth and reduce poverty, yet they will need to make good use of available business models and productivity-enhancing technologies to do so.

CHAPTER 2. Energy Storage Business Solutions for Emerging Markets

Energy storage technologies promise to deliver efficiency, productivity gains, and business opportunities for remote areas of emerging countries.

RESILIENCE

CHAPTER 3. Creating Mobile Telecom Markets in Africa

Mobile telecommunications can link communities and citizens to financial services and help farmers improve crop yields.

INTEGRATION

CHAPTER 4. How Emerging Market Leaders Can Spur Technological Gains

Emerging market leaders can take steps to help firms overcome barriers to technology implementation, from regulatory frameworks to education, trade, and access to finance.

CHAPTER 5. Creating Agricultural Markets Through Commodity Exchanges

Commodity exchanges can provide emerging market economies with orderly, transparent, and efficient markets by acting as mechanisms that mitigate price risk, discover equilibrium prices, and connect buyers and sellers.

CHAPTER 6. Technology-Enabled Supply Chain Finance

Supply chain finance structures offer an alternative solution to finance the trade flows of small and medium enterprises in emerging markets.

CHAPTER 7. Modelo Peru: A Mobile Money Platform Offering Financial Inclusion

A mobile money strategy in Peru emerged as a collaboration between financial institutions, telecom companies, and the government, with the goal of better serving the nation's unbanked and underbanked.

INCLUSIVENESS

CHAPTER 8. Fintech is Reaching the Poor in Africa and Asia: A Start-Up Perspective

Traditional banks and financial technology companies, or FinTechs, offer innovative digital financial services that grant unbanked individuals access to financial transactions.

CHAPTER 9. Digital Financial Services—Challenges and Opportunities for EM Banks

A host of non-bank innovators are offering new financial technology products and services in emerging market economies.

SUSTAINABILITY

CHAPTER 10. Precision Farming Enables Climate-Smart Agribusiness

Emerging market countries can benefit from advanced farming technologies that mitigate the effects of climate change and protect environmental resources.

CHAPTER 11. Private Enterprise Can Reduce Food Loss Through Climate-Smart Agriculture

There are many examples of private sector enterprises that have tackled post-harvest loss successfully. They focus on education, collaboration, and improved storage and transport technology. ■



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INTRODUCTION

Technological progress has been powered by innovation, human ingenuity, and the rate at which technology has been adopted, adapted, and spread. While advanced countries have an established history of innovation, most emerging markets do not, and they are still playing catch up.¹

Private companies have seized on this opportunity to adopt and scale innovative technologies in these markets, a process that is creating new customers, buyers, sellers, and employees. These firms are profiting while simultaneously serving previously unserved or underserved consumers. This is a prime example of the private sector achieving economic success while at the same time advancing development and supporting economic growth.²

Today, new technologies and innovations are converging in new ways to change how people live, work, and organize their lives. Rapid cost reduction magnifies their growth and impact. Many breakthroughs offer such rapid, discontinuous improvements in capabilities or reductions in cost that they threaten the viability of existing development approaches. This wave of disruption has the potential to create new opportunities to achieve the Sustainable Development Goals (SDGs).

This report focuses on how technology is contributing to market creation and expansion in emerging markets. It includes analysis and examples of increased access to products and services—energy, financial, and other types—that have been unavailable to large population segments. The report also looks at the impact of technology on market participants, ecosystems, and existing players.

Technological change is a primary driver of productivity growth and higher living standards.³ Technology can bring structural changes to economies and lead to societal change and human development, including reaching populations in need. In Africa, the availability of faster internet via undersea fiber optic cable has contributed to a reduction in inequality, the creation of new business models, and the generation of new jobs, bringing new opportunities for unskilled workers to climb the economic ladder. Between 2009 and 2015, internet bandwidth grew twentyfold, and mobile broadband alone supported around 3.8 million jobs in the continent in 2015.⁴

Adaptation or adoption of new technologies from other countries allows companies in emerging markets to increase their productivity, better serve customer needs, reach previously underserved and unserved customers, and be more competitive. In these countries, firms typically operate far from the global technological frontier. Here, productivity-raising innovation often can drive substantial cost reductions and allow scarce resources to be allocated to more productive uses.⁵ The extent of such “wealth effects”⁶ depends not only on the speed of technology introduction via innovation,

CREATING MARKETS

Creating markets, including through technology, has been part of IFC’s core mission since 1956, as described in its Articles of Agreement.

Article I states: *“The purpose of the Corporation is to further economic development by encouraging the growth of productive private enterprise in member countries, particularly in the less developed areas ...”* IFC shall, among other means, *“seek to stimulate, and to help create conditions conducive to, the flow of private capital.”*

adaptation, and adoption, but also on the extent of its diffusion within a given market.⁷

Emerging markets are adopting technologies at various paces. Yet penetration rates of those technologies—the percentage of workers in a country using them and their

diffusion across the population—remain low among developing and transition countries.⁸ For instance, despite the rapid proliferation of mobile phones in Africa, only half of the population of Sub-Saharan Africa owns a mobile phone, and just a fourth can access the internet on it, often with limited data transmission capability.⁹ (Figure 1 illustrates stark differences in how countries use and connect to the internet.)

WHAT WE MEAN BY “TECHNOLOGY”

We adopt a broad definition of technology in this paper, in line with its original meaning of “skillful craft,” derived from the Greek words τέχνη (*techne* = skill, knowledge, manual ability) and -λογία (*logia* from *logos* = word, reason). The term therefore refers not only to a piece of equipment but also to the means, skills, knowledge, processes, and methods associated with it.

LEAPFROGGING THROUGH ADOPTION OR ADAPTATION

Developing countries, especially those in Africa, still face significant gaps in many development outcomes. These gaps require disruptive solutions and innovative thinking, including looking at typical constraints to investing in potential opportunities, attracting the private sector, and creating a supportive environment for technological diffusion.

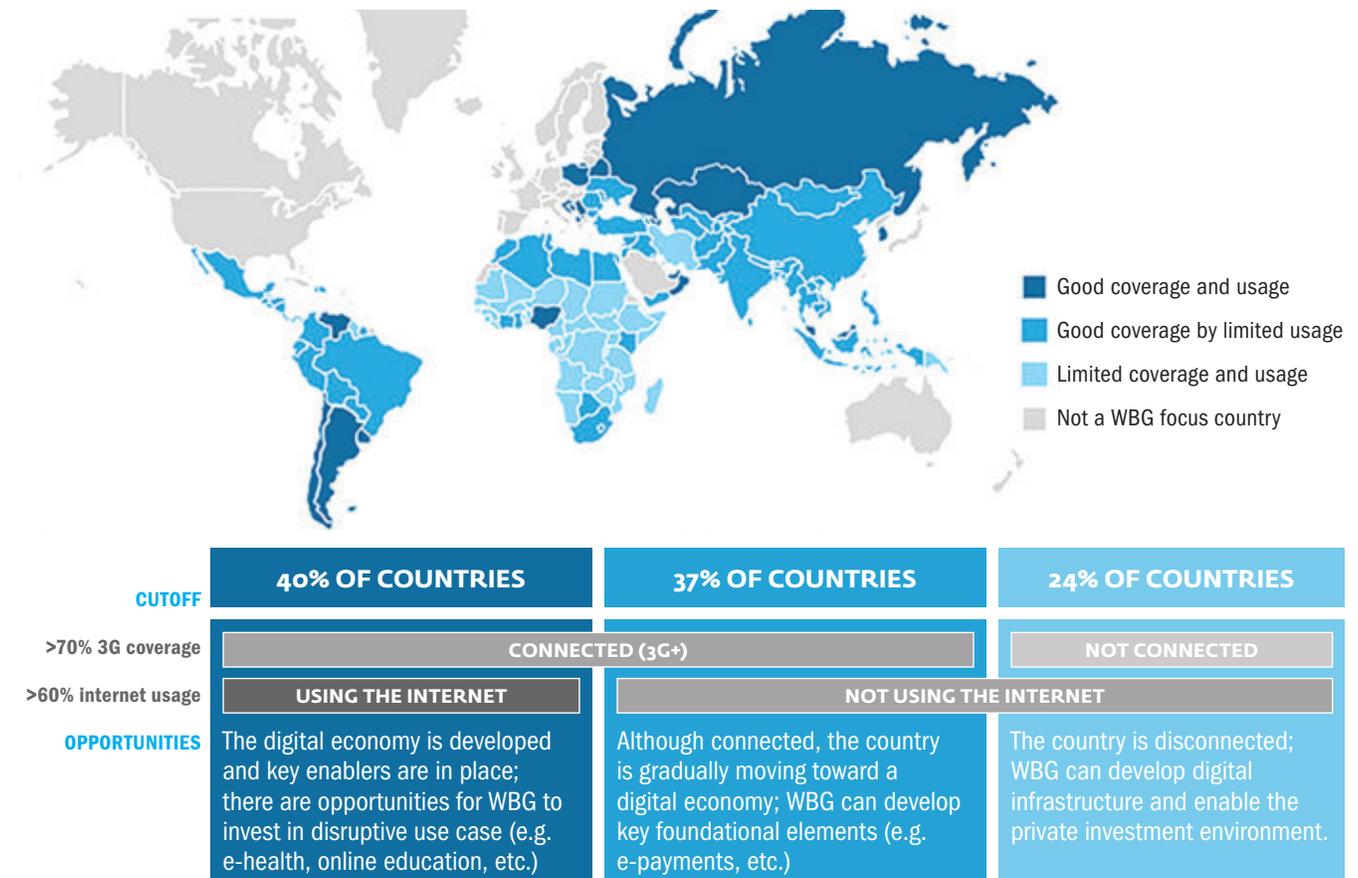


FIGURE 1 Four Billion People Worldwide Still Do Not Participate in the Digital Economy

Source: World Bank Group

An example of a disruptive solution is leapfrogging.¹⁰ It allows developing countries to skip steps in the traditional development ladder via innovative practices and technology adoption. This process requires the support of physical and institutional infrastructure, as well as the ability of education to impart skills for absorbing technology and developing and applying innovation.

The World Bank Group has synthesized its experience in six different sectors from Africa, illustrating challenges and examples of leapfrogging based on innovative practices and technology adoption. These sectors—agriculture, education, energy, finance, governance, and information and communications technology (ICT)—exhibit spillover effects that create dynamic synergies between them.

For example, in the financial services sector, technological innovation provides multiple leapfrogging opportunities. And it can make capital more efficient, risk management more targeted, hedging better matched, and trading less costly. In addition, it can help unbundle risk, improve liquidity, bring broader access to capital, and lead to more optimal portfolio diversification. Such technological innovation increases the ability of both traditional banks and financial technology companies to reach and include previously underserved populations. In economies where large shares of the populations remain unbanked, traditional banks and financial technological companies are both competing and collaborating to reach these potential clients. New technological platforms increase inclusiveness for the unserved, for example through Modelo Peru or the Ethiopia Commodity Exchange. The most salient leapfrogging phenomenon in the financial sector has been the impact of mobile phones on financial inclusion.

ICT infrastructure is critical to enable leapfrogging into other sectors in which traditional alternatives remain inadequate, such as traditional banking services, fixed telephone lines, and traditional energy solutions.

CONTRIBUTION TO MARKET CREATION

IFC and other development institutions are working to mobilize the private financing needed to accomplish the United Nations Sustainable Development Goals (SDGs) by 2030. While technological changes provide

opportunities to identify new pathways to development, IFC will focus on harnessing the potential of technology to ‘Create Markets’. This strategy entails responding to the challenges that keep private capital from being allocated at a sufficient scale to address major development gaps. By creating markets, systemic barriers to growth can be overcome and a pipeline of investable projects can be expanded by building a bridge between government and private sector needs.¹¹

As part of its Anticipated Impact Measurement and Monitoring (AIMM) system, IFC assesses the degree to which an intervention improves the structure and functioning of markets. Each intervention has the potential to alter the dynamics of markets by promoting any or several of five distinct objectives.¹² These objectives are:

- 1. Competitiveness:** Competitive markets are those that firms can effectively enter, exit, and compete in, while innovating and striving for efficiency under essential regulatory and government intervention. Competitive markets also support product or process innovation, improve management practices, and/or reduce product costs.
- 2. Resilience:** Improving the depth, structure, regulation, and governance of markets makes them more resilient to shocks. This includes supporting growth without excessive volatility or destabilizing economic reversals.
- 3. Integration:** Promoting enhanced physical and/or financial connectivity, within and across markets, supports greater market integration.
- 4. Inclusiveness:** Inclusive markets support fair and full access for marginalized groups (the poor, women, youth, rural populations, etc.) to goods and services, finance, and economic opportunity.
- 5. Sustainability:** When firms and consumers adopt environmental and social sustainability technologies and practices, they promote greater market sustainability.

HOW TECHNOLOGY IS CHANGING THE GAME

According to the World Development Report 2016: Digital Dividends, the use of technology can facilitate market creation through various channels,

TABLE 1 Digital Solutions Are Transforming the Delivery of Products and Services

SECTOR	CHALLENGES	DIGITAL SOLUTIONS	OBJECTIVE				
			1	2	3	4	5
Health	Traditional healthcare is doctor/hospital-centric and difficult/slow to scale.	Digital solutions (mHealth, eHealth) are allowing more access and affordability and, together with artificial intelligence , show growing potential for diagnosis and preventive care.			●	●	
Financial Services	High costs of operations and lack of consumer information.	Online platforms and marketplaces are accelerating access to markets and credit.	●		●	●	
Agribusiness	Isolated farmers work in a traditional and inefficient manner.	Access to information helps farmers improve yield and to connect with supply chains. <i>Example: mKrishi increased farmer profitability by 45 percent in India.</i>			●		●
Power	Due to limited grid coverage, rural populations lack electricity.	Off-grid energy solutions linked to e-payments give access to remote populations (50M users out of 1.2B lacking access to energy).	●			●	

Source: World Bank Group; Objectives 1-5 are 1 = Competitiveness; 2 = Resilience; 3 = Integration; 4 = Inclusiveness; 5 = Sustainability.

including: greater access to products, services, and job opportunities for individuals; access to markets, finance, and competition for businesses; and greater efficiency and reach for better responsiveness, for governments.¹³

Several examples of digital solutions—and how they create markets—are shown in Table 1.

It is clear that technology can be an effective, enabling tool for market creation. However, while technology is *necessary* to market creation efforts, it is not always *sufficient*, and countries need to work to implement policies that complement it. These policies include stronger regulations to ensure competition among businesses, programs to adapt labor force skills to the demands of a changing labor market, and ensuring accountable institutions. Without effective implementation of these policies, opportunities to achieve inclusion, efficiency, and innovation may give way instead to limited control, inequality, and concentration.¹⁴ Alignment between use of new technologies based on the ecosystems that support them is also critical to maximizing the impact they can have in disrupting the status quo and creating markets.¹⁵

This report will present some of the ways technological change is impacting traditional paths for development and creating markets. The analysis will be classified according to the five AIMM System attributes described above: Competitiveness, Resilience, Integration, Inclusiveness, and Sustainability.

COMPETITIVENESS

Innovation and adoption of new technologies can allow markets to be more competitive. Many emerging markets still face important challenges regarding infrastructure gaps and service delivery, especially in remote rural areas. Infrastructure is key to including unserved and underserved populations, yet technology costs such as mobile handsets, combined with low average revenue per user (ARPU), often discourage investment in these locations.¹⁶

However, the advance of technology and the reduction of its costs are generating disruptions in several markets, allowing for some infrastructure to be “unbundled.” Natural monopolies offer an example. These are typically utility companies with considerable economies of scale and large fixed costs. In the energy sector, so-called “smart-grid”—the application of digital communications technology to identify and adjust to local changes in electricity supply networks—has proved to be a disruptive catalyst that could enable new market entrants to enter the electricity supply market.¹⁷ This has allowed firms to effectively enter and exit markets, offer product and process innovations, and deliver cost reductions to customers while generating productivity and efficiency gains in more than one sector, as well as new business opportunities.¹⁸



20,473,000

People in Africa who are currently meeting their basic electricity needs through off-grid solar products meeting Lighting Global Quality Standards.



13,285,000

Quality-verified solar lighting products sold through local distributorships in Africa since 2009.



3,986,000

Metric tons of GHGs avoided in Africa, the CO₂-equivalent of taking 841,977 cars off the road for a year.

FIGURE 2 Lighting Africa's Impact as of December 2016

Source: Blimpo, Moussa P. et al. 2017. "Leapfrogging: The Key to Africa's Development?" World Bank Group and China Development Bank, p. 56.

New technologies such as battery storage and off-grid solutions are opening new opportunities for ICT infrastructure deployment in remote locations, bringing telecommunication, internet connectivity, and power to underserved locations. This has the potential to expand the reach of education and health services, thus creating new markets in these sectors.¹⁹

Extending broadband and internet access yields notable benefits for small and medium-sized enterprises (SMEs), supports innovation, and leads to the emergence of new enterprises in emerging countries. Due to improved access to broadband and mobile internet, SMEs grow through productivity gains and the decreased cost of selling final products. These SME gains have positive spillover effects on the rest of the economy, resulting in greater market competitiveness and expansion.

As technology becomes more central in all economic agents' lives, available information is constantly increasing and innovations are removing intermediaries involved in traditional transactions and value chains. This allows for reductions in costs and time, and better tools for monitoring, among other benefits. Also, it facilitates the access of isolated actors to the market. There are several cases of disintermediation reducing

transaction costs (including search and information costs) and information asymmetries. Various sectors provide examples, including energy and agriculture (farmer and big data, allowing market access) and non-bank fintech financial services (payments, remittances, trade finance).

One example from the agriculture sector is the establishment of the Ethiopia Commodity Exchange, which as a technologically advanced exchange offers trades based on an electronic warehouse receipt system that links data from warehouse operations, clearing and settlement, and market-information onto a single platform. It has transformed the agriculture sector in Ethiopia, making it more dynamic and efficient by providing enhanced transparency, access to market data, and the ability to trace and determine the quality of products, and thereby reducing information costs considerably.²⁰

RESILIENCE

Resilient markets can withstand physical and financial shocks, support growth without excessive volatility, and stabilize economies with improved structure and regulated governance. Such markets can be effectively achieved through technology advancement and innovation. Technology in agribusiness, ICT, and banking sectors provides resilience to climate change and improves transparency, accessibility, and feasibility of goods and services. Beyond these advantages, technology platforms will eventually promote market competitiveness, integration, and sustainability.

Technology innovations that can potentially improve resilience in the market include rapid adoption of risk index insurance, including innovative payment and collateral options and lowering the time to develop local currency denominated bonds. In general, there is potential for leapfrogging in agriculture financing, agricultural index insurance, financial inclusion, local currency financing, and infrastructure finance.

Mobile telecommunications have several benefits, from linking communities and citizens, to mobile applications that bring financial services to the unbanked and help farmers improve crop yields. Researchers estimate that an increase of mobile

broadband penetration by 1.8 percentage points will improve economic growth by 0.7 percentage points.²¹

Expanding broadband access brings countries huge economic and social benefits. This can mean saving lives through improved health care, creating jobs for high-skilled workers, and improving education for both children and adults. Technology advancement enables developing countries to reduce health care disparities between rural and urban areas, and brings diagnostic abilities to physically remote locations. In addition, the availability of online courses and information distribution through broadband access helps to implement innovative education systems that promote education. Such benefits generate many economic and social opportunities that expand and develop new markets.

Africa's mobile telecom sector is a prime example. With the proper mix of regulation and competition, investment, and affordability, the sector (including mobile phones and broadband access) can flourish. The liberalization process in Africa's mobile sector took place in the presence of enabling telecommunications legislation. Appropriate legislation is required to provide certainty to the government and investors that the liberalization process is legally sound.

The development of a corresponding regulatory framework is generally an ongoing process that occurs over time. Key among these measures is the establishment of a separate national regulatory agency, which can instill confidence that the competitive process will be administered in a fair and transparent manner. By 2015, all but a few countries in Africa had established their national regulatory agencies (NRAs).

INFORMATION DISSEMINATION AND RISK MITIGATION

New technologies such as blockchain can also act as mitigating tools for challenges related to de-risking. New regulations related to anti-money laundering and combatting the financing of terrorism are increasing capital requirements and compliance costs for financial institutions. As a result, many banks are restricting their relationships with clients—or with entire segments of clients—in order to avoid risk (this process is known as de-risking). This issue affects mainly

smaller markets and firms and, ultimately, vulnerable individuals in poorer countries.²²

Blockchain, combined with biometric identification, has the potential to mitigate the effects of de-risking by reducing regulatory compliance costs and increasing the transparency of transactions, and thus increasing access to financial services.²³

Regarding innovation and identification for development (ID4D), approximately 1.1 billion individuals around the world—primarily from low- and middle-income countries—are unable to prove their identity. Without identification, they are unable to access vital services and opportunities, including financial services, social benefits, healthcare, education, and rights, among others.²⁴ Fortunately, rapidly declining costs of digital and biometric technologies have created an opportunity to leapfrog traditional approaches to identification. This can help reach individuals in remote and rural areas, giving them the opportunity to participate in formal markets. This is also relevant for risk mitigation, as the use of proper authentication protocols can help governments mitigate risks of leakages, fraud, and corruption, and thereby make better use of scarce resources.²⁵

INTEGRATION

INTEGRATION AND GLOBALIZATION

Historically, changes in technology and globalization have defined comparative advantage and the patterns of manufacturing specialization. Beginning in the late 20th century, the ICT revolution enabled the creation of global value chains (GVCs). This provided opportunities for developing countries to access new markets and diversify exports. Instead of learning and establishing an entire production process, suddenly they could specialize in a narrower segment and improve their competitiveness. In addition, participation in GVCs provides exposure to large firms with managerial and technical expertise, allowing for the transfer of knowledge and know-how from advanced to emerging economies as well as among emerging economies.²⁶ In this way, the integration of emerging market firms into GVCs plays a major role in disseminating knowledge of technology and business models.²⁷

However, with the servicification of manufacturing, and advanced technologies such as smart automation, the internet of things, advanced robotics, and 3D printing becoming more important, the relevance of high-skilled work and infrastructure for production is increasing.

Technology is becoming a major part of production efficiency. Thus, emerging markets will need to adapt to the increasing demand for a well-educated workforce. On the individual firm level, experienced management is needed but often not available, as management in emerging market firms (and not only there) often do not handle innovation or adaptation well. This is codependent with education and training policies. Companies rely on a sound primary and secondary education, but also on robust vocational training, and these cannot always be provided by companies themselves. Competently trained workers are essential to following through on the innovations of engineers and scientists, and to applying and improving them in the workplace.²⁸

Technology-enabled supply chain finance structures offer an alternative solution to finance the trade flows of small and medium enterprises, with benefits for all stakeholders, including large enterprises, their SME trade counterparts, and financial institutions. This type of financing helps banks extend working capital finance to SMEs by leveraging commercial and trust relationships between the SMEs and corporates. It helps large corporates improve their working capital management and decreases supply chain disruptions. And it enables banks to better assess, measure, and manage the risks of extending financing to SMEs.

In recent years, there has been a shift toward digitization and automation of both supply chain finance transitional flows and supply chain financial solutions. Leveraging the wide range of trade and transactional data, rapidly growing technology platforms are now playing a crucial role in increasing transparency by providing risk profiling credit information for banks to gain a larger share of the market.

Technology-enabled supply chain finance not only provides insights on market trends but also helps banks better manage risks. André Casterman, a member of the ICC Banking Committee, states that

“a big innovation in the market is using transactional data for risk assessment and mitigation. The data from physical value chains and payment data collected through technology providers can be used to enhance the knowledge of the credit-worthiness of a particular enterprise, industry, or region.”²⁹

Supply chain finance can help banks grow their SME portfolios in a sustainable and risk-mitigated manner. The industry is rapidly evolving, with local and regional financial institutions realizing the inherent opportunities within their corporate portfolios. Market trade flows and the increased availability and proficiency of technology platforms have made supply chain finance portfolio growth more feasible.

PLATFORMS, MARKETPLACES AND NETWORK EFFECTS

With increased use of big data, new algorithms and cloud computing are reconfiguring the structure of economies. Digital platforms provide a set of shared techniques, technologies, and interfaces to a broad number of users. Thus, in a digital platform, social and economic interactions are mediated online.³⁰ Market disruptions that produce leapfrogging can be made through products or platforms. Such platforms enable a new set of actors to realize profits (for example, profits from the excess capacity of a guest bedroom or a car share). Platform-based disruptions can have effects on an industry and beyond its boundaries, and have the capacity to produce societal shifts as well.³¹

Evidence shows that ICT adoption that puts platforms in place is relevant to inclusive growth. Two cross-country studies highlight two additional channels. First, a market access effect that allows smaller firms to access larger markets and gain productivity. Second, a worker mobility effect, as access to the internet reduces the cost of moving workers across sectors and regions, and increases labor-market efficiencies by allowing better employer-employee matches.³²

There are several kinds of platforms that allow the inclusion of new actors in markets and have a positive effect on productivity. These include online learning platforms that reach underserved populations or bring more material to them; different payment platforms

for inclusive financial services; health-related platforms that allow greater care and coverage; and e-commerce platforms that enhance convenient, low-cost channels to link buyers and sellers and promote the inclusion and development of small enterprises. However, the development, adoption, and uptake of these platforms requires investment in infrastructure. The greater the advances in telecommunications capacity, the greater the potential impacts that these platforms can deliver.³³

Platforms also benefit from cloud computing, which is yet another platform that enables and increases productivity gains for firms, including SMEs. Cloud computing can eliminate the need for expensive stand-alone capital expenditure on information technology infrastructure (for example, by utilizing shared resources through one or more providers).³⁴ The technology is also enabling cross-regional interoperability benefits. An example is regionally integrated telecom markets, where providers allow seamless usage across several countries such as Kenya, Uganda, and Rwanda.

Kenya has implemented a National Broadband Strategy (NBS) to deliver high connection speeds and greater efficiency of access, with the goal of becoming a knowledge-based economy by 2030. This strategy has encouraged the growth of start-up and e-commerce segments in Kenya that have spurred economic and social benefits and created new markets. Under a development plan known as Vision 2020, Rwanda has begun work to transition from an agriculture-based to a knowledge-based economy by offering new levels of connectivity and integration in order to offer broad network coverage throughout the country. The goal is to increase labor productivity and reduce unemployment by leveraging digitalization to create jobs and markets. According to the World Economic Forum, increasing digitalization by 10 percent reduces an economy's unemployment rate by 1.02 percentage points.³⁵ Additional examples of beneficial platforms include service-based (IT services) and agricultural platforms that increase export opportunities and capital expenditure optimization.³⁶

Platforms tend to have network economies of scale. That is, more value is created as the platform is more

widely used. This affects incentives for competition, which can be *between* platforms or *within* a platform with interoperability. One example of the latter is the mobile wallet platform “Bim” in Peru that brought together mobile money issuers, telecom enterprises, and the government to create a single platform where competition would be enabled.³⁷ In general, it has been a challenge in the mobile operator sector to embrace opportunities of open standards and collaboration since competition on digital platforms can be “asymmetric.” There is a trade-off because collaborators on the platform can target each other's customers, generating value leakage for each competitor.³⁸ However, the primary benefit of collaboration is the facilitation of scaling rapidly and reaching new and additional users, and thus generating more value for all actors from network effects.³⁹

INCLUSIVENESS

TECHNOLOGY AND SERVICE DELIVERY

With regard to financial services, many fintech innovations have allowed for payment systems, remittances, insurance, deposits, and other financial services without the need of intermediaries such as banks. Blockchain technology is not only applicable to financial services, but can serve as a “registry, inventory system, and transaction platform for recording, tracking, monitoring, and transferring rights to different asset classes, including intellectual property, votes, digital identity, health data, and real estate.”⁴⁰ As mentioned above, the most salient leapfrogging experience in the financial sector in emerging markets has been the impact of mobile money bringing financial services to the unbanked and underbanked, and Kenya's M-Pesa is the best example of this.

Furthermore, information dissemination and disintermediation also benefit service delivery in sectors such as education and health. The use of technology is a cross-cutting enabler in the education sector. For example, the internet can help extend learning beyond classrooms, allowing it to reach millions of children who lack access to quality education. “Students can use technologies to access courses not offered at their school;

rural students can complete their studies without leaving their communities; and adults can benefit from a more flexible study schedule.”⁴¹ Digital technologies have the potential to improve monitoring of different aspects of an education system, which can facilitate beneficial education reforms.

In the health sector, services such as mobile health (mHealth) and digital health (eHealth) can provide various benefits. These include reaching remote areas that physicians cannot easily access,⁴² improving diagnoses, surveillance and monitoring and reduction in the use of emergency services,⁴³ improved coordination between service providers, and reduced times of patient data gathering through digital medical records.⁴⁴ These technology innovations create competitive incentives for healthcare providers to expand services they offer, generate jobs, and work toward affordable prices for patients.

Again, Modelo Peru’s Bim is an example, this time of technology-driven inclusiveness. The innovative mobile money strategy integrates government, banks, and telecommunication companies with the goal of bringing financial services to large unbanked populations through its new distribution platform based on mobile phone technology.⁴⁵

CODEPENDENCY OF TECHNOLOGY ADOPTION AND INFRASTRUCTURE ACCESS

The use of technology innovations to foster inclusion is highly dependent on infrastructure improvements, especially in energy and telecommunications. For instance, the use of mobile money requires access to telecom services, which necessitates both mobile phones and the electricity to charge them.⁴⁶ Opportunities for generating a significant impact in fields such as education and healthcare also rely on the ability of users to be sufficiently skilled in a technology,⁴⁷ as the uptake of new technologies is rarely automatic. Enabling services requires a scale of investments that governments are not able to achieve alone, which is why it is crucial to create conditions that attract a sustainable flow of private investment and allow for both public and private sectors to work together to enable innovation.⁴⁸

SUSTAINABILITY

Firms and consumers that adopt environmental and social sustainability technologies and practices also promote greater market sustainability.

Tanzania’s economy relies heavily on agriculture, and climate change is already affecting the productivity

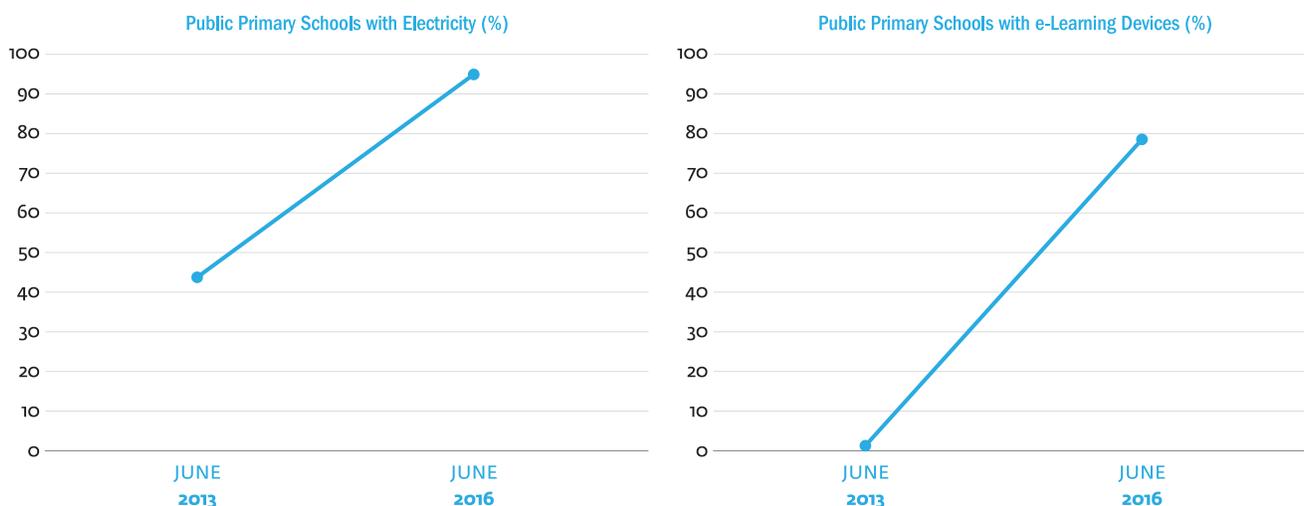


FIGURE 3 Electrification and e-Learning Devices in Kenyan Primary Schools

Source: Blimpo, Moussa P. et al. 2017. “Leapfrogging: The Key to Africa’s Development?” World Bank Group and China Development Bank, p. 42.

levels of key commodities. The East African country is committed to increasing yields through Climate Smart Agriculture by offering better input supplies (seeds, chemicals, and fertilizers), precision farming techniques, and improved irrigation systems to smallholder farmers. It also seeks to protect smallholder farmers against climate related risks, increase productivity levels through crop insurance, and use warehouse receipts to improve storage efficiencies. These technologies allow the agricultural supply chain to improve post-harvest practices, including improved transport and storage facilities, better farm management, and improved harvesting techniques. These will help to reduce crop losses and maximize the portion of harvested output delivered to markets. In this way, billions of tons of food can potentially be saved, leading to improved food security, better nutrition, increased productivity, and greater political stability in developing countries.

In addition to Tanzania's warehouse financing, Ghana's agribusiness centers and the Philippines' NorMinVeggies illustrate that climate-smart agriculture across the food value chain can help reduce post-harvest food loss, promote economic stability, and encourage sustained growth in agribusiness in developing countries.⁴⁹ Agribusiness centers in Ghana offer farmers technologies to adopt climate-smart agricultural practices and extension services. The centers build partnerships with microfinance institutions to offer farmers inventory credit, creating economies of scale for smallholder farmers. Similarly, smallholder farmers in the Philippines are able

to obtain access to capital, technical advice, and technological solutions for post-harvest loss in the emergence of NorMinVeggies, which greatly benefit smallholder farms through quality assurance schemes, production schedules, and traceability systems.

A simple, affordable, and effective mix of technologies is required to achieve benefits for small-scale farmers and to create sustainable investment opportunities. For instance, agro-advisory networks and imagery-equipped drones for soil and crop monitoring in the Indian and Sub-Saharan African rural areas constantly support crop planning and management.⁵⁰ Such climate-smart agriculture practices could increase productivity levels and farming incomes, make rural communities more resilient, and ensure the sustainable use of water and energy.

Technology can be critical in accelerating and supporting market creation, especially in time of rapid transformation. Unless countries put into place foundational building blocks, they will not be able to compete in the future global economy and take advantage of new pathways to growth. These building blocks will enable the advancement of new markets, with the potential to shape basic necessities and physical assets. To catalyze robust technology-enabled growth that also protects data, infrastructure, and services, the rate of technological adoption and diffusion must increase in developing countries, along with associated enabling environments.

In the next part of this report, we describe the role of technology in creating markets along the five attributes described in this introduction. ■

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CHAPTER 1

Productivity and the Role of Technology in Emerging Markets

By Florian Mölders

The global productivity slowdown is affecting mature as well as emerging economies and this pattern has been particularly prominent over the past five years. Productivity levels in mature economies are almost five times higher than those of emerging countries, providing ample catch-up opportunities for emerging markets in their efforts to generate growth and eradicate poverty. This article highlights the forces of new technologies and business models as key drivers for emerging and mature economies' productivity and hence future growth patterns. However, emerging markets have to find a way to make good use of available productivity-enhancing technologies and business models that meet their economies' needs and capabilities.

The global growth rate of total factor productivity (TFP), which measures the efficiency gains of labor and capital together, has come to a near standstill in the aftermath of the 2008-2009 financial crisis. It grew on average 1.2 percent a year from 1999 to 2008, slowed to 0.3 percent from 2009 to 2012, and has fallen to near zero since then.

Most advanced economies, including the United States, Japan, and the Euro Area, are experiencing zero or negative productivity TFP growth (Figure 1), while developing countries are more of a mixed bag, with productivity growth rates that vary greatly. China and India experienced TFP growth of 0.8 percent and 1.0 percent, respectively, from 2010 to 2014; Brazil and Mexico saw TFP fall over that period, by 0.4 percent (Brazil) and 0.9 percent (Mexico).

Nonetheless, in absolute terms, TFP levels in advanced economies remain almost five times as high as those of emerging economies and there is also a substantial gap in labor productivity levels, or value-added per worker (Figure 2). The large disparity in productivity levels between advanced and emerging economies suggests that there is ample room for emerging markets to accelerate productivity growth.

To reduce poverty and boost shared prosperity, emerging markets have to rely on TFP increases—especially through the adoption of technological innovations—rather than relying solely on demographic factors such as population growth or natural resources.

WHY TOTAL FACTOR PRODUCTIVITY MATTERS

It is the growth of productivity, not total GDP, which determines the standard of living. Productivity measures how effective a firm or a country turns inputs such as labor and capital into outputs. If a firm produces twice as many cars as its competitor with a similar set of employees, machines, and other inputs, we can conclude that the former firm is twice as productive as the latter. Technology (in its broadest sense, encompassing both physical technology as well as new knowledge and business models) is the main driver of productivity changes.

GLOBALIZATION PAUSE

Prior to the financial crisis emerging markets experienced a few decades of strong growth, thanks in large part to globalization, increased market access, and ready consumer demand in advanced economies. Emerging economies experienced record-high growth rates from the early 1990s to 2008 (increasing their share of global GDP by a factor of 1.5, to 34 percent).⁵¹

Yet since the crisis, the ongoing integration of the world economy has lost momentum when measured by countries' trade intensities, overall exports, and foreign direct investment. And globalization cuts both ways: Less global trade, lower commodity prices, and tighter financial conditions (including trade finance) have resulted in slower growth rates in the developing world, led by China's slowdown. Average GDP growth in emerging markets fell from 7.6 percent in 2010 to 4 percent in 2015 and is expected to decline further.⁵²

Increasingly since 2010, the biggest drag on emerging market growth rates has come from domestic factors (as external conditions deteriorated), including bouts of policy uncertainty and a lack of fiscal and monetary stimulus. Looking at the contribution to the growth rate in emerging economies, the primary factor holding back economic growth in recent years has been a slowdown in productivity.⁵³ By 2014, total factor productivity growth in the developing world had fallen well below its historical average.

SHRINKING THE TECHNOLOGY GAP

The growth of TFP is driven primarily by the adoption of technological advancements. "New technologies embody higher productivity. Therefore, an acceleration in the rate at which new technologies arrive in [a] country raises aggregate productivity growth," wrote Diego Comin and Marti Ferrer in a 2013 paper on the role of technology adoption in income divergences between advanced and emerging economies.⁵⁴

Fortunately, emerging markets have been adopting technologies much more rapidly in recent decades. Late nineteenth-century innovations such as telephones and electricity took decades to disseminate from western to non-western countries. By contrast, more recent technologies such as cellphones and the Internet spread to these economies at a far higher rate.

However, productivity is also affected by the penetration rate—the percentage of workers in a country using the new technology. And while emerging markets are adopting technologies more quickly, penetration rates and diffusion of these pre-existing, new-to-market, or new-to-firm technologies remain low among developing and transition countries.⁵⁵

Factors that account for the low penetration levels can be categorized under country-specific characteristics (for example political risk), firm-level characteristics (such as level of managerial quality), and general

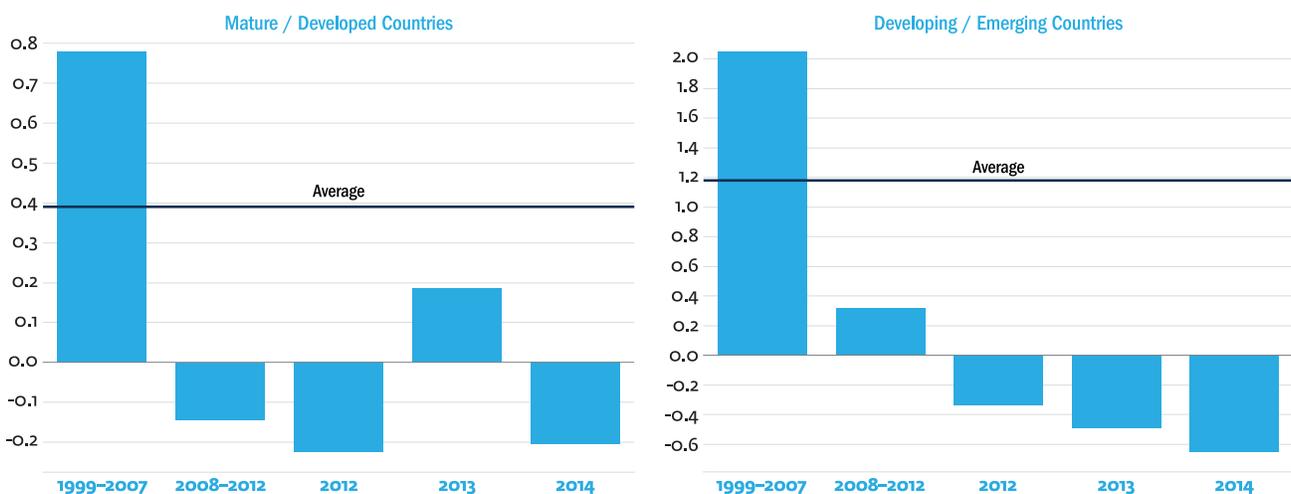


FIGURE 1 Total Factor Productivity Growth Rates—Mature / Developed and Developing / Emerging Countries

Source: *The Conference Board, IFC Research*

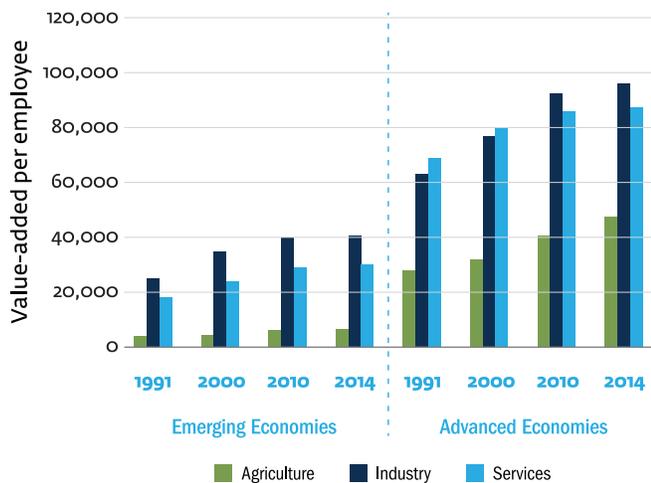


FIGURE 2 Labor Productivity—Emerging and Advanced Economies

Source: ILO, UNdata, IFC Research; calculated using 2011 PPP exchange rates

bottlenecks (access to finance, infrastructure, among other factors), that are common in emerging economies. Comin and Ferrer found that while adoption rates between advanced and emerging economies have converged over the last two centuries, penetration rates have diverged, and that divergence has played a dominant role in sustaining the gap in productivity levels between advanced and emerging countries.

Innovations that lead to technological advances provide comparative advantages to companies that then generate higher revenues through market power over a limited period of time. However, innovations also come at a price, that of significant spending on research and development. Innovative activity is highly concentrated within high-income countries, yet economic catch-up among lower-income countries also leads to an increase in their R&D capacities (Figure 3).

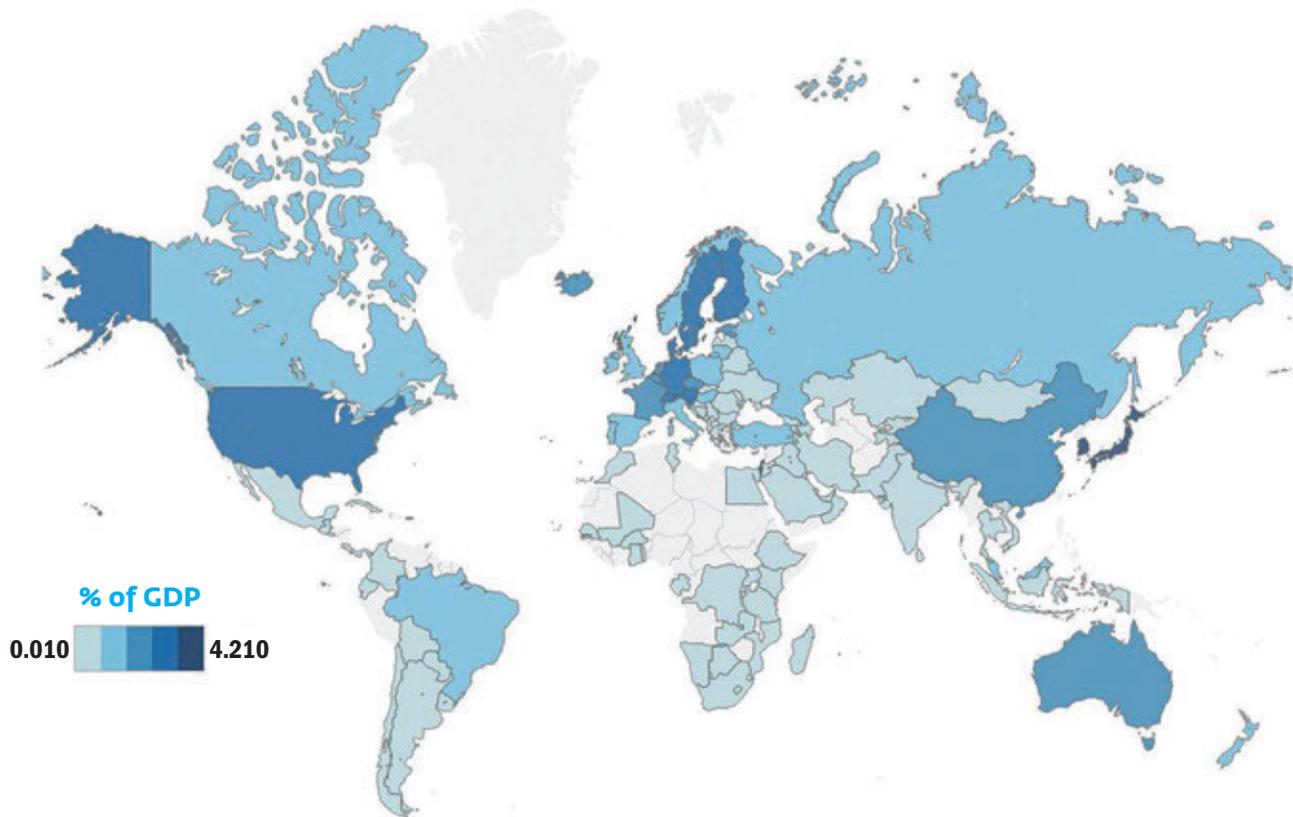


FIGURE 3 Gross Domestic Expenditures on R&D (GERD) as % of GDP

Note: GERD refers to gross expenditures on R&D from the business enterprise, higher education, government, and private non-profit sectors. Latest available data from 2008–2014; Source: UNESCO Institute for Statistics.

CHANNELS FOR TECHNOLOGY ADOPTION

While most innovations and new technologies are produced in advanced economies, they find their way to lower-income countries through a variety of channels. International trade, foreign direct investment, and cross-country research collaborations are most highly correlated with an increase in knowledge and technology flows from advanced to emerging economies.

- **International trade:** For example, an auto manufacturer produces a new model with fuel efficiency significantly above that in models produced by its competitors. When the new model is exported to another country, the importing country immediately gains access to the embodied technology, even if not in an intellectual property sense (for example it cannot alter the model and resell it on the global market). Foreign firms routinely gain technology from imported products, especially through reverse engineering. As a result, integration into global value chains via trade networks and regional integration plays a major role in disseminating knowledge of technologies and business models.
- **Foreign Direct Investment:** Should the abovementioned carmaker not only export cars but also invest in another country—either through a factory, a merger or acquisition, or a loan to a foreign supplier—flows of knowledge occur through the transfer of physical technology (machinery or software) or the streamlining of managerial practices (better accounting techniques, for example). The firm may also choose to train local employees and thereby provide them with knowledge about the use of the new technology, an indirect channel of technology transfer through education.
- **Research and Development Collaboration:** The same automaker might choose to relocate some of its own R&D activity to another country. Cost differences between advanced and emerging economies, coupled with an increase in the stock of human capital in emerging economies, can lead to a relocation of research activities from higher to lower-income countries. Recent empirical evidence⁵⁶ suggests that an increase in R&D collaboration with countries that have lower levels of innovative capacity also increases

the flow of technology and technical knowledge. As discussed above, this development also has the potential to allow emerging economies to generate more innovative capacity.

“Buyer-seller relationships along the value chain are effective ways to transfer both technological knowledge and better working practices.”⁵⁷ Vertical integration along the value chain may be more conducive to knowledge “spillovers” than horizontal integration, which can be impeded by competition between the company with the technology (the new entrant into the market) and domestic/incumbent firms. However, market competition in general, and competition across borders in particular, do provide incentives for firms to upgrade their production technology in order to retain their consumer base in domestic markets and to extend it into foreign markets.

Of course, technology adoption by emerging economies also has the potential to slow the growth of international trade. Greater automation in manufacturing industries in developing countries has made production there less labor intensive, decreasing those economies’ greatest cost advantage (inexpensive labor). This has a potentially adverse effect on the labor market by reversing the trend of outsourcing labor-intensive manufacturing from high-income to low-income countries, and hampering those low-income countries’ ability to create new manufacturing jobs.⁵⁸

THE CRITICAL ROLE OF DIGITAL TECHNOLOGIES

The spread of digital technologies in an economy provides the IT infrastructure that facilitates the adoption of new technologies and business models.⁵⁹ It increases an economy’s capacity to absorb and capitalize on business innovations that significantly reduce transaction costs through technologies such as online markets and mobile payment systems. Such technologies require information and communication infrastructure in order to supply customers and allow market entrants to develop new products and/or tailor existing business models to the local market.

There is a high correlation between a country’s per-capita income level and the extent to which digital technologies are available to key agents in its economy,

according to a Digital Adoption Index created by the World Bank and Microsoft (Figure 4). Most adopted innovations do not advance the global technological frontier, but instead utilize existing technologies to help firms boost their productivity.

OPPORTUNITIES AHEAD

According to the World Economic Forum, a fundamental shift is going on “in how we produce, consume and relate to one another, driven by the convergence of the physical world, the digital world and human beings ourselves.”⁶⁰ This has implications for service delivery by the private sector in developing and emerging countries and also offers tremendous opportunities to advance development goals by providing access to financial, energy, and education services.



FIGURE 4 Digital Adoption Index

The Business sub-index is the simple average of four normalized indicators: the percentage of businesses with websites, the number of secure servers per million residents, download speed (Kbps), and 3G coverage in the country. Note: Advanced/developed economies (UAE, Qatar and Kuwait excluded); Emerging markets (groups as defined by IMF); Source: World Bank Group, Microsoft (<http://www.digitaladoptionindex.org/>)

New technologies arrive in emerging countries with high expectations among development actors and great potential for citizens of those countries. Adopted innovations and technologies can raise productivity levels and living standards in these economies without relying on increased labor inputs. There is considerable scope for emerging countries to adopt technologies, step-by-step moving closer to the technological frontier.

If it is to be effective, technology must take local context into consideration. Ideally, low-income and low-productivity economies can find a path toward more efficient production activities that are also inclusive. While powerful, technology is merely one of many tools needed for successful development.

CONCLUSION

Global productivity growth has largely stalled since the global financial crisis, both in emerging and mature economies. The latter, however, continue to exhibit productivity levels five times higher than the former. This vast gap suggests that increasing the rate of productivity growth in developing countries is critical to a rebound in growth and broad-based increases in standards of living.

The causes of the productivity growth slowdown in emerging markets are manifold and complex. Some are cyclical, while other, structural changes in domestic political economy and global financial and trade systems are highly uncertain. One thing however is for sure: Digital technology has lowered the threshold for technology-driven growth in emerging markets, an opportunity that should not be missed. ■

CHAPTER 2

Energy Storage Business Solutions for Emerging Markets

By Sean Ong

With the application of new storage capacity technologies, advances in the capabilities of energy networks promise to deliver not only efficiency and productivity gains but also business opportunities for remote areas in emerging countries. New technologies, including those in the fields of batteries and off-grid solutions, can potentially change the way electricity is delivered to rural and remote households, and can also supply businesses and infrastructure with energy. Communication and service delivery options can be boosted with access to information technology infrastructure. Such access is required to bridge the “digital divide” and realize the potential of digital services in low-income countries or frontier markets.

Information and communications technology, or ICT, is critical in today’s global economy as education, work, and information are increasingly disseminated over digital platforms. Access to ICT contributes to economic growth and promotes new and innovative industries.

Individuals and organizations with access to digital services enjoy a distinct economic advantage over populations that lack it. This gap, often referred to as the digital divide, has been a subject of intense focus in efforts to develop and support emerging markets.⁶¹

Large technology companies have also launched efforts to bring internet connectivity to rural areas of emerging market nations. For example, Google’s Project Loon⁶² and Facebook’s Project Aquila⁶³ seek to provide internet access via weather balloons and solar-powered aircraft. Microsoft’s White Space project⁶⁴ seeks to utilize unused frequency bands of the television spectrum for internet connectivity.

According to a McKinsey Global Institute report, increasing internet access in Africa could transform sectors as diverse as agriculture, retail, and health care, and contribute as much as \$300 billion per year to Africa’s GDP within 10 years.⁶⁵ The 2016 World Development Report demonstrates that increased access to ICT in developing regions contributes to job creation,

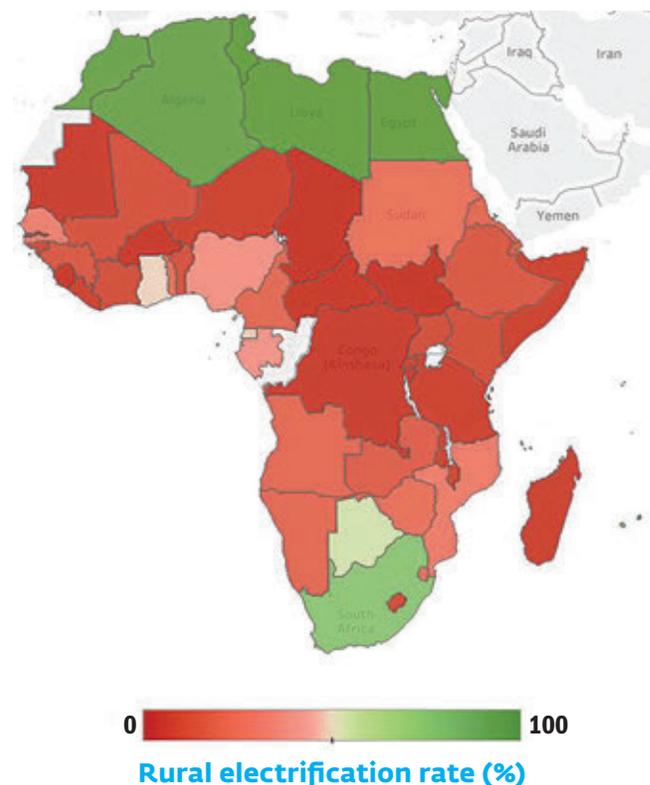


FIGURE 1 Rural Access to Electricity in Africa (2013)

Source: Data from World Energy Outlook 2015, International Energy Agency; illustration by IFC Thought Leadership, 2016.

increased labor productivity, expansion of business and entrepreneurship, and additional consumer benefits.⁶⁶

COST DECLINES ENABLE NEW ICT OPPORTUNITIES

One reason the digital divide remains prevalent in emerging economies is the limited access that rural areas have to affordable and reliable electricity. Fortunately, recent cost declines in solar photovoltaics and energy storage technologies are making micro-grids in these remote areas an increasingly viable strategy that can bridge the digital divide without the use of capital-intensive transmission lines.

The Maarifa Information Centre in Tanzania⁶⁷ and the EFACAP School in Lascahobas, Haiti, are examples of off-grid renewable and battery storage projects bringing ICT to rural areas (see boxes below).^{68,69}

Solar energy prices have declined more than 63 percent since 2000⁷⁰ and the cost of lithium-ion energy storage has fallen by up to 70 percent over the last two years and is expected to continue to drop.⁷¹ Energy storage cost declines are primarily due to the recent increase in lithium-ion battery production for electric vehicles and other uses.

With these recent cost declines it is helpful to assess the cost effectiveness of powering ICT with renewable energy and energy storage. This can be done using IFC's Storage Assessment Model (iSAM).⁷²

Reducing battery installed costs to \$300/kWh increases cost effectiveness by an additional 20 percent to 30 percent. Using today's storage and solar costs, iSAM model results show that providing off-grid power with renewable resources is already more cost effective than diesel generation. As solar and storage costs continue to decline, so will the cost of providing power for ICT in remote areas.

The cost comparison with diesel generation is important because most off-grid telecommunication towers are powered with diesel fuel. A 2012 study of telecom towers in East Africa showed that 23.5 percent of them are located in areas without access to grid infrastructure.⁷³ Some 95 percent of these off-grid towers are powered using diesel fuel. Additionally, 69 percent of grid-connected telecom towers include diesel generators for backup power. So there is enormous potential for solar and battery storage to offset diesel generation for both off-grid and grid-connected telecom towers and other rural ICT infrastructure.

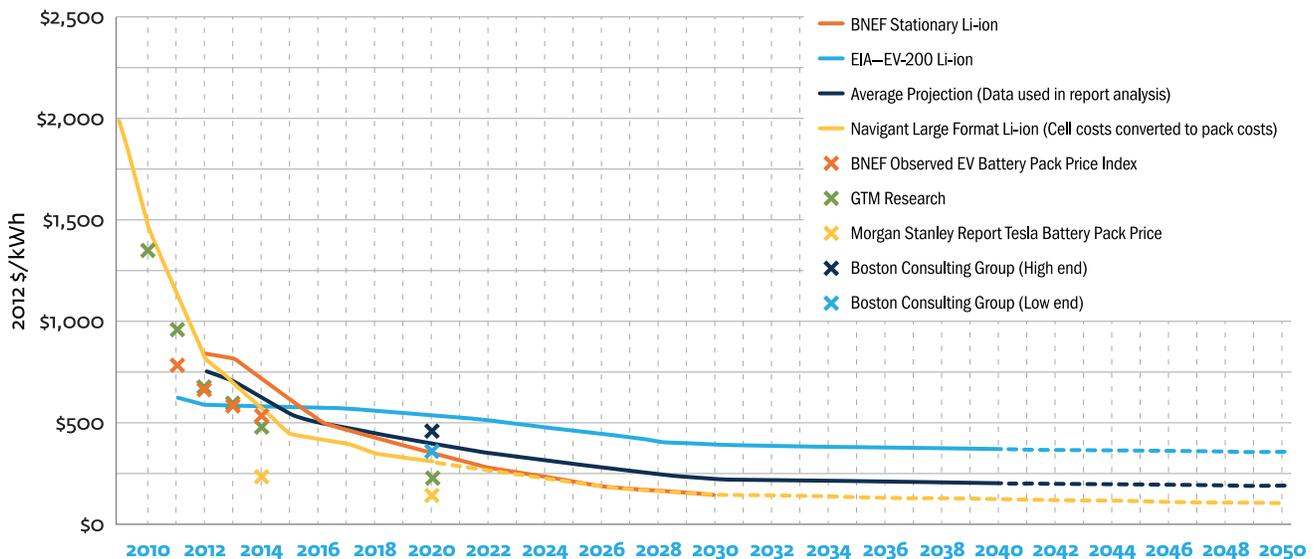


FIGURE 2 Lithium-Ion Battery Prices Have Declined Sharply and Are Expected to Continue Declining

Source: Rocky Mountain Institute, *The Economics of Load Defection – How Grid-Connected Solar-Plus-Battery Systems will Compete with Traditional Electric Service, Why it Matters, and Possible Paths Forward*, April 2015.

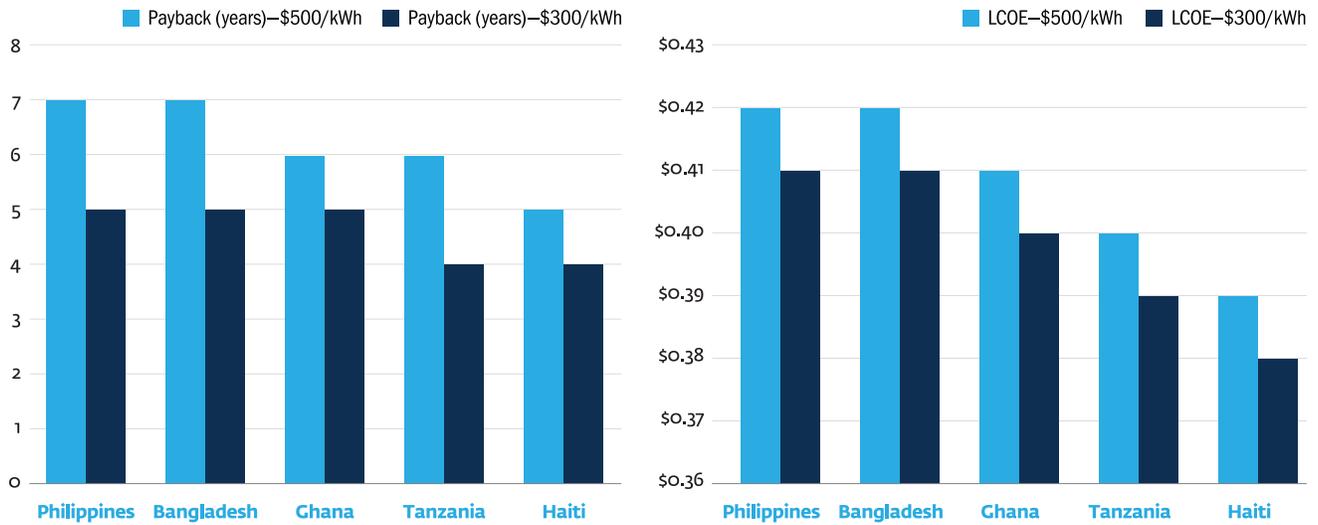


FIGURE 3 Micro-Grid Payback Times and Power Costs—\$500/kWh and \$300/kWh Lithium-Ion Battery

Figure 3 illustrates micro-grid electricity cost results from five selected countries. Key assumptions include a 30 kWh lithium-ion battery bank with a capital cost of \$500/kWh and a 20kW photovoltaic installation at \$3.00/W. As shown, payback periods range from five to seven years (compared to being powered with only diesel generation). LCOE is levelized cost of energy

With continued cost declines, solar and battery storage may also open up new opportunities for ICT infrastructure deployment in remote locations where it has been cost-prohibitive for diesel power or where transportation of diesel fuel has been a challenge.

Using solar and storage to power information and communications technology has several additional advantages. When reliance on diesel fuel is lowered or eliminated, the overall project risk is reduced for volatile fuel prices and fuel theft. Also, solar and battery storage units have no moving parts, allowing for quiet operation and reduced maintenance compared with diesel generation.

GHANA CASE STUDY

Ghana is an example of an emerging market nation in which access to the internet is limited in rural areas but where solar and storage solutions can have a meaningful impact on the deployment of internet and communications technology. Only 12 percent of Ghana’s residents have access to a personal computer. As of 2012, there were 3.5 million internet users, about 13 percent of the population.

SOLAR-POWERED INTERNET CONNECTIVITY IN LASCAHOBAS, HAITI

Established in 2011, solar-powered Internet connectivity at the EFACAP School (Ecoles fondamentales d’application et centre d’application pédagogique) in Lascahobas, Haiti, demonstrates innovative methods for powering Internet and communications technology infrastructure in remote areas.

Using a 2.4 kW solar photovoltaic and battery system, a long distance wireless link was established between the school and a communications tower located in downtown Lascahobas. This allows some 400 students, teachers and administrators to charge their devices and laptops and access the Internet through a campus-wide WiFi hotspot array.

The school is also considering other ways that Internet access can be leveraged for the community, beyond educational uses.

The Watly machine, now being tested in Ghana, is a current effort to use off-grid solar and storage.⁷⁴ The 140 kWh solar and battery unit provides electricity and internet access within an 800-meter radius, in addition to water purification services that can deliver 5,000 liters of safe drinking water each day.

Solar and battery installations in Ghana are not without challenges, however. An assessment conducted by the Ghana Ministry of Energy found that installations are poorly maintained and often abandoned after three years.⁷⁵ There are also the difficulties of removing the accumulation of dust and bird droppings from solar panels, system failures due to mishandling of battery charge regulators, and a lack of access to fuses and other maintenance components.

TANZANIA CASE STUDY

Tanzania's internet penetration is even lower than Ghana's. Only 4 percent of residents have access to a personal computer and 11 percent have internet access.

Nearly 96 percent of Tanzania residents not covered by a cellular network live in a rural or off-grid location, suggesting that the focus of ICT growth in the region will be in these remote areas.

According to the 2012 GMSA Green Power for Mobile study, solar/battery/diesel hybrid solutions have great potential in Tanzania, where solar power has good availability, reliability, market acceptance, and supply chain readiness. Due to the recent cost declines in solar and storage solutions, these technologies are already being deployed in large numbers across the country.

For example, the Tanzania Government has announced the One Million Solar Homes initiative⁷⁶ which will deploy solar and battery storage solutions to a million homes over three years. IFC is providing \$7 million for the first phase of the initiative, which is expected to reach 100,000 households and small businesses in Tanzania.⁷⁷ Currently, solar is being installed at a rate of 10,000 homes and businesses per month.⁷⁸

Of course Tanzania too has challenges with this technology. There are barriers to adoption that include high initial capital costs, space requirements at ICT infrastructure sites, and scarcity of funding. There are also operational risks in terms of theft and

SONGAMBELE MAARIFA CENTRE IN TANZANIA

The Songambele Maarifa Centre in Tanzania demonstrates how renewable energy and battery power can enable ICT access in remote areas.

Powered by 1 kW of photovoltaic solar electricity, 1 kW of wind generation, and a battery system, the facility provides village residents with computer Internet access (via GSM network), educational videos and media, and other communication services.

The facility became fully operational in April 2015 and has enabled computer literacy among residents, increased crop harvests due to information obtained at the center, increased learning among youths, and even provided university education for some residents. The facility was made possible by support from Renewable World and coordination with the Arid Lands Information Network, and the Dodoma Environmental Network.

breakage of solar panels as well as reliability issues due to weather variations.⁷⁹

BUSINESS OPPORTUNITIES

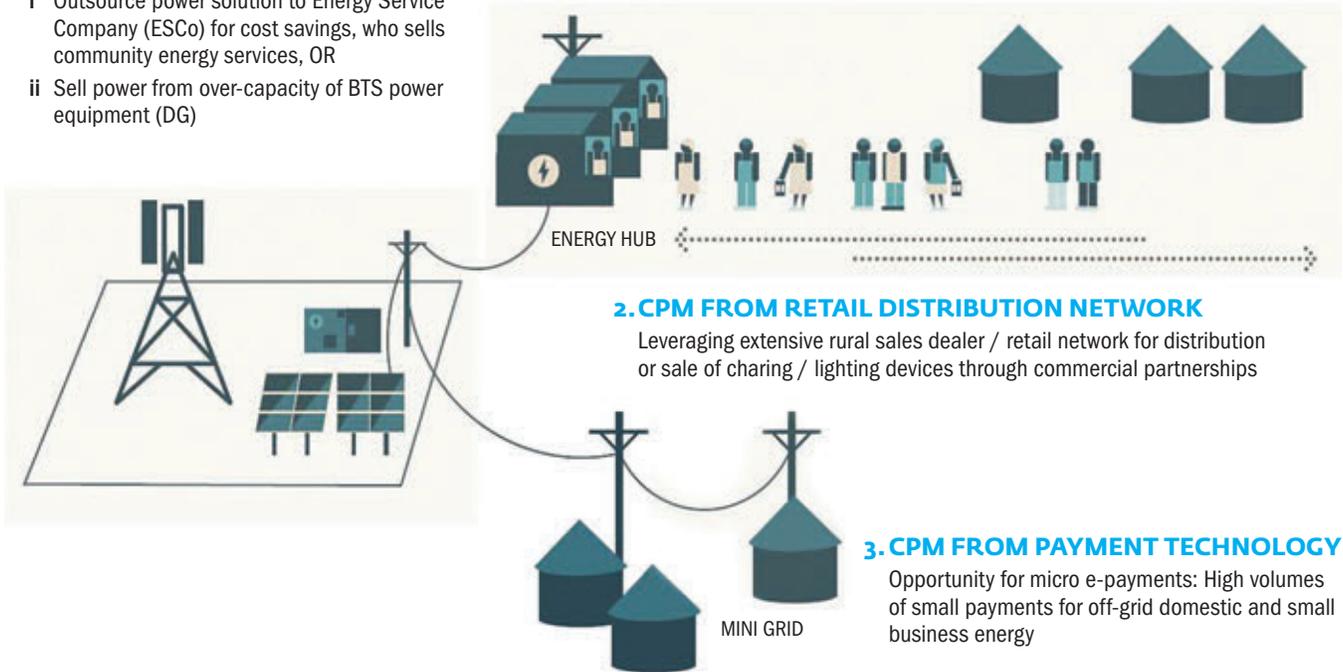
The benefits of increased access to internet and communication technology in remote regions have long been understood, yet the cost of infrastructure needed to provide it has been prohibitive. Now, however, with recent declines in energy storage costs, powering off-grid ICT infrastructure using renewable resources is an increasingly attractive option.

Providing that access is also an opportunity for established companies to reach new populations and potential customers. Expanded access will also foster local innovation and may contribute to entrepreneurship and new business opportunities in local communities.

Telecom companies can also benefit from the increase in data demand and offset declines in voice revenue (due to increased communication via text and data).⁸⁰

1. CPM FROM BASE TRANSCIVER STATION (BTS) INFRASTRUCTURE

- i Outsource power solution to Energy Service Company (ESCO) for cost savings, who sells community energy services, OR
- ii Sell power from over-capacity of BTS power equipment (DG)



2. CPM FROM RETAIL DISTRIBUTION NETWORK

Leveraging extensive rural sales dealer / retail network for distribution or sale of charging / lighting devices through commercial partnerships

3. CPM FROM PAYMENT TECHNOLOGY

Opportunity for micro e-payments: High volumes of small payments for off-grid domestic and small business energy

FIGURE 4 The Community Power From Mobile (Cpm) Model Illustrates How Clean Energy and Information Technology Enables New Business Opportunities

Source: GSMA Green Power for Mobile.

Cheaper storage and solar technologies will also create opportunities for independent power producers to invest in powering communications infrastructure. These include collaborations between telecom operators, local communication centers, schools, small and medium-sized enterprises, and other parties that benefit from expanded ICT access and delivery.

One emerging business model for financing and powering rural communications infrastructure is the Energy Service Company, or ESCo. In this arrangement the ESCo owns, operates, and maintains the on-site power generation equipment and sells power to the telecom company or other ICT infrastructure company.

The network or telecom company pays the ESCo just as they would pay an electric utility if grid access were available. This model helps to reduce the costs and operational burdens of deploying power generation, which have typically been the responsibility of the network operator or tower company.

The ESCo business model has a long track record in

developed countries, primarily in the energy efficiency industry where ESCos finance energy efficient upgrades for buildings and receive payment from the utility bill savings.⁸¹

For rural ICT infrastructure, the GSM Association estimates that the market potential for ESCos in East Africa alone is \$155 million annually (in 2015), with the internal rate of return ranging from 22 percent to 31 percent.

Synergies also exist between the need to power internet and communications infrastructure and the need to provide power to populations without access to the electric grid.

As illustrated in Figure 4, the “community power from mobile” model is an opportunity for energy service companies to build “solar + storage” and diesel hybrid power plants. These can provide power for telecom towers and base transceiver stations and establish mini-grids to serve homes, businesses, and “energy hubs” for charging mobile phones.

The current lack of electricity access is a major barrier to mobile phone use for off-grid subscribers, where the cost of phone charging can be as high as 50 percent of a mobile user's monthly expenses.⁸²

Further synergies and business opportunities between ICT infrastructure, renewable power, and mobile subscribers come from innovative payment methods such as pre-paid solar electricity services. Instead of relying on typical payment collection methods (with high transaction costs and losses), electricity bills can now be paid by cellphone through mobile money services such as M-Pesa in Kenya and Tanzania.

This approach also generates a large amount of data that helps to establish credit histories for a previously underserved segment of the population. This enables energy service companies or other energy suppliers to identify new markets and to differentiate customers based on varying levels of service, thus allowing them to tailor the service to a customer's ability to pay.

CONCLUSION

With rapidly declining costs for both solar photovoltaic and battery storage, new opportunities are emerging to power information and communications technology infrastructure in remote areas.

As a result, powering telecom towers and other ICT infrastructure in this way can be more cost effective than diesel generation. Coupled with the increase in the supply of lithium-ion batteries, this cost effectiveness gap will continue to grow. And new business models are emerging that leverage synergies between the need to power ICT infrastructure, the need to power off-grid populations, and the proliferation of mobile phones in emerging countries.

As ICT infrastructure expands—bringing telecommunication, internet connectivity, and power to remote regions—access to this infrastructure will foster education, entrepreneurship, and new business opportunities, and open new markets. ■

CHAPTER 3

Creating Mobile Telecom Markets in Africa

By Edgardo Sepulveda

Mobile telecommunications has many benefits, from linking communities and citizens to mobile applications that bring financial services to the unbanked and help farmers improve crop yields. Yet at one time it looked as though Africa's mobile sector might fare as poorly as its fixed line system did. Instead, an appropriate mix of regulation and competition, investment, and affordability allowed mobile phones and broadband access to flourish.

Just two decades ago only one person in a hundred owned a telephone in Sub-Saharan Africa. It was this state of affairs in the region and other developing economies that gave the oft-repeated 1995 statement that “half the world’s population has never made a phone call” such galvanizing power.⁸³

Historically the region had performed poorly in the provision of public infrastructure in general, and that was particularly the case with regard to telecommunications infrastructure, with demand far outstripping supply. Many fixed operators were slow to expand service and households and businesses were often forced to join waiting lists to receive service; many had to wait for several years to be connected. The waiting list in 1995 was about 1.5 million, or about a quarter of the six million lines in service.

Mobile telephony, then burgeoning in advanced economies, could have taken the same sluggish path in Africa as had fixed telephony. In 1990 only two countries in Sub-Saharan Africa had introduced mobile cellular service, with fewer than ten thousand subscribers between them.

Instead, a very different story unfolded. By 1995 half the countries in the region had introduced mobile service, with a total of about half a million subscribers. By 2000, virtually all countries in Sub-Saharan Africa had mobile service, with total subscribers surpassing ten million. Within five years subscribers had increased to 90 million, expanding to almost 400 million subscribers by 2010 and about 750 million by 2015.

Coverage and penetration statistics are equally impressive. The percentage of the population covered by mobile networks climbed from almost zero in 1995 to more than 80 percent in 2015. Mobile penetration has tracked mobile coverage—as networks expanded and populations gained network access, the majority of the newly-covered became subscribers. Mobile broadband penetration has grown to about 20 percent in 2015.

Figure 1 shows that the difference in the evolution of fixed and mobile penetration rates in the region has been dramatic: While fixed penetration has remained relatively stable at around 1 percent, mobile penetration surpassed fixed penetration by 2000 and reached 75 percent in 2015.⁸⁴ For most people in the region, the first phone they ever used was a mobile phone.

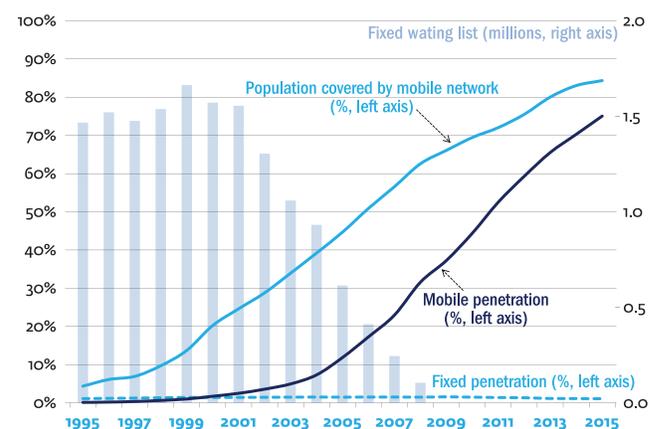


FIGURE 1 Mobile / Fixed Penetration and Fixed Waiting List

Source: International Telecommunication Union (ITU) and author's calculations

LIBERALIZATION, COMPETITION, AND REGULATION

The initial liberalization process in Africa’s mobile sector was relatively more straightforward than reform efforts in the fixed sector. Mobile service was new, so initial reform efforts generally were not constrained by the need to deal with competition and privatization issues relative to existing, state-owned fixed operators. Furthermore, the demonstration effect was important—by the mid-1990s mobile competition was the norm in advanced economies.

While there was significant variation across the region relative to the timing and sequencing of the liberalization process, as well as important differences between the initial phases of the process (for example, the licensing of the first and second mobile operators) and later phases (when third and subsequent mobile operators were licensed), there were typically a number of common elements in each process.

First, liberalization generally takes place in the presence of enabling telecommunications legislation. Appropriate legislation is required to provide certainty to the government and investors that the liberalization process is legally sound. The development of the corresponding regulatory framework is generally an ongoing process that is developed over time; it is often relatively “thin” in the initial phases while more developed in the later phases.

Key among these measures is the establishment of a separate national regulatory agency, or NRA, which tends to promote confidence that the competitive process will be administered in a fair and transparent manner. The first such institutions had been established in the region in the early 1990’s, but by 1995 only a handful were operating. By the early 2000’s, however, more than half the countries in the region had established NRAs, and by 2015 all but a few countries had established them.

Second, governments decide to license one or more new mobile operators. One of the first steps in this process is the government preparing and issuing a bid or tender document for the process. Based on strategic considerations and legal, economic, and other research, this document establishes the rules and procedures, the selection criteria, and the operating environment, including the allocated spectrum, tariffs and interconnection matters, and roll-out obligations. Based on an evaluation of the submitted bids, the government agency awards the license to the selected bidder. This process is repeated every time a new mobile operator is licensed.

And third, government establishes mechanisms to finance the expansion of access and infrastructure. In spite of impressive coverage gains by the mobile industry, many governments in Sub-Saharan Africa established universal service funds and promoted public-private partnerships to finance the expansion of

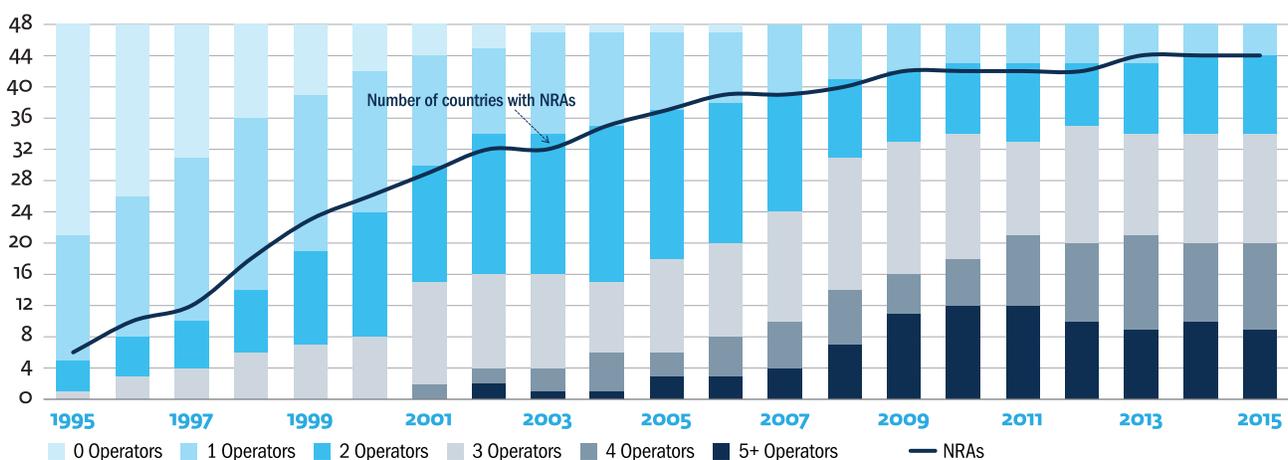


FIGURE 2 Number of Mobile Operators/Country, Number of NRAs

Source: ITU, GSMA, World Bank and author’s calculations

IMPROVING MOBILE COVERAGE IN MADAGASCAR

With the objective of providing service in remote geographic areas of Madagascar that had remained unserved or under-served, the World Bank provided technical and financial assistance over the 2007–2015 period. It has provided more than two million Malagasy in 660 rural communities with access to new technologies. In the covered regions, Internet service penetration has improved from near zero in 2007, to 13.4 percent in 2015. This project is an example of the World Bank assisting the Government of Madagascar to finance a specific mechanism to expand access to close the digital divide.

Via this assistance a total of 68 telecommunication towers were installed by private sector independent tower operators selected via a competitive selection process that allocated subsidy financing. The project fostered economic activity in these often difficult-to-reach regions and facilitated commercial activity by improving access to information and creating new opportunities.

access to unserved and underserved locations and to provide for other forms of infrastructure.

Figure 2 shows the evolution of the mobile competitive landscape in the region. In 1995, only half the countries had any mobile service; most that did had one operator, with only a handful having some competition with two or three operators. By 2000, almost all Sub-Saharan Africa countries had introduced mobile service, and fully half had established a competitive market with two or more operators. By 2005, about three-quarters of the countries in the region had two or more operators, and a handful of countries had introduced four or more operators. By 2010 the vast majority of countries had three or four operators. Figure 2 also shows that the growth in the region of separate NRAs closely coincided with the introduction of mobile (two or more operators) competition.

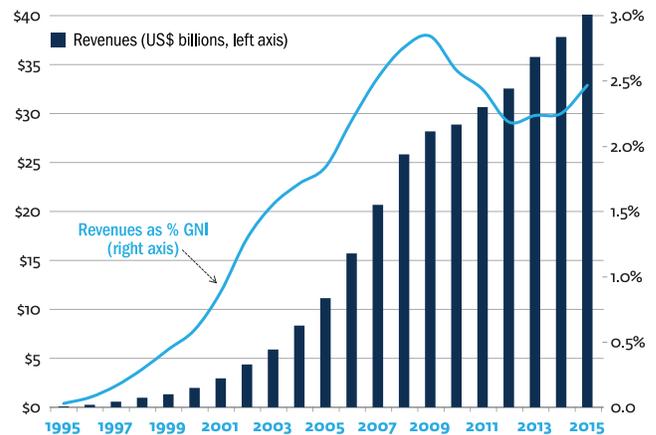


FIGURE 3 Mobile Revenues

Source: ITU, GSMA, World Bank and author's calculations

While some of the first mobile operators in countries were subsidiaries of the existing state-owned fixed operators, most were private sector operators. Virtually all second and subsequent mobile operators were private sector. This ownership pattern reflects the prevailing trend around the world. Africa is also similar to other regions in that most mobile operators are subsidiaries or otherwise related to a large regional mobile group.

AFFORDABLE, PRE-PAID PHONES

Two other innovations made mobile service more accessible. First, certain device manufacturers focused their attention on making basic affordable mobile handsets for the African market. And second, mobile service was offered under “pre-paid” terms (as well as the traditional “contract” terms). As a result, in Sub-Saharan Africa pre-paid service has accounted for 85 percent to 95 percent of all mobile subscriptions.

MOBILE REVENUES AND INVESTMENT

Mobile service revenues have increased along with subscriptions. Revenues in the region totaled \$100 million in 1995, accounting for only about 0.02 percent of gross national income for the region (Figure 3). Revenues continued to grow much faster than national economies, so that relative to GNI, they peaked in

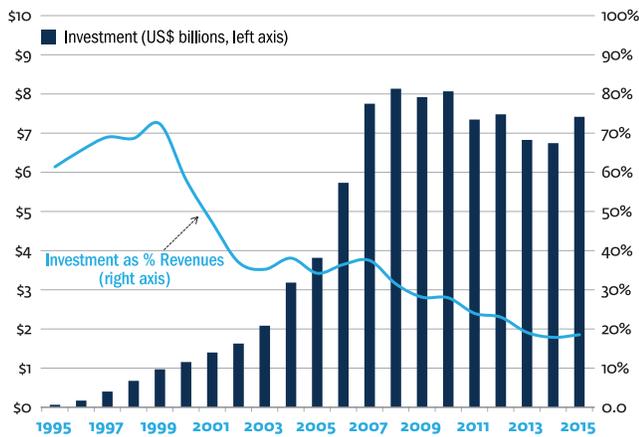


FIGURE 4 Investment in Mobile Networks

Source: ITU, GSMA, World Bank and author’s calculations

2009 at 2.8 percent. Mobile revenues continued to increase, reaching \$40 billion in 2015, with the voice/data ratio approximately 85 percent to 15 percent.

Mobile revenues are only one component of the direct and indirect contribution that the mobile “ecosystem” makes to the region’s economies. Other direct contributions include content/apps,⁸⁵ distribution and retailers, infrastructure providers, and handset manufacturers. Indirect contributions result from the “multipliers” associated with the effect that the direct expenditures have on related industries. And the use of mobile technology results in increased efficiency for workers and firms. In 2014 it was estimated that the direct, indirect and efficiency effects accounted for about 5.7 percent of regional GDP,⁸⁶ or about 2.5 times greater than mobile revenues.

Investment in mobile networks has increased commensurately. Figure 4 shows that investment reached \$1 billion in 2000, jumped to \$4 billion by 2005, and plateaued at the \$7-\$9 billion range during the 2007–2015 period. Relative to mobile revenues, investment was highest in the 1995–2000 period, as first and second mobile operators entered the market and built networks. Relative to revenues, investment in the 2001–2006 period declined, as operators “filled their networks” and increased their revenues. For

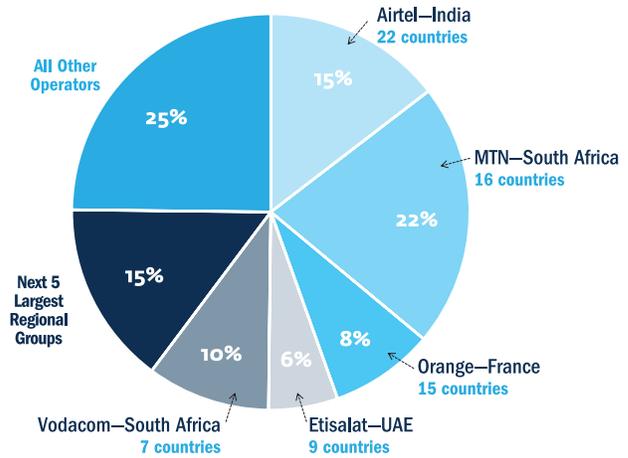


FIGURE 5 Market Shares and Countries of Operations of Five Largest Regional Mobile Groups, 2015

Source: GSMA, World Bank and author’s calculations

2007–2015 investment relative to revenues declined to the 20 percent to 30 percent range, consistent with mature networks in other parts of the world. Most of the investment over this period has come from outside the respective countries, often in the form of foreign direct investment sponsored by one of the large Pan-African mobile groups.⁸⁷ Indeed, Figure 5 shows that the five largest of such groups accounted for 60 percent of all subscriptions in the region, the next five largest groups accounted for 15 percent, and the smaller groups and independent operators accounting for the remaining 25 percent. Figure 5 also shows the diversified geographical provenance of these groups, from within and outside the region.

WORLD BANK AND IFC ROLES

The World Bank has provided extensive financing and technical assistance to the telecommunications sector in the region. Via its financing instruments,⁸⁸ the Bank has approved over two dozen telecommunications-related projects in thirty countries since 1995 with total financing of \$1.2 billion.⁸⁹

Broadly speaking, these lending projects included both regulatory and infrastructure components.⁹⁰ About 20 percent of total financing went toward strengthening telecommunications regulatory

frameworks. In seven specific projects this regulatory strengthening included assistance in the licensing of mobile operators. Most of the remaining 80 percent of the financing was infrastructure related, including subsidies and other types of financing to increase coverage and improve access.

IFC has provided more than \$1.4 billion in financing to companies in the technology, media, and telecommunications (TMT) industries in the region since 1995. The bulk of these operations (44 of 58) were to mobile telecommunications operators and independent tower operators.⁹¹ Across its entire portfolio, IFC provides financing under four broad categories: loans, equity, guarantees and risk-management products. Over 90 percent of the financing to mobile telecom operators was in the form of loans. However, for independent

tower operators, which have been a more recent financing segment, the portfolio is approximately balanced between loans and equity. IFC has provided financing to mobile telecommunications operators during the launch, expansion and rollout of new technologies.

CONCLUSION

Fixed line telephony never quite took off in Sub-Saharan Africa. Mobile telephony could have gone the same way. Instead, because of the right mix of regulation and competition, investment and affordability—and assistance from development institutions like the World Bank and IFC—over three quarters of the region’s inhabitants now have direct access to telecommunications and all the benefits it can bring. ■

CHAPTER 4

How Emerging Market Leaders Can Spur Technological Gains

By Florian Mölders, Thomas Rehermann, and Nana Esi Hammah

New technologies help firms in emerging markets make significant gains. But these firms often face barriers to successfully incorporating new technologies into their businesses. Emerging-market leaders, however, can take steps to help firms overcome these barriers, including strengthening regulatory frameworks, improving education, fostering trade, and increasing access to finance.

Access to technologies is critical for firms in emerging markets. Genuine innovations, as well as technologies that have been adapted or adopted from other countries, allow firms to boost productivity, save time, better serve customers, and ultimately become more competitive in both domestic and international markets.

Emerging-market governments can play a major role in helping companies gain access to technology. By creating a proper environment for businesses to acquire new and existing technologies, they can improve the competitiveness of their countries' firms and develop their economies.

TRIBANCO IN BRAZIL

Brazil's strong regulatory framework for the financial sector allowed local financial institution Tribanco to boost business for its parent company, Grupo Martins, Latin America's largest wholesaler and distributor of food, electronics, home improvement supplies, and pet food. Tribanco was able to provide new services to Grupo Martins' clients such as business training, and new products including as loans and customer credit cards, enabling the company to maintain market share against foreign competitors.

Source: IFC, *Inclusive Business Case Study: Tribanco*, 2012

RULES OF THE GAME

Regulations and laws at all levels—national, regional, and local—have a major impact on how firms can benefit from new technologies. Well-designed intellectual property rights, for example, ensure that firms profit from their innovations, and so encourage them to invest in research and development. Emerging-market governments can also lay the groundwork for new technologies to take off by creating market entry and exit rules, reducing corruption, cutting red tape, and building up high quality and reliable infrastructure, including communications technology, electricity, and water services.

ACCESS TO SKILLS

Firms also need an educated and well-trained workforce to research and develop new technologies and to take advantage of existing technologies. By investing in high-quality education and research institutions, emerging-market governments can build such a workforce, keep skilled workers from emigrating, and foster the development of new technologies.

Because skilled workers are critical for firms that want to adapt new technologies, they often invest in training their own workers, especially in regions that lack strong universities and research institutions. Governments can support private sector efforts by fostering education and training in much needed fields and connecting labor supply to potential employers.

MILlicom IN AFRICA AND LATIN AMERICA

Intense international competition in the mobile services sector has driven Luxembourg-based Millicom to build and maintain market share in 12 countries across Africa and Latin America. Millicom provides value-added services such as borrowing for urgent calls or text messages if customers are unable to top-up their accounts, and text menus and services in countries with low smartphone penetration and data availability. Millicom also offers mobile financial services, such as person-to-person money transfers, international remittances, and payments to people who lack access to formal banks.

Source: IFC, *Inclusive Business Case Study: Millicom*, 2014

MARKET ACCESS AND EXPOSURE

Competition, at both the national and international levels, drives firms to invest in a new technology, innovation, or business model. For example, when a firm spots an opportunity in an international market, it may adopt a new technology to raise quality standards and cut production costs in an attempt to generate customers abroad. By opening up markets beyond their borders, emerging-market governments can help firms expand their consumer bases. With more customers in more countries, firms may be able to reduce production costs and improve production quality by taking advantage of economies of scale.

In addition, an open trade policy can boost foreign direct investment. Access to markets allows a firm to operate different stages of a production process in different countries or to establish production facilities in a foreign country in order to avoid tariffs and other trade costs. Investments in modern infrastructure and transportation networks help countries gain even more from open markets.

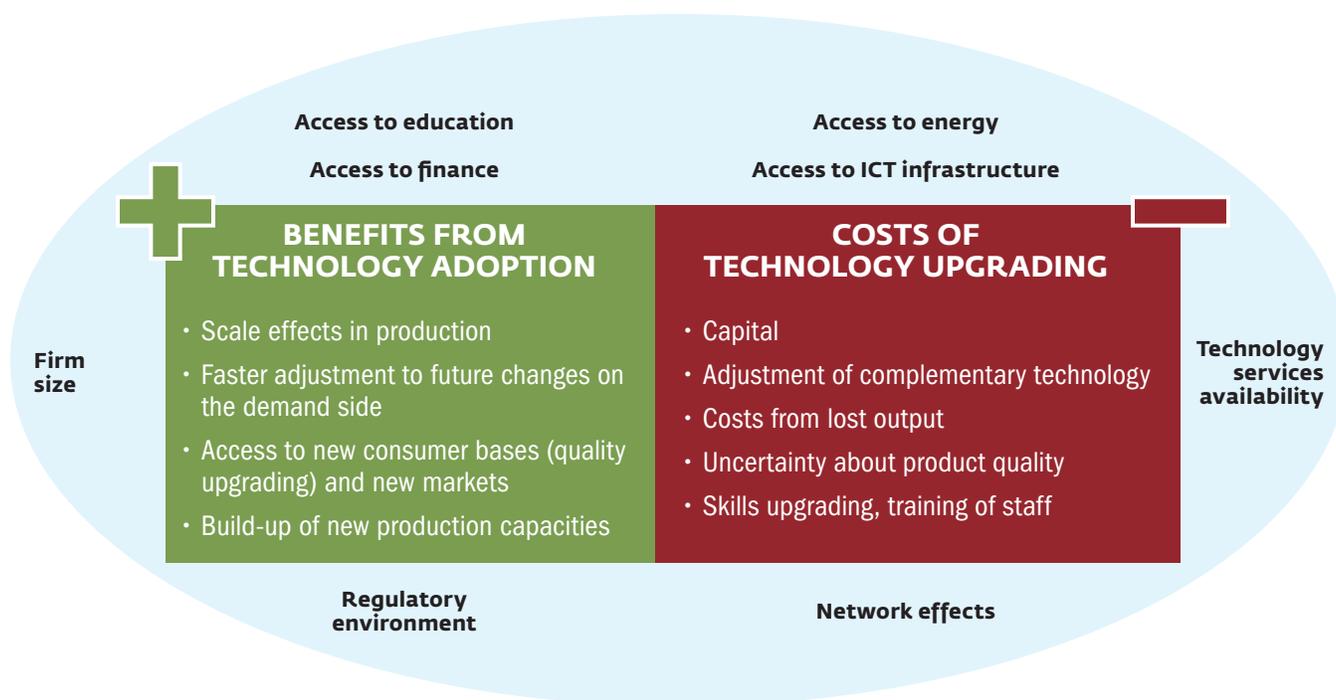


FIGURE 1 What Matters for Technology Adoption?

The green and red boxes highlight the benefits and costs of adopting a new technology, while the factors in gray outline the parameters that influence a firm's ability to access technology. Source: IFC Thought Leadership

BRIDGE INTERNATIONAL ACADEMIES IN AFRICA

Bridge International Academies is a private company that provides high quality and low-cost education to low-income students across Africa. Students pay \$6 a month to attend classes. Bridge uses smartphones and tablets to closely monitor teacher and student performance, deliver standard lessons, and manage billing. In order to identify and train teachers, Bridge developed an International Training Institute with a 235-hour intensive training course. In 2015 Bridge had 414 academies in Kenya, Uganda, and Nigeria. The company plans to expand to Asia in coming years.

Source: Brookings, "Bridge International Academies – Delivering Quality Education at a Low Cost in Kenya, Nigeria, and Uganda," 2016.

Beyond individual firms, entire economies can benefit from global trade ties, as high-value global production creates skilled jobs and facilitates the sharing of knowledge between economies.

ACCESS TO FINANCE

New technologies can be expensive and risky to invest in, and they require investments in worker training and production upgrades. Therefore firms also need ready access to finance—including loans, equity, or bond issuances—in order to adopt new technologies.

Firms may need one or more of these sources of capital to invest in upgrades, depending on the technology. In its 2014 Transition Report, the European Bank for Reconstruction and Development found that firms in Europe's transition countries tended to use bank loans to fund the licenses and technical capacity needed to adopt new technologies. When those technologies needed to be modified or adapted to the local context, larger investments were required for research and development. For that they often turned to alternate sources of funding such as private equity or venture capital.

Firms with access to finance are around 30 percent more likely to introduce a new product, according to the EBRD report,⁹² while companies that lack financial resources are less innovative, and those that pay high rates of interest struggle to upgrade technology.⁹³

The public sector can help remedy the financing situation. It can boost the amount of credit available by promoting competition among existing financial institutions and promoting new financial start-ups. Such start-ups gather data from multiple sources and use that data to verify credit, help banks make better loans, and ultimately increase access to finance.

ENGRO IN PAKISTAN

Since 2009 IFC has provided financing to Engro Foods Limited, the second largest producer of processed milk in Pakistan. Engro employs 1,700 workers to manufacture, process, and sell dairy products, juice, ice cream, and frozen desserts. It has also brought 300,000 milk farmers into its supply chain. In addition to a subordinated loan of up to \$50 million, IFC continues to provide Engro funding during difficult market conditions. This financing has allowed the company to develop a management information system called Engro Milk Automation Network that enables a village-wide procurement network. Engro collects, transmits, and monitors real time data from its Milk Collection Centers. After testing and accepting milk from a farmer, a unique magnetic card assigned to each farmer is swiped at a point-of-sale terminal. Engro's network uses that data to make improvements to the process. In addition, the network can pay farmers with direct electronic deposits or send money to collection centers, which pay farmers in cash. Farmers can also seek veterinary support for sick cattle, apply for loans, and top up their mobile phones. In the future, Engro may expand the role of the networks to include more banking services.

Source: IFC, "Shared Prosperity through Inclusive Business: How Successful Companies Reach the Base of the Pyramid," 2014

ACCESSING NEW MARKETS

New technologies have been crucial to the provision of products and services to the 4.5 billion people who live on \$8 a day or less. These people have combined spending power of \$5 trillion annually, but they often live in areas with poor infrastructure, an obstacle that prevents their participation in markets. Companies that want to serve these markets must offer affordable, accessible, and relevant products and services. The most successful companies have moved beyond merely selling to low-income consumers to working directly with them using local talent and business models. They use technology to overcome constraints such as inadequate physical infrastructure, lack of skills and financing, and weak regulatory environments.

Utilizing Mobile Telephony. The growth and spread of information and communication technologies have spurred low-cost innovations in the field of mobile telephony. Mobile bank branches and innovations such as mobile money, which allows money transfers between mobile phone user accounts, have played a significant role in bringing financial services to low-income customers. About 80 percent of low-income customers without access to physical financial services now use digital financial services. In Bangladesh, for example, bKash facilitates salary payments, international remittances, and payments at local mom-and-pop shops around the country. It now has 23 million customers.

Overcoming Constraints. ECOM Agroindustrial Corp, one of the world's leading commodity traders, provides direct financing and technical assistance to small, low-income coffee growers, helping them improve productivity, increase quality, and gain the certification necessary for premium pricing. As of 2012, ECOM had purchased more than 81,000 metric tons of certified coffee in the six years since its inclusive business model was established, paying farmers about \$15 million.

Adapting Processes. A Mexico City eye care provider, salaUno, uses a hub-and-spoke model to reach customers in far off locations and offer prices that are 40 percent lower than those of its competitors. All of the company's processes are designed to increase efficiency and lower costs, while at the same time maintaining its high quality of care.

Differentiating the Product. Vinte is a housing developer that offers affordable, quality homes to first-time low and middle-income home buyers in Mexico. The company incorporates technologies into its designs that not only increase the appeal of its homes but also lower the ongoing costs of home ownership. For example, Vinte's homes are designed to reduce gas bills by 75 percent. They also provide the option of rooftop solar cells, which can significantly reduce fuel bills. Homeowners can monitor the electricity, gas, and water consumption with individual meters and adjust their habits as needed to save money.

Source: Karolien Bais, "The Base of the Pyramid as a Development Strategy," Oxfam Novib, 2008. Raphael Kaplinsky, "Bottom of the Pyramid Innovation and Pro-Poor Growth," World Bank, 2011. Triki Thouraya and Faye Issa, "Financial Inclusion in Africa," African Development Bank, 2013. World Bank, "World Development Report 2016: Digital Dividends." IFC, "Shared Prosperity through Inclusive Business: How Successful Companies Reach the Base of the Pyramid," 2014.

CONCLUSION

Firms in emerging markets face numerous obstacles to incorporating beneficial new technologies in their operations. These obstacles include lack of access to financing, a shortage of qualified workers, obstructive regulatory frameworks, and substandard

infrastructure. While there is no standard approach to getting firms to adopt new technologies in emerging markets, significant investments in education, infrastructure, and business environments, as well as improved access to finance, can help emerging-market countries overcome these obstacles. ■

CHAPTER 5

Creating Agricultural Markets: How the Ethiopia Commodity Exchange Connects Farmers and Buyers through Partnership and Technology

By Abenet Bekele Haile, Ariane Volk, and Thomas Rehermann

Commodity exchanges can provide emerging market economies with orderly, transparent, and efficient markets by acting as mechanisms that mitigate price risk, discover equilibrium prices, and connect buyers and sellers. Exchanges can also reduce transaction costs and information asymmetries by using technology to disseminate market information while creating better supply chains. The Ethiopia Commodity Exchange is striving to transform Ethiopia’s agriculture sector from a fragmented one marked by high transaction costs and low quality standards to a thriving and reliable part of the country’s economy. Ethiopia’s exchange continues to expand its activity across the farming regions of the country.

Commodity trading has existed for hundreds of years. The first commodity exchanges were in Asia where Japan established an exchange for rice in Osaka in the 17th century and traded with futures contracts as early as 1697, almost two centuries before they were used in

the United States in 1867.⁹⁴ Ethiopia now joins the ranks of these nations with its Addis Ababa-based Ethiopia Commodity Exchange, or ECX, launched in 2008 with the goal of transforming the country’s agricultural sector.

THE PURPOSE OF COMMODITY EXCHANGES

Commodity exchanges are organized market venues where buyers and sellers of a commodity meet to trade it or its derivatives. They are designed to help mitigate counterparty risk and ensure that payments are made through reliable financial service providers. Exchanges provide a framework for market actors, financial institutions, and commodity operators to interact based on rules that provide legal protections.

Exchanges further reduce information asymmetry. This encourages competition among buyers and sellers by allowing them to discover the real value of commodities in the market.

Commodity exchanges in emerging markets typically trade with spot contracts that offer immediate delivery of the traded good, while those in more advanced economies tend to trade in futures and options contracts.

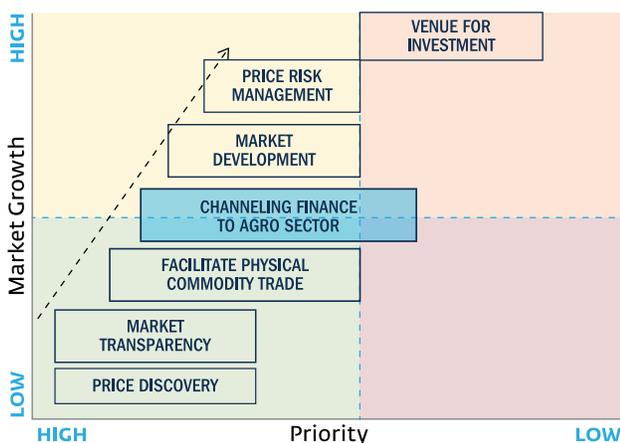


FIGURE 1 Benefits of Commodity Exchanges to Emerging Markets

Source: Based on UNCTAD Report, *Development Impact of Commodity Exchanges in EM*, 2009

Commodity exchanges are adaptable and can remedy several risk factors in emerging markets, including price risks, poor price discovery, and a lack of market transparency (Figure 1). “If properly organized, a whole array of other problems, including problems with finding buyers or sellers, quality problems, difficulties in obtaining credit, and counterparty risks” can be solved through exchanges.⁹⁵

These exchanges further support the warehousing, transportation, quality accreditation, financial services, and telecom and insurance sectors, allowing them to flourish.

THE ETHIOPIA COMMODITY EXCHANGE MARKET

Ethiopia’s exchange was formed to overhaul the country’s agriculture sector and create a dynamic, forward-looking, and efficient agricultural market system.⁹⁶ The first modern commodity exchange in Sub-Saharan Africa outside South Africa and a pioneer for Rwanda’s East Africa Exchange, it now connects 3.5 million Ethiopian smallholder farmers to markets.⁹⁷

Similar to those in most emerging markets, Ethiopia’s exchange was launched with an open outcry system which deployed spot contracts for three staple foods—maize, wheat, and haricot beans—with one satellite delivery center and two partner commercial banks.

Before its launch, Ethiopia’s agriculture sector was fragmented and suffered from high transaction costs,

equally high contract default rates, a lack of quality standards, and an unreliable commodity supply.

Weak infrastructure in terms of electricity, roads, telecommunications, financial services, and warehouses, along with an absence of necessary market infrastructures, including reliable and timely market information, standards, and reliable ways to connect buyers and sellers, all hampered the exchange’s initial progress.⁹⁸

In the eight years since its inception, the exchange has evolved to handle larger trade volumes (Figure 2). The volume of coffee and sesame traded has grown from 138,000 metric tons in 2008–2009 to 715,000 metric tons in 2015–2016.

As depicted in Figure 3, Ethiopia’s commodity exchange trade value of coffee and sesame have remained buoyant—about 10 billion Ethiopian birr (equivalent to \$440 million) in the first half of 2017 alone. Other traded commodities include green mung beans, red kidney beans, wheat, and maize.

Ethiopia’s exchange was positioned to function as an end-to-end service for commodity warehousing, quality control, trading, clearing, and market data dissemination. Its indigenous all-in-one model gave it the functions of an exchange, quality certifier, warehouse operator, and clearinghouse.

However, in order to advance the service provision, this model was replaced in 2016 by a system placing the warehouse and quality control operations and



FIGURE 2 Volume of Traded Coffee and Sesame

Source: Ethiopia Commodity Exchange Strategy Planning Unit Report, 2016.

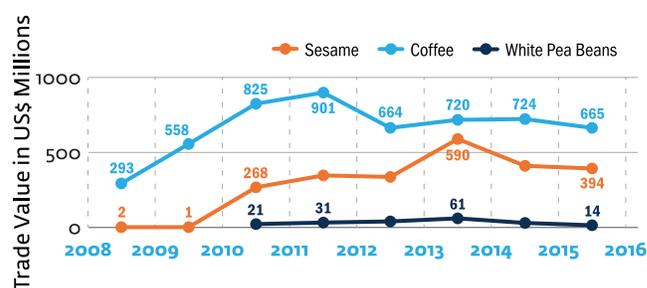


FIGURE 3 Transaction Value for Coffee and Sesame

Source: Ethiopia Commodity Exchange Strategy Planning Unit Report, 2016.

the central depository functions under the Ethiopian Agricultural Commodities Warehousing Service Enterprise, a separate business entity. A regulatory body, the Ethiopian Commodity Exchange Authority, was also established to oversee the overall operation of the exchange as well as its external operators.

A lack of awareness about structured markets was a daunting hurdle in the initial stage of the exchange's implementation. The exchange has successfully marketed itself through intensive campaigns and the training of farmers.

THE PARTNERSHIP

Ethiopia's exchange is a commercial non-profit entity established as a public-private partnership. Unprecedentedly, it is jointly governed by private and public sector members of its Board of Directors, with five of the eleven board members from the private sector.⁹⁹ Major decisions such as adjusting fees, reinvesting net profits, appointing chief executive officers, and approving and amending exchange rules require a two-thirds majority vote.

The exchange is demutualized, however, with ownership (represented by the public sector) separated from membership and management. Memberships are classed into ordinary (trading and intermediary) membership, which entitles the member to a permanent seat on the exchange, and special (limited trading and intermediary) membership, which is valid for a year. Permanent membership seats are sold at auction and cost \$75,000 per seat on average,¹⁰⁰ giving the member the right to trade commodities on the exchange.

In total, Ethiopia's exchange has 346 members, including 33 farm cooperatives, of which 7 percent are trading members.¹⁰¹ Ordinary members have the right to govern the exchange by being elected as a representative to the Board of Directors.

Members are expected to produce an audited financial statement that satisfies the minimum net worth requirement according to their membership class. To actively trade in the exchange, members (either a person or a business) must secure recognition as 'exchange actors' from the Ethiopian Commodity Exchange Authority.

A TECHNOLOGY-DRIVEN EXCHANGE

Ethiopia's technologically advanced exchange offers trades based on an electronic warehouse receipt system that links data from warehouse operations, clearing and settlement, and market-information onto one platform. The system also has a warehouse receipt financing component to provide short-term working capital loans to small-scale traders.

The exchange also provides a fully secured clearing and settlement service and central depository that are electronically linked to eleven commercial banks and a warehouse operator, which in turn is linked to a network of warehouses across the country.

These connected warehouses reduce price dispersion among regions and transaction costs for regional farmers.¹⁰² The exchange's secured payment system is digitally linked to the warehouse operator, financial institutions, tax administration agency, and more than 16,000 traders.

The exchange settles transactions of more than \$10 million per day with settlements made the following business day. Similarly, the exchange's clearinghouse has cleared more than \$6 billion worth of transactions so far without default.

Market participants in Ethiopia now have access to reliable market data through various sources provided by the exchange, including a mobile push service that delivers up-to-date daily market information to farmers and agro-processors via text message and interactive voice response services offered in Amharic, Oromoiffa, Tigrigna, and English.

As a result, small-scale farmers receive 70 percent of the final price of a trade, up from 38 percent prior to the establishment of the exchange.¹⁰³

The exchange continues to innovate. In July 2015, with the help of a \$2.2 million grant from the Investment Climate Facility for Africa, it introduced a \$3.8 million electronic trading platform to replace the original open outcry system. This created the capacity to execute significantly more transactions than the former system, with greater speed and data capture display functions, and the ability to cater to far more participants.¹⁰⁴ The majority of the exchange's trades are now made electronically.

Ethiopia’s exchange is also expanding its activities throughout the country’s major agriculture producing areas. The goal is to open more trading centers in order to increase liquidity and accessibility to both commercial and smallholder farmers. The exchange’s second trading center, built in Hawassa, will begin operations by the end of 2017.

INTEGRATING TRACEABILITY INTO THE EXCHANGE

Since its launch, Ethiopia’s exchange has traded more than 3.9 million metric tons of agricultural commodities. However, only a fraction of these commodities were traced to their source using a traceability system.

Food regulations in Europe and the United States require traceability of commodities along the agricultural value chain, as part of international requirements to meet health and safety standards. The European Union General Food Law, for example, mandates that all food and feed producers and operators have a traceability system.¹⁰⁵

Growing concern about a lack of traceability, particularly for coffee, prompted Ethiopia’s exchange to initiate a traceability project on export-oriented commodities, including coffee and sesame, in 2013.

Two years later the exchange officially launched its cloud-based IBM-enabled national traceability system, which runs jointly with the warehouse operator Ethiopian Agricultural Commodities Warehousing Service

Enterprise. The \$4.5 million program, implemented in collaboration with the United States Agency for International Development, was designed to function with a bar code system to track commodity trades.¹⁰⁶

The agriculture sector is now required to disclose data on quality, health and safety standards, as well as the movement of commodities along the supply chain, from the processing unit to the shelf. Businesses associated with the agriculture sector, including commodity suppliers and warehouse operators, greatly benefit from the tracking, which helps detect embezzlement and fraud as well as poor quality products, and also helps warehouse operators optimize storage space.

The traceability process (Figure 4): Bags of commodities traded on the exchange are tagged with geo-referencing to washing and hulling stations or aggregation points throughout Ethiopia’s agricultural regions. The bag-tagging system provides the commodity exchange with continuous real-time data analytics. It is also capable of learning and predicting the quality of commodities based on domestic growth and processing conditions.¹⁰⁷ Bags containing close to 27,000 metric tons of coffee have been tagged and traded by the exchange so far.¹⁰⁸

Still at the pilot stage with only two locations, Ethiopia’s traceability project—designed to satisfy trading partners’ rules-of-origin requirements—is expected to become a full-scale operation for both coffee and sesame commodities within the next few years.¹⁰⁹



FIGURE 4 Traceability Process Flow

Source: Traceability project 2014; EACWSE = Ethiopian Agricultural Commodities Warehousing Service Enterprise.

CONCLUSION

An efficient and reliable commodities exchange system can provide producers and agribusinesses in emerging markets with a competitive edge.

The implementation of information technology in exchanges can have a transformational effect for emerging markets, delivering transparency, access to market data, and the ability to trace and determine the quality of products. It plays a crucial role in creating and promoting fair and orderly markets and mitigating price risks.

Exchanges can also bring broad-based economic benefits, stimulating growth while linking smallholder farmers, financial institutions, and communications technology. ■

CHAPTER 6

Technology-Enabled Supply Chain Finance for Small and Medium Enterprises is a Major Growth Opportunity for Banks

By Qamar Saleem, Martin Hommes, and Aksinya Sorokina

In most emerging markets, small and medium enterprises, or SMEs, lack access to the credit and liquidity they require for their daily working capital needs. This is partly due to the fact that the credit risk of such businesses is typically difficult to assess and their working capital needs are unpredictable. In most countries these businesses operate primarily in the retail and wholesale trade segments, and banks have generally not done enough to finance their domestic or international trade operations, especially open account transactions. Supply chain finance structures offer an alternative solution to finance the trade flows of these enterprises, with benefits for all stakeholders, including large enterprises, their SME trade counterparts, and financial institutions. This type of financing helps banks extend working capital finance to SMEs by leveraging commercial and trust relationships between the SMEs and corporates; it helps large corporates improve their working capital management and decreases supply chain disruptions; and it enables banks to better assess, measure, and manage the risks of extending financing to SMEs.

Supply chain finance is a broad category of financing with multiple products, and it contributes significantly to global trade finance, which has an estimated financing gap of \$1.9 trillion annually around the world.¹¹⁰ According to the Aite Group, the estimated potential volume of reverse factoring, one of the common supply chain finance products, ranges from \$255 to \$280 billion, globally.¹¹¹

Growth in the supply chain finance sector is rising steadily. In the period between 2008 and 2014, domestic factoring volume increased on average by six percent per year across 70 countries in Europe, the Americas, Africa, Asia and the Pacific. International factoring volume grew on average 16.6 percent per year.¹¹² Moreover, research conducted by Demica shows that supply chain financing at major international banks is growing by a rate of 30 to 40 percent a year, and much of the expected future growth will be driven by local supply chains.¹¹³

Companies can use supply chain finance to significantly increase their economic value by

extending days payable outstanding, reducing days sales outstanding, reducing automation related costs, and boosting trade volumes as a result of greater economies of scale. “The strategic relationship between supplier, buyer, and a bank would naturally prevent either party from failing to deliver on mutual contractual obligations,” according to Eugenio Cavenaghi of Banco Santander.¹¹⁴ The compelling benefits of supply chain finance make it clear that it is a very attractive market opportunity for banks.

Supply chain finance has traditionally been driven by international banks that focused more on cross border trade, but its adoption has been slow due to weak recourse environments, as well as scalability and origination costs. However, in recent years there has been a shift toward digitization and automation of both supply chain finance transactional flows and supply chain financial solutions. Leveraging the wide range of trade and transactional data, rapidly growing technology platforms are now playing a crucial role

in increasing transparency by providing risk profiling credit information for banks to gain a larger share of the market.

According to Enrico Camerinelli of the Aite Group, the key trends in supply chain finance are its ability to:

- Transition from paper-based transactions to electronic invoicing
- Move from a buyer-centric model to a distributed network of buyers and suppliers with no defined central anchor
- Use transactional data to assess the credit worthiness of potential borrowers¹¹⁵

Supply chain finance not only provides market trends and prevents disruptions, but also helps banks better manage risks. André Casterman, a member of the ICC Banking Committee states that “a big innovation in the market is using transactional data for risk assessment and mitigation. The data from the physical value chains and payment data collected through technology providers can be used to enhance the knowledge of the credit-worthiness of a particular enterprise, industry, or region.” The playing field has changed, propelling the supply chain finance sector forward.

AUTOMATION CONSIDERATIONS

Technology, either in-house or multi-bank platforms, is central to any successful supply chain finance program. When selecting the technology, three important factors need to be considered. These are automation, simplicity, and scalability (Figure 1). The nature of supply chain finance platforms is quite diverse, making selecting a well-suited supply chain finance platform a monumental task that requires banks to clearly understand the goals of the program, as well as current capabilities and gaps.

Supply chain finance solutions can take various forms in order to address different challenges. A bank considering launching or scaling up its supply chain finance business typically has the following two options: (1) use a bank-led platform, either developing an internal IT infrastructure or adopting another bank’s platform; (2) contracting a bank-independent platform through: (a) licensing the technology solution from a technology platform; (b) outsourcing the automation services to a third-party platform such as Software as a Service; or (c) participating in a marketplace as one of multiple funders.

AUTOMATION

Key Features

- Speed of transactional flow
- Data collection from physical supply chain flows
- Reporting functionality
- Integration with the core banking system

Key Benefits

- Increased productivity
- Timeliness of invoice delivery
- Multi-party transaction visibility
- Efficiency

SIMPLICITY

Key Features

- Intuitive interface
- Structured workflow, easy accessibility by all parties
- Flexible connectivity to various core systems

Key Benefits

- Ease of use for ultimate user
- Minimum level of training required for staff and trade counterparts

SCALABILITY

Key Features

- Ability to scale up transactional volume
- Efficient problem solving with integration and operationalization
- Ability to extend offering to more than one product

Key Benefits

- Reduced number of errors
- Unconstraint business growth

FIGURE 1 Success Factors for an Effective Supply Chain Finance Technology Solution

Source: IFC

BANK LED PLATFORMS

Bank led platforms, especially those developed internally, provide a high level of flexibility and can be highly configurable, enabling easy integration of treasury, procurement, and IT work streams. In such a scenario, banks are the sole owner and funder of the program, which establishes exclusivity rights to the supply chain solution and strengthens its connection with clients, providing the bank with a competitive advantage.

However, developing such a platform from scratch can be highly complex, delaying the launch of a supply chain finance program and invariably requiring a substantial financial investment.

Development, implementation and maintenance make this option expensive and less adaptive. Big banks such as Citibank, HSBC, ICICI Bank, Deutsche Bank, Santander, and JPMorgan Chase manage their individual proprietary supply chain finance platforms. However, these institutions are pioneers in supply chain finance and their systems are well integrated into their transaction banking capabilities.

Smaller financial institutions may also choose to partner with another bank to use their technology platform. This allows the institution to provide additional financing while avoiding the credit process and the additional cost of hosting a platform. However, this option is exercised more in a syndicated supply chain finance transactions and is not prevalent due to data sharing issues.

The number of independent third-party platforms has increased significantly. According to Casterman, “the financing option provided by business-to-business platforms is an important development in the market.” He adds that AP Ariba and Basware are among the largest Purchase-to-Payments networks facilitating financing. They collaborate with financial institutions to combine their transaction data with the participating bank’s balance sheet to satisfy funding requirements.¹¹⁶ So, depending on the needs and goals of the supply chain finance program for the bank and the businesses, the external platforms can be contracted in three different ways: (1) licensed, (2) Software as a Service; or (3) marketplace.

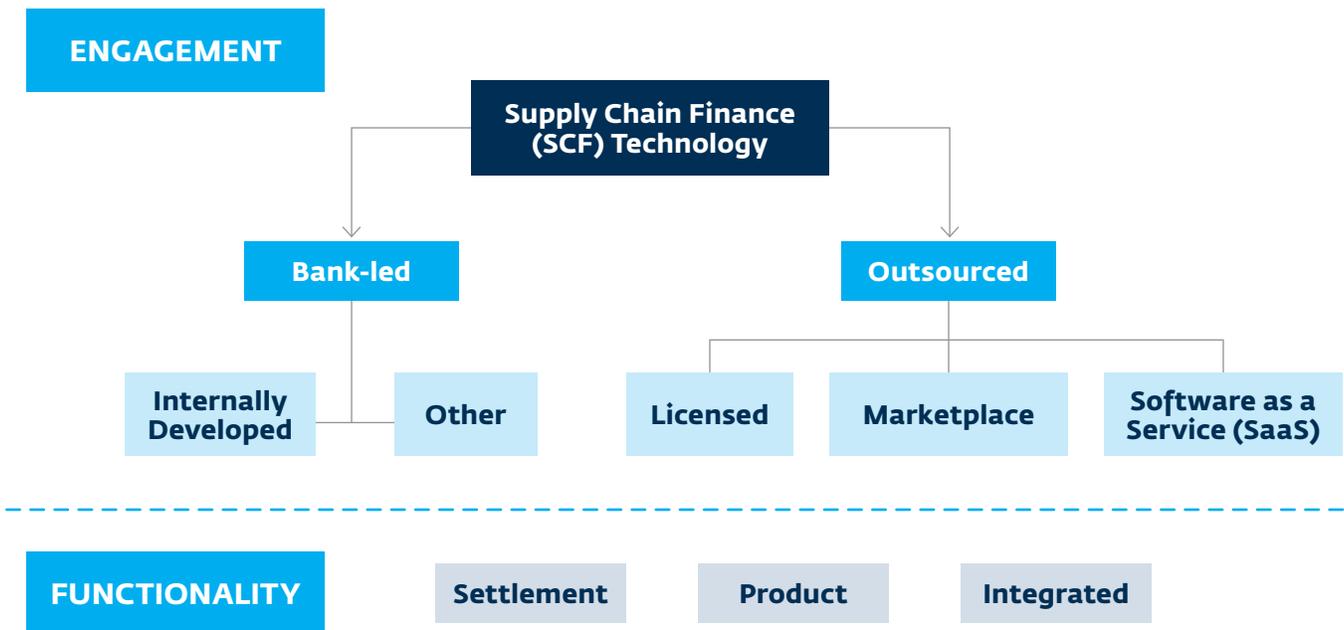


FIGURE 2 Supply Chain Finance Technology Solutions Engagement Categorization

Source: IFC (SCF = Supply chain finance; SaaS = Software as a Service).

Licensed. Financial institutions can buy a readily available solution and license it. The license agreement with an external supply chain finance platform may include installation, integration with the core banking system, and ongoing support and maintenance—all undertaken under the platform’s brand. The financial institution can also white label the solution and present it under a new name. White-labeled solutions provide great marketing benefits, although they increase the cost of implementation. Platforms such as Premium Technology (FinShare), Orbian, and Demica work with banks on white-label solutions, along with their own proprietary offerings. In addition, to ensure that first-comer benefits are fully explored in a given market, financial institutions could consider an exclusive relationship for a given time period, on a case-to-case basis, with an external technology provider.

Software as a Service. The financial institution can also use an external software company’s services on a ‘Software as a Service’ basis, where the provider is responsible for data aggregation and hosting, for managing the transactions, and for communication with stakeholders. In comparison to the licensed solution, this option features faster implementation, up-to-date technology, low integration requirements, and low costs.

Such a solution typically has a standardized set of functionalities and therefore may be less customized and tailored toward the specific needs of each financial institution. The bank also carries the business risk of the technology company by contractually hiring it to manage the supply chain finance related business processes. Some examples of the Software as a Service model used in the supply chain finance space include Kyriba, Taulia, and Prime Revenue.

Marketplace. Technology solutions can be enabled for stakeholders along the supply chain through the marketplace, providing them with access to a wide range of financial institutions and enabling them to sell invoices directly to investors, including banks, hedge funds, and private equity firms. In such a model, the suppliers and buyers can choose a funder among investors registered on the platform and based on the specifics of the transaction, geography, and price. The bank can also agree or disagree on finance

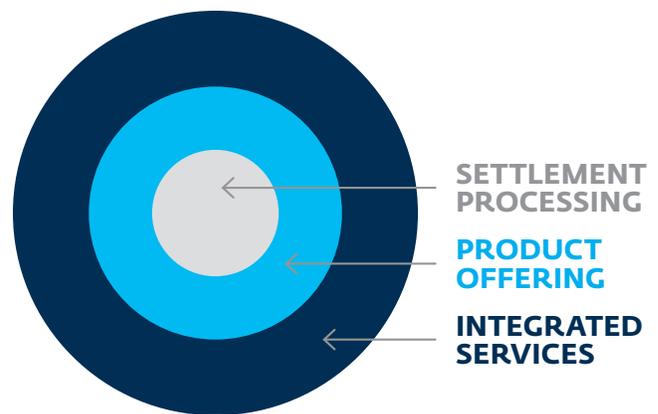


FIGURE 3 Functionality of Supply Chain Finance Platforms

Source: IFC

specific transactions. The marketplace can also work as an auction, allowing various investors to bid and participate in the invoice auctioning. Platforms such as Prime Revenue, Ariba, Orbian, Nafin, Bolero, and the Receivables Exchange are examples of supply chain finance marketplaces.

SERVICE LEVEL FUNCTIONALITIES OF SUPPLY CHAIN FINANCE PLATFORMS

A bank can select the technology platform best suited to its requirements from a range of vendors and at varying degrees of functional complexity. Market practitioners define various segmentation methodologies of the platforms depending on their functionality. Alexander Malaket, a member of the ICC Banking Committee, for example, defines three types of supply chain finance platforms: (1) payment processors for trade settlement, (2) package providers for standardized products and financing, and (3) global trade management providers for payment settlement, distribution of risk, cash management, and other comprehensive services. Banks can select platforms that best match their needs and fill the gaps of their own technology infrastructure.

Settlement processing. Platforms such as Ariba, Oxygen Finance, and GT Nexus support the electronic flow of trade documents and information, document exchange, automation of payments, e-invoicing,

data matching, and reconciliation between buyers and sellers. Such platforms provide banks with transparency on buyer and supplier transactions, simplifying financing decisions and allowing buyers and suppliers to collaborate on a single platform.

Product offering. In addition to process management, platforms such as PrimeRevenue, GT Nexus, Premium Technology, GSCF, GTC, Misys, and Octet provide financial institutions with an automated system for managing their trade accounts through various structured supply chain finance products, including invoice discounting, purchase order financing, reverse factoring, and distributor finance.

Integrated services. In order to ensure a seamless and efficient supply chain finance program it is crucial that all participating parties—both the supplier and buyer treasuries, sales, procurement, IT, legal, and the financial institution—clearly understand the processes, responsibilities, and pricing involved. Technology providers such as Demica and Prime Revenue can provide an advisory role to stakeholders on various related matters, including assisting with the complicated onboarding process. Such services might lie in the following areas:

-  **Cash management and treasury solutions**
-  **Structuring the SCF process and organizational set up**
-  **Onboarding and training of trade counterparts**
-  **Advise on data extraction and reporting**
-  **Analytics on trade volumes, performance, and trends**
-  **Collaboration with collection agencies**
-  **Advise in the area of tax / accounting**
-  **Advise in the area of legal frameworks / documentation**
-  **Continuous ad-hoc support**

Source: IFC

It is important to consider that the above categorization is not mutually exclusive and that there is a degree of overlap owing to the emerging nature of the industry. Another dimension to consider when looking at technology platforms is the anchor focus and the product range.

There are platforms that focus more on international and tier one anchor companies, while the emerging platforms place greater focus on tier two and/or regional and local corporates. In addition, the range of products offered by the platforms varies, especially when it comes to their ability to offer distributor finance solutions.¹¹⁷

EMERGING TRENDS IN SUPPLY CHAIN FINANCE

Supply chain finance securitization. Supply chain finance trade payables and receivables can be packaged into securities and distributed to capital markets along with other types of derivatives. Some platforms (for example, the one offered by CRX Markets) offer an auction-based securitization platform that provides various types of investors with access to this type of instrument.

New solutions are appearing in the market that have the ability to reduce the risk of a single issuer, distribute an exposure across several suppliers in a bundled security, issue it in capital markets, or sell it directly to private or institutional investors. Alexander Malaket says that “securitization is part of the market and gains attention in periods where banks experience balance sheet limitations and constraints and must remove trade business from the balance sheet. Fintech companies will have a role to play in these securitization processes which strive to diversify the risks.”¹¹⁸

Blockchain technology. With innovation occurring in the financial technology space, banks are looking for new ways to compete. According to Casterman, “blockchain technology can boost purchase order financing by providing greater security, better efficiency, and higher confidence in the data used for making financial decisions. Today, purchase order financing is quite underutilized, since it often requires a confirmation through letters of credit or other instruments. Blockchain can ease this requirement and enable purchase order financing for wider use by SMEs.”¹¹⁹

According to the Global Trade Review, a number of institutions including Standard Chartered Bank, DBS Bank, and Infocomm Development Authority of Singapore are discussing the possibility of developing a blockchain-based invoice trading platform. It is based on Ripple’s distributed ledger technology for tracking invoices, backing loans to suppliers, and reducing the risk of invoice duplication while maintaining client confidentiality.¹²⁰ Such a platform would allow banks to convert invoices into digital assets on a distributed ledger. Participants get a cryptographic identity, while information on the status of invoices is accessible to all users, allowing third parties to verify the authenticity of trade documents.

BUILDING COMPETENCIES BEYOND TECHNOLOGY FOR SUSTAINABLE SUPPLY CHAIN FINANCE SOLUTIONS

Technology solutions are an important factor, although they are not the only driver of success when launching a supply chain finance program. There are other important factors, summarized in Figure 4.

Operational model. A supply chain finance program requires a clear operational structure within the bank. This includes a well-defined place in the organizational



FIGURE 4 Competency Framework of a Successful Supply Chain Finance Program

Source: IFC

structure, clear responsibilities, and streamlined processes. To achieve these it is important to quantify the business opportunity for supply chain finance and gain a thorough understanding of the operating and legal environment that will define the types of products and service offerings required for a specific market. It is equally critical to design good methodologies to segment not only the corporate clients, but also their suppliers and distributors, along with having an appropriate coverage and commercial model to target, engage, and service clients in the supply chain.

Products and Services. When designing the product strategy and choosing which type of supply chain finance products to offer, it is important to understand the market size and competitive landscape in order to innovate and find the appropriate offering that will quickly gain a sizeable market share in the market, as well as the legal and financial infrastructure landscape (such as moveable collateral registries) that will help to identify the most demanded and scalable supply chain finance products. A detailed product design with good accompanying credit policies and a product implementation plan are key to successfully launching the new product supply chain finance offering.

Sales and Delivery Channels. When designing the sales model, financial institutions must establish a cost-benefit analysis (for example, peer group comparison of working capital efficiency) for each corporate client chosen to join the supply chain finance program. It must also create an onboarding mechanism for suppliers and distributors, detailing the functionality of the program as well as the products, technology, and benefits of participating in the program. In addition, a suitable sales outfit is required to allow the bank to rapidly acquire, onboard, and manage a portfolio of new clients. To achieve efficiency while keeping operational costs low, financial institutions must tailor their service offering based on the size of the targeted business.

HR & Systems. Banks need to create the proper incentive and reward mechanisms to align their sales force and achieve the growth and scale of the program. Training is often needed to equip the front line team, both corporate and SME staff, with the necessary technical and operational skills to sell and fully service clients in the supply chains.

Credit Risk Management. A number of areas need to be in place to successfully and safely scale up the supply chain finance program, including designing the appropriate credit policies detailing the anchor client classification criteria and corresponding buyers and suppliers. Industry benchmarks can also be established to improve the design of risk and pricing profiles.

For more advanced cases, the use of application and behavioral scoring models can help to support the credit differentiation process, while installing early warning systems will help the bank to anticipate adverse movements in its portfolio and minimize expected losses. A well-structured collections framework and an active client management approach at the corporate and SME level are key to minimizing losses when late payment cases arise.

Management Dedication. According to Eugenio Cavenaghi, Head of Trade, Export and Supply Chain Finance at Banco Santander, “the major challenge for banks in establishing a supply chain finance business is aligning the interests of various internal stakeholders. Senior management and business line leaders should understand the importance and benefits of supply chain finance which includes high returns, low risk, and a strengthened relationship with the clients. Once the interests are aligned, the institution should mobilize the necessary resources. In order to establish a well-functioning supply chain finance business, the bank needs to allocate significant resources, both human and financial.”¹²¹

Creating a supply chain finance program involves a complex set of processes and procedures, which

requires a strong central coordination function with a dedicated supply chain finance team. The team has to be responsible for gaining the buy-in from various stakeholders in the bank (for example, corporate/commercial, retail/small business, credit, compliance, IT, legal, and HR), which often entails clear profit sharing/shadowing arrangements, and a strong commitment from management to drive the program through inception to implementation.

In addition, this team also coordinates the external relations with third parties and partners who work in the supply chain finance space.

CONCLUSION

Supply chain finance can help banks grow their SME portfolios in a sustainable and risk-mitigated manner. The industry is rapidly evolving, with local and regional financial institutions realizing the inherent opportunities within their corporate portfolios. Market trade flows and the increased availability and proficiency of technology platforms has made supply chain finance portfolio growth more feasible.

Fortunately for financial institutions, there are multiple options beyond building an internal supply chain finance IT solution, including external technology providers.

At the same time, financial institutions need to understand the market for supply chain finance and make the best use of technology to create a solid supply chain finance program that is successful, scalable, and sustainable. ■

CHAPTER 7

Modelo Peru: A Mobile Money Platform Offering Interoperability Towards Financial Inclusion

By Paola Elvira Del Carpio Ponce

Like most emerging markets, Peru suffers from low banking penetration and faces challenges to providing financial services. Beginning in 2015, a strategy called Modelo Peru emerged as a collaboration between financial institutions, telecom companies, and the government, with the goal of launching a mobile money platform to better serve the nation's unbanked and underbanked. The platform's main innovative feature is interoperability among these three groups to achieve scale and breed competition among e-money issuers.

Yet after two years the project continues to struggle to align all involved financial institutions toward its development objective, as well as ramp up the number and value of transactions the mobile platform handles. Important challenges to success include investing in a wider distribution network that more effectively reaches the unbanked, and building a strong digital ecosystem that makes the platform relevant and understandable to users. These challenges require better collaboration from the parties involved as well as strong political will. Absent those, mobile financial services in Peru will remain an alternative financial service rather than a tool for financial inclusion.

Emerging markets face various challenges in their attempts at widespread provision of financial services. Peru is no exception. Despite having been one of Latin America's fastest growing economies between 2010 and 2014, only 29 percent of Peruvian adults own an account in a financial institution, far below the regional average of 51 percent.¹²² In fact, although it is considered an upper-middle income country, Peru's account penetration is similar to the average of the countries with lowest income and banking interest rates in the region (33 percent).¹²³

Among the reasons that Peruvians lack a bank account is the perception that the costs of maintaining one—including commission, transaction, and transport costs—outweigh the benefits. In rural areas, the average time it takes to access a financial attention point (a financial institution office, ATM, or agent) is 1.5 hours, compared

with the national average of 22 minutes, and just seven minutes on average in Lima and Callao Province.¹²⁴

Thus, while the infrastructure of attention points has increased considerably in recent years, disparities among regions remain significant. Currently, 68.9 percent of Peruvian districts have a financial system presence, 56.4 percent of which have access only to agents. Still, 5 percent of the adult population—a group that is among the poorest in Peru¹²⁵—has no access to any kind of financial attention point at all.¹²⁶

In this context, and with almost 70 percent of the Peruvian economy having a certain degree of informality,¹²⁷ the preference for cash is very strong. Some 90 percent of transactions in the country are made in cash.¹²⁸ The main costs associated with the exclusive use of cash are inconvenience (time, transportation, queues) and security (risk of theft and counterfeit currency).

By contrast, the mobile phone market has grown considerably and is more widespread in the country. Peru reached a mobile subscriber rate of 66 percent in 2015, above Latin America’s average rate of 65 percent.¹²⁹

As a result, when officials looked for a logical solution to Peru’s lack of available financial services, they settled on a broad channel based on mobile phones. However, because the availability of 3G networks is still limited throughout the country, an inclusive solution required a technology that does not require a smartphone or mobile internet.¹³⁰

To address its banking issues, the Peruvian government took a proactive stance, defined by a strong country commitment and a regulatory environment conducive to financial inclusion. And despite its many challenges, Peru has been considered as the country with the best enabling environment for financial inclusion in the world for several consecutive years, paving the way for creation of a mobile money platform.¹³¹

This note examines Modelo Peru’s Billetera Movil, or Bim, “the world’s first fully-interoperable national mobile money platform” supported by financial

institutions, the government, and telecommunication companies to serve the unbanked and underbanked. This innovative model has gained international attention due to its design based on interoperability among the three groups. After almost two years in operation, it is useful to understand the advances and challenges of the project, and to gather lessons for other similar cases in the future.

THE POTENTIAL IMPACT OF MOBILE MONEY

Several countries with low banking penetration rates have created mobile money platforms to promote financial inclusion. The first and most successful case was Kenya’s M-Pesa, primarily used for person-to-person (P2P) remittances. Before that technology became widespread, most transfers of money were made via cash or informally through third parties.¹³² M-Pesa increased per-capita consumption levels and brought 2 percent of Kenyan households out of poverty between 2008 and 2014, increasing financial resilience and savings, especially for female-headed households.¹³³

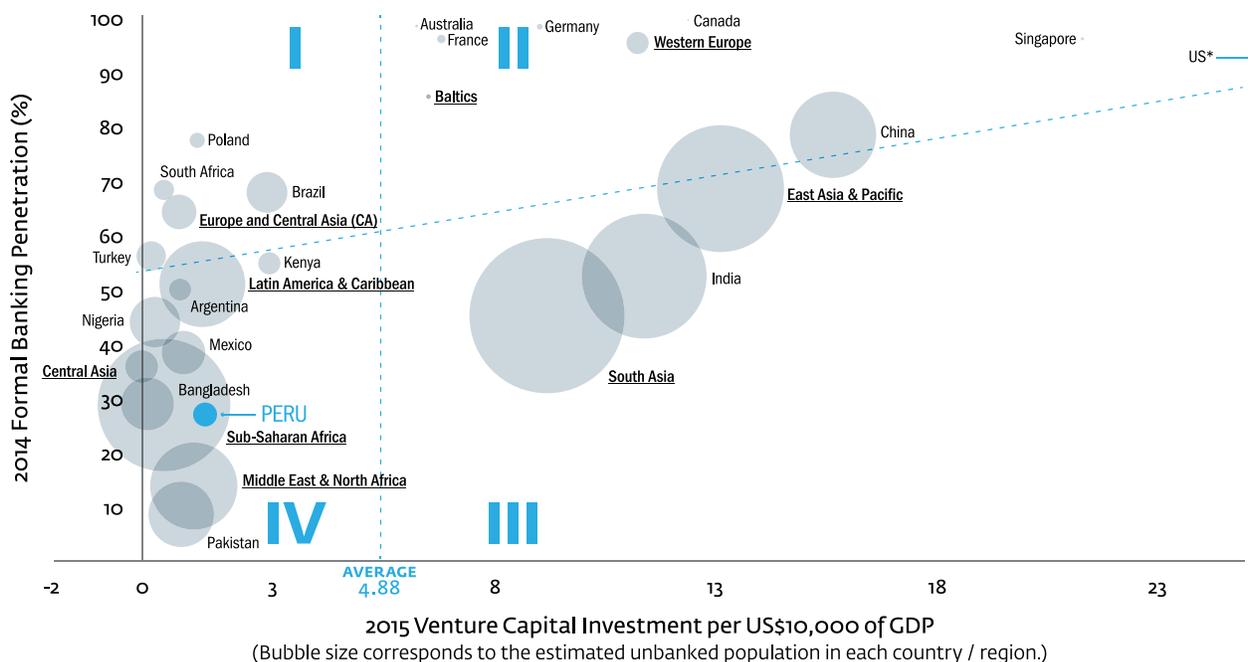


FIGURE 1 “The Banking-FinTech Development Space”—Peru Appears Currently in Quadrant IV

Peru displays values similar to other countries with high shares of unbanked populations and relatively low activity in venture capital investment, a proxy for the development of technological ecosystems. Source: Saal, Matthew et al. 2017. “Digital Financial Services: Challenges and Opportunities for Emerging Market Banks.” EM Compass Note 42. IFC, August 2017.

*The values for the US are outside the shown scale, i.e. 50 for x-axis and 94 percent for y-axis. The values for Peru are 1.6 for x-axis and 29 percent for y-axis.

Access to mobile money reduces both fixed and variable costs of transfers and makes consumption smoothing more effective. It also enables families and individuals to protect themselves against shocks such as income and health risks, and allows individuals to reach a wider network of social support, as physical proximity is not necessary for P2P money transfers.

Mobile financial services (MFS) providers are business models as for-profit businesses. They can be mobile network operators (MNOs) like Vodafone in the case of M-Pesa, or they can be companies that develop the platform and then partner with MNOs to provide connectivity to end users, as is the case with Pagos Digitales Peruanos (PDP) in Peru. These companies also partner with banks, governments, and others to allow customers to carry out different transactions, generating a digital ecosystem.¹³⁴ Regardless of the business model, an effective distribution network is critical, including a network of agents or franchisees to help customers set up accounts and make transactions. Agents are entrepreneurs themselves, as they are paid a commission for every account they open or transaction they facilitate. Customer care, service quality, and cash management depend directly on these actors, which highlights their importance.

BACKGROUND OF MODELO PERU'S CREATION

In 2013, the Electronic Money Law was enacted in Peru, establishing a legal framework for mobile money to serve as a tool for financial inclusion. The law determined that enterprises authorized to issue electronic money can be considered either financial institutions or electronic money provider enterprises supervised by the regulator (Superintendency of Banks, Insurance Companies and Private Pension Fund Managers-SBS). In addition, complementary norms were published, such as a regulation that creates simplified accounts. These accounts reduce Know-Your-Client and Anti-Money Laundering requirements, and can be opened merely by presenting a valid identity card containing the recipient's full name and current address. However, they also have limits on account balances (about \$600) and transaction size (about \$300), with total transactions between two parties limited to \$1,200 per month. Electronic money provider enterprises,

created by the new legislation, can then offer these simplified bank accounts.

The Peruvian Bank Association (ASBANC) approached Banco de la Nación—the bank that represents the Peruvian government in commercial transactions—as well as microfinance institutions and rural savings and credit union representatives, to create a joint interoperable platform large enough to reach the unbanked, and with the potential for rapid scale. One challenge when deploying such platforms is the reluctance to embrace opportunities of open standards and collaboration, as competition on digital platforms is “asymmetric,” and there is a risk of collaborators competing for each other's customers (scale versus value leakage).¹³⁵

In Peru, most commercial banks are located in the coastal regions, with 59 percent of bank branches located in the capital city of Lima. By 2015, only 31 percent of the districts in Peru had access to the private banking system. In the same year, Banco de la Nación expanded the number of its branches, ATMs, and agents to increase access to financial services by 20 percent.

As commercial banks—which hold the vast majority of assets in the financial system—do not reach several locations in the country, building an inclusive digital ecosystem necessarily implied working jointly with other institutions. In addition, interoperability would also be needed between telecommunications providers (telcos) within the platform, since these providers' mobile network coverage is just as uneven, with some zones only covered by one provider, and some with no coverage at all. Therefore, an inclusive solution implied equal use of the platforms by users from different mobile services providers.

In July 2015, Peru launched the National Strategy for Financial Inclusion, known as ENIF, to allow financial institutions, telcos, the regulator, and different government actors to work together.

PLATFORM DESIGN AND BUSINESS MODEL

Also in July 2015, ASBANC launched Pagos Digitales Peruanos (PDP), the company in charge of designing, maintaining and managing the joint interoperable platform. PDP's shares are 51 percent owned by ASBANC's nonprofit Center of Financial Studies (CEFI)

and 49 percent by the rest of the electronic money issuers. Telecom companies and the government have an interest in the platform working and are critical allies for Modelo Peru and ENIF to advance, but are not part of the decision-making structure of PDP.

Ericsson won the bid from a group of 22 different money solutions providers to develop the platform¹³⁶—named Billetera Movil (Bim) and launched in February 2016—which connects banks and telecoms with the unbanked population.¹³⁷ Over 30 mobile money issuers can operate on the platform, with each generating their own transactions report while having an intermediary like the PDP settle all transactions.¹³⁸

The platform is simple. It connects low-income residents to financial services via short message services (SMS) messaging. The process of signing up and opening an electronic wallet is completely free and can take less than a minute. In addition, all participating financial institutions offer their services through Bim so that the branding effort can be focused exclusively around the name “Bim.”¹³⁹

Bim is innovative and maximizes the reach of all actors on the platform:

- **Electronic money issuers:** Users can make transactions within the platform, regardless of the financial institution the other party is working with, without commissions for transactions between institutions. Users don’t need to know what institution other parties are working with.
- **Telecommunications companies:** Bim works with Peru’s three main telecommunications companies (Movistar, Claro, and Entel), covering around 90 percent of the mobile market, and is coordinating to include Bitel, the telco that holds most of the remaining market share.
- **Between cash-in/cash-out institutions:** Users can reach any agent in Bim’s network, regardless of their contract.

OPERATION OF THE PLATFORM

Users can be individuals or non-financial businesses, including government actors, electronic money issuers, and distribution networks such as agents and certain ATMs. Agents perform actions directly with

platform users, enrolling new users to Bim, facilitating transactions (payments, mobile top-ups, and transfers), and performing cash-in and cash-out operations. By early 2017, Bim already had 8,500 physical points of sale (POS), 19 percent of the all available points in the country. Most of the remaining points are not directly owned by any bank but operate through aggregator networks, that is, firms that are allowed to affiliate and manage agents’ operations for more than one financial institution. Most of them have not yet joined Modelo Peru.¹⁴⁰

Users can open an e-wallet account without a preexisting bank account, Internet access on their phone, or credit.¹⁴¹ A new user merely needs to present a personal national identification number, select a passcode, and choose a financial institution with which they will create an account. In line with regulation, the money stored in the e-wallet is safeguarded by a trust fund created by each e-money issuer.

The platform allows users to perform the following operations:

- Cash in (mainly through agents),
- Cash out (through agents and recently through ATMs of the banks BBVA and Banco de la Nación),
- Make person-to-person transfers,
- Buy airtime, and
- Pay for specific services, e.g., person-to-business (P2B) or person-to-government (P2G).

Currently, two payment options are possible: (1) RUS, a simplified tax for self-employed taxpayers and microbusinesses payed to SUNAT (National Superintendence of Tax Administration); and (2) payments to a technological institute called TECSUP. Fees are only applied for transfers and cash-out transactions and are meant to cover the cost of SMS from PDP to the mobile network operators.

Pagos Digitales Peruanos is partnering with Banco de la Nación to provide government-to-person (G2P) operations such as facilitating payments for cash transfer programs to the poor. In addition, PDP has agreements with some enterprises to promote supplier payments from shopkeepers via Bim (business-to-business transactions, or B2B).

PROMOTING GOVERNMENT-TO-PERSON TRANSACTIONS AMONG THE POOREST

The Ministry of Development and Financial Inclusion is currently working on a pilot to evaluate the potential of digitizing payments for cash transfer programs through Bim. The potential beneficiaries of these programs are among the poorest of the population. Currently, cash transfers are made through deposits in savings accounts (where there is a Banco de la Nación office available) or in cash, using transport companies that deliver the money at a designated place and time. The latter transfer process is used for around 20 percent of the total beneficiaries of Juntos and Pension 65 and implies significantly higher costs both for the government and the beneficiaries (who often must travel long distances to reach a payment point).

Carolina Trivelli, former Minister of Development and Social Inclusion and former CEO of PDP, believes this is a positive initiative but is skeptical that it is a strategy that would build a wide ecosystem to expand the use of Bim.¹⁴² Government-to-person operations with the most vulnerable populations may reduce costs for government but do not have clear benefits the poor in the short run because the remotest areas also do not have any cash-in/cash-out points for Bim.¹⁴³ Furthermore, it could take significant time

for people with less digital capabilities, including the elderly, to adopt the use of the platform.

Nicolas Besich, Principal Researcher at Videnza Consultores who conducted a project on the promotion and use of Bim among Juntos beneficiaries in Catacaos, Piura, highlighted that these users' limited education levels could complicate their adoption of Bim. Also, even when 77 percent of the users he contacted had a cellphone in the household, less than half of the actual beneficiaries are effective owners of the cellphone. However, the potential reduction in transaction costs related to receiving money would be significant if the distribution network reaches these populations.¹⁴⁴

Other G2P operations may have more potential to begin with. These include the National Scholarship Programs, per diem for health workers, salaries of military personnel based far from their homes, and subsidies for new mothers.²⁴ Subnational government payments, on the other hand, are desirable but pose a significant coordination challenge given the fragmentation of payment systems and the degree of autonomy over payments policy at the local level.¹⁴⁶

SLOW ADOPTION

Adoption of the Bim platform has been slow, however. Peruvians in general continue to prefer cash transactions, and they maintain a high level of distrust of financial institutions, which have traditionally been associated with excessive fees, and the difficulty and inconvenience when needing to solve problems within the system are the main reasons for this perception. In addition, there is a widespread lack of understanding of electronic money, and an associated fear of not having someone to contact or provide assistance if something goes wrong.¹⁴⁷ Clearly, substantial financial education is required to help the unbanked become more comfortable with digital payments.

The implementation of Peru's National Strategy for Financial Inclusion by all the parties responsible for it is critical for Bim to have a proper environment to operate. PDP message campaigns need to tackle this by convincing consumers that the new platform offers a simpler way to store money and make payments and other financial transactions, but that it also retains a concrete connection to financial institutions.

Significant progress in this stage of Bim's rollout would require agents to succeed, since they are instrumental in building trust with the local population and instilling confidence in them to use electronic money. However, it has been difficult to work with banking agents that already had direct relationships with each bank.

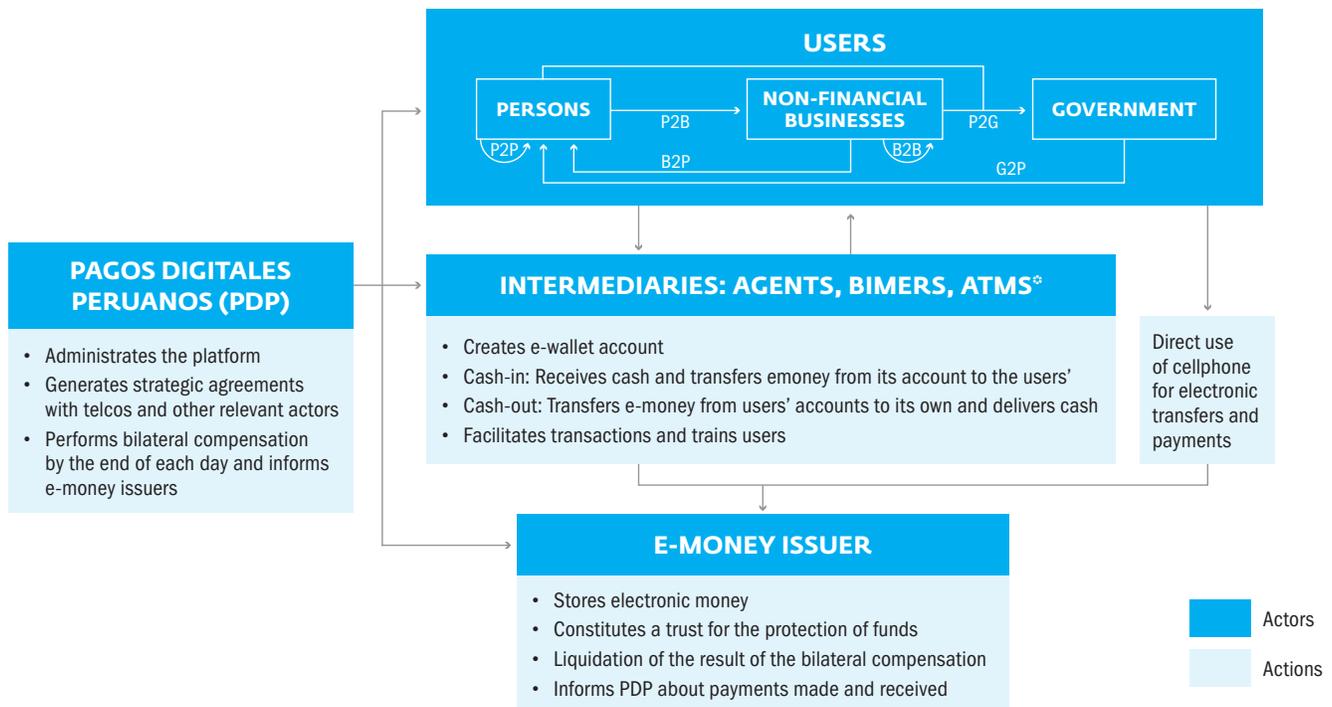


FIGURE 2 Main Actors and Their Activity on the Platform

Source: Abad, Liliana, Vásquez, Jose Luis and Milton Vega. 2016. “Regulación de Pagos Minoristas: Modelo Peru.” *Revista Moneda* 168. BCRP (Banco Central de Reserva del Peru); BBVA. 2013. “El marco regulatorio del dinero electrónico en el Peru y la inclusión financiera.” *Observatorio Economico – Inclusion Financiera Peru*; Antón-Díaz, Pablo, and Tomás Conde. 2017. “Modelo Peru: Unique Model, Unique Challenges, Bright Future.” Brief 001. Center for Financial Inclusion and Institute of International Finance.

Bim’s launch meant twice the work for these agents. They needed to operate using two separate technologies (phone and point of sale), and had to render accounts twice to the bank. As agents are not used to working with phones, it took them twice as long to learn how to operate Bim’s interface, compared with the use of POS. Also, as Bim is not yet widely used, some agents routinely forget to charge their phones or do not prefund their Bim accounts. This generates a self-reinforcing problem: even if there is demand for the use of the agent, their inability to help potential Bim customers discourages user adoption of the platform, and this lack of interest further limits incentives for the agents to use it.¹⁴⁸

Bim has yet to gain a presence in rural or unbanked areas, due to the limited number of agents in these regions. Historically, banks have not ventured far into rural areas due to high transaction costs and low profit margins. They have been more inclined to

prioritize existing networks on the platform rather than develop new ones, taking advantage of an alternative transaction channel while gathering transactional information from clients.

According to Trivelli, it is especially challenging to accomplish the needed investment from financial institutions in more agents throughout the country because it is costly to implement and, after the platform is widely used, they will be used less.¹⁴⁹ In addition, it must be noted that expanding agent networks is also challenging, as they perform banking services and require a certain size and degree of formality to be accepted as agents by the regulator.

PDP has now postponed the goal of reaching unbanked areas immediately and has refocused efforts on peri-urban areas—where there remains a large proportion of the population with limited access to the financial system.

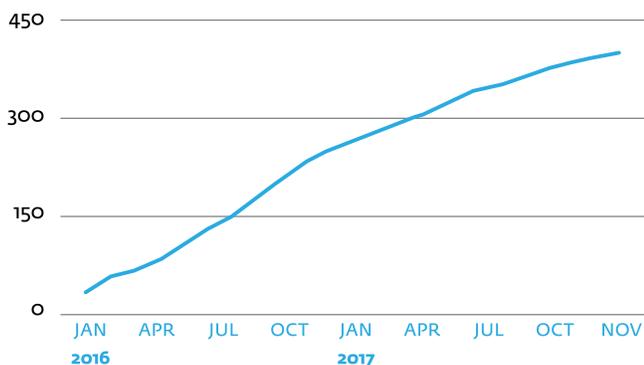


FIGURE 3 Number of Users (in thousands)

Source: *Semana Económica*. 2017. “Dinero electrónico: los planes de la Billetera Móvil en el 2018”. <http://semanaeconomica.com/articulo/mercados-yfinanzas/banca-y-finanzas/257808-dinero-electronico-losplanes-de-la-billetera-movil-en-el-2018/>

To address challenges related to agents using two systems instead of one (a cellphone and a POS) and also to add more attention points for customers, PDP has partnered with Ericsson and three banks: BCP, BBVA, and Banco de la Nación, to ensure that:¹⁵⁰

- All BCP agent networks can now be used for cash-in and cash-out operations (approximately six thousand agents),
- All BBVA agent networks can now be used for cash-in and cash-out operations (approximately 1000 agents), and more than 1,800 ATMs can be used for cash-out operations,
- All Banco de la Nación agents (6500), ATMs (900), and branches (600) can now be used for cash out operations.

PDP is piloting a strategy with some small businesses in Lima known as “Bimers.” These businesses act as promoters of the platform, creating their own Bim e-wallets, making cash-in operations in an agent for their wallet, and then performing operations for other people and gaining a small commission for each facilitation. This model is said to be an “uberization” of agents, as it includes promoters that do not require a license but only an ID to operate. The practice has been accepted by the regulator.¹⁵¹

As for the future, PDP has planned other partnerships to build a stronger digital ecosystem that will

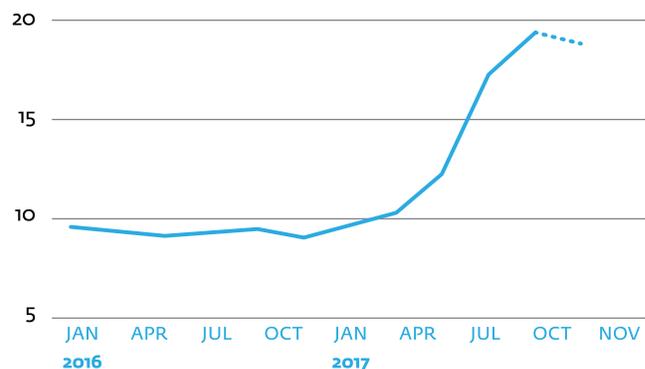


FIGURE 4 Average Value of Transactions in Peruvian Sol (PEN)

Source: *Semana Económica*. 2017. “Dinero electrónico: los planes de la Billetera Móvil en el 2018”. 20 soles are equal to ca. \$6.

incentivize people to use the platform more frequently. By April 2018, it is expected that Bim will be connected to the POS network of the company working with Mastercard, which will enable users to transact with some 80,000 businesses.¹⁵²

Other future projects include: incorporating the payment of more services such as utilities and international remittances; including the fourth most important telco operator (Bitel) in the platform; and creating a mobile app for smartphones to bring additional functionality to those users who own one.¹⁵³ Also, government-to-person and person-to-government operations will be promoted at the national and subnational levels. These operations represent an important opportunity to strengthen the digital ecosystem, but they will also require strong coordination with the government.¹⁵⁴ Engaging and coordinating with the government at different levels is pivotal for PDP to develop the ecosystem required for the use of the platform.

Despite challenges, it is expected that the Bim platform will continue to gain broader use among Peruvians, though progress may continue to be slow. Expansion will be driven by growing agent networks and increased use of Bim for government-to-person transactions, which will render it necessary for certain groups of the population.

Bim is still in a nascent stage, and similar platforms have been operation much longer. Kenya’s M-Pesa platform, for example, has been operating for over 10 years.

CONCLUSION

The use of mobile money in Peru can help the country achieve nation-wide financial inclusion, while also increasing financial resilience for the poor. Modelo Peru emerged as a result of collaboration between financial institutions, telecom companies, and the Peruvian government, in a context where financial inclusion was a priority for the government and regulatory policy was favorable.

Modelo Peru’s Bim platform is innovative because of its interoperability on three levels—government, telecoms, and financial institutions. And in contrast to other mobile money platforms, competition is provided inside the Bim platform and not between platforms. However, interoperability has also brought the challenge of aligning all relevant parties’ incentives. And use of Bim has lagged expectations.

The primary challenge to more widespread use of Bim among Peru’s underbanked and unbanked in the short run is the size and scope of the distribution network throughout the country. This requires a significant investment on a distribution network whose use will diminish as the platform is more widely used and the money stays in the network rather than having the constant need for cash-out operations. As challenging as this may be, it is pivotal for the success of Modelo Peru, as evidence has shown the importance of distribution strategies for FinTech solutions. It is expected that the new approach of “Bimers” will help achieve this more rapidly.

In addition, it is critical that a digital ecosystem is developed, so that the platform is created for various transfers and payments. To this end, PDP will need to work on both the demand and the supply sides.

Regarding the demand side, campaigns will need to

tackle the negative perceptions of financial institutions, address financial literacy issues, and promote the concept and convenience of electronic money given the society’s strong preference for cash. In addition, the prevalence of P2P internal remittances within the country is significant in Peru and should be seen as an opportunity for Bim. Among the young population involved in internal migration, 38 percent sent remittances to their former household and 60 percent received remittances in 2013.¹⁵⁵

As to the supply side, PDP is already working on new partnerships and strategies, with government-to-person being one possibility, as described above. These initiatives could be complemented with others such as person-to-government (payment of local and national taxes), person-to-business (payment for services), and business-to-person (payment of salaries, for example). Different incentive schemes could be established to promote the use of Bim over other channels for these types of payments (for instance, longer deadlines or discounts when paying through Bim). All of these initiatives, however, will require a strong coordination among several actors in addition to political will from different governmental actors.

To date, the adoption and popularity of Bim demonstrate that well implemented regulation is necessary but not sufficient to the success of a mobile money platform. Political will and the cooperation of all related actors are also critical.

Without ensuring a wider distribution network and developing the required ecosystem, Modelo Peru will likely remain an alternative financial service where banking services are already available, instead of effectively promoting financial inclusion for the unbanked and underbanked. However, this platform still has plenty of space to mature. If it can address the challenges it faces, it has the potential to produce an important development impact and create a precedent for other interoperable financial inclusion efforts. ■

CHAPTER 8

How Fintech is Reaching the Poor in Africa and Asia: A Start-Up Perspective

By Alex J. Alexander, Lin Shi, and Bensam Solomon

This note explores the way traditional banks and financial technology companies, or FinTechs, interact in Africa and Asia, and their ability to offer innovative digital financial services that grant unbanked individuals access to financial transactions. The FinTech sector is experiencing explosive growth in both continents, but while Asian banks have managed to efficiently integrate with FinTech solutions, African banks have been slower to adapt to this change. Still, the outlook for mobile banking remains positive, and its prevalence will boost the financial industry in both regions.

The digital age has unleashed a disruptive movement across the financial industry allowing financial institutions to attract previously “unbanked” individuals in emerging markets, while retaining already existing traditional bank clientele.¹⁵⁶ Digitalization has ushered in digital financial services,

which provide innovative financial technologies that offer a greater number of individuals access to financial products and services.

This note will use the terms digital financial services, financial technology companies, and FinTech interchangeably.

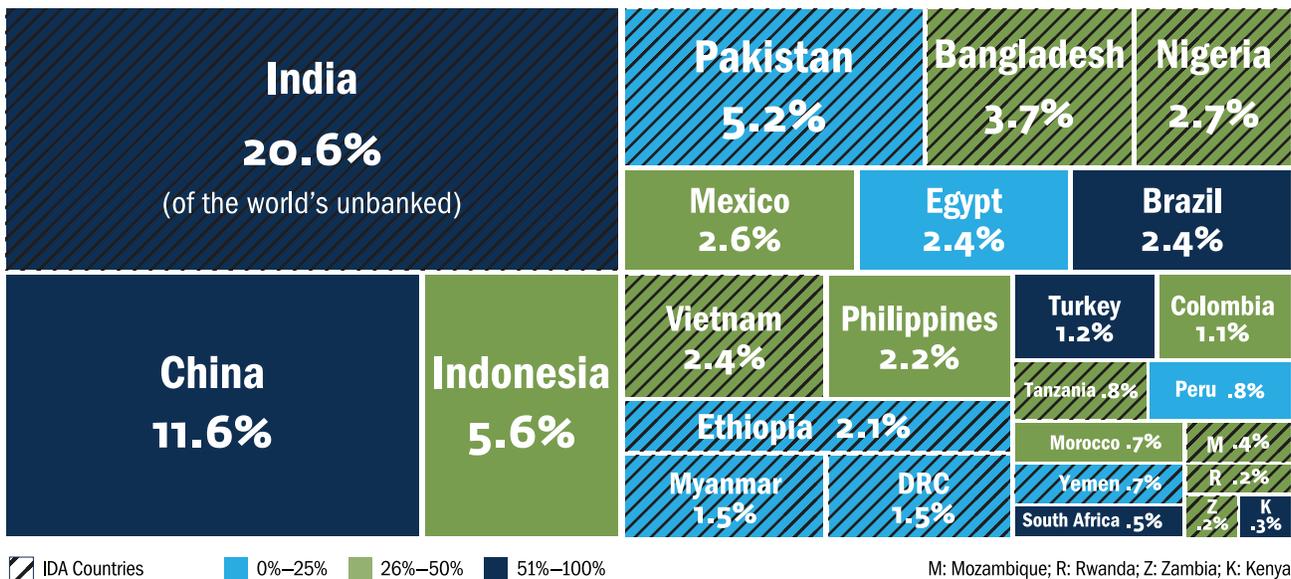


FIGURE 1 Some 73 Percent of the World’s Unbanked Reside in 25 Countries (Predominantly in Asia, Access is Low in Africa)

Shaded Countries = IDA International Development Association (poorest countries); Sources: Global Findex 2014, IMF Financial Access Survey 2012.

Figure 1 illustrates the portions of 25 countries that lack access to banking or financial services, as of 2014. Given that more than half of the world’s unbanked live in Asia, and many more live in populous African countries like Nigeria and Ethiopia, the focus is on these regions in particular.

Although the banking sector is relatively developed in Asia, the large populations in China and India mean there are still significant unbanked populations in that region, while access to banking in Africa is generally low.

DIGITAL FINANCIAL SERVICES, A BUSINESS OPPORTUNITY FOR EMERGING MARKETS

Since approximately two billion people in emerging markets are unbanked, the provision of digital financial services is as much about creating markets for these future clients as it is about altering current bank-customer relationships. Such services, according to the Consultative Group for the Assistance of the Poor (CGAP), have a “significant potential to provide a range of affordable, convenient and secure banking services to poor people in developing countries.”¹⁵⁷ In emerging

markets, these services are instrumental to private sector productivity.

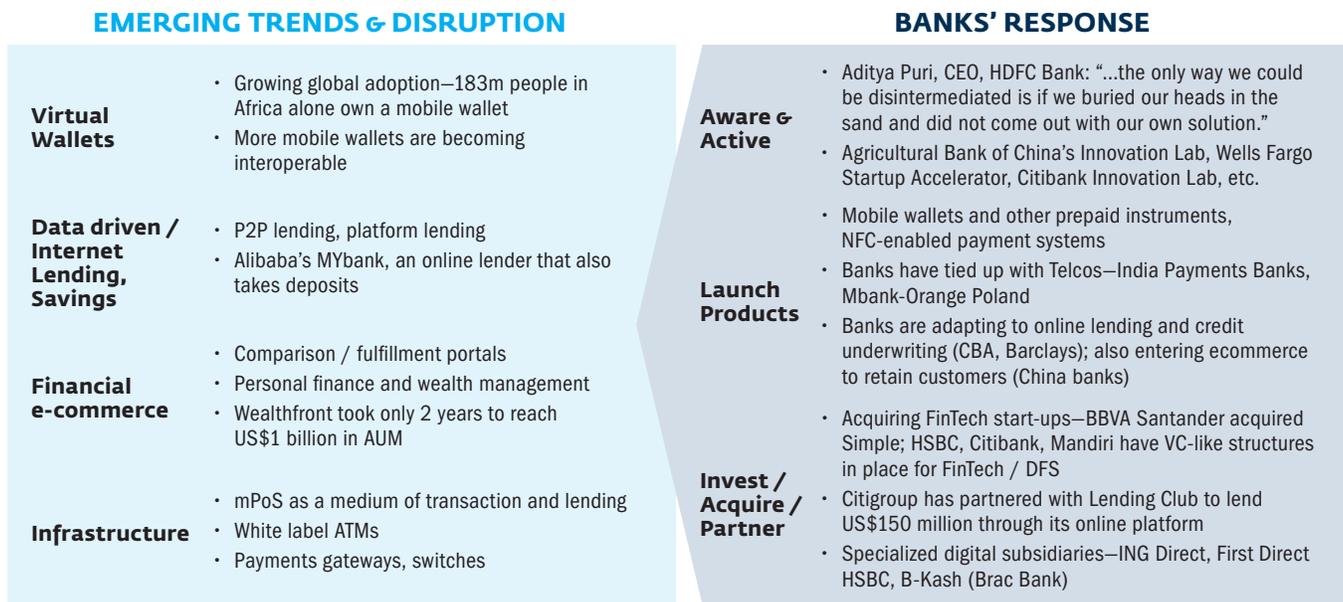
Digitalization of the traditional banking sector transforms the way banks react to their customers, offering them digital solutions such as:

- Virtual in-branch investment advisors
- Online and mobile banking products and services
- Increased use of social media and data analytics to communicate with customers, and lower operational costs¹⁵⁸

Figure 2 illustrates the massive disruption banks in emerging markets face—despite proactive adoption of digital financial technology—from the emergence of FinTechs.

The FinTech sector is experiencing explosive growth, attracting \$12.2 billion from investors in 2014, three times more than the previous year,¹⁵⁹ and a massive \$19 billion in 2016. The industry’s outlook remains positive.

Strongly backed by venture capitalists, FinTech companies are set to influence the financial industry in three significant ways:



However, most banks have not yet fully responded to the emerging threats and opportunities.

FIGURE 2 Supply Side: Financial Industry’s Response to Emerging Trends

Source: Holtmann, Martin, *Digital Financial Services – Challenges and opportunities for Banks*, Presentation provided at the Sixteenth Annual Conference on Policy Challenges for the Financial Sector - Finance in Flux: The Technological Transformation of the Financial Sector, June 1-3, 2016, Washington, DC. Abbreviations in figure: AUM = Assets under Management; mPOS = mobile point of sale; NFC = National Finance Center, a federal agency within the US government.

First, drive efficient financial services, as more banks in emerging markets turn to FinTech innovations to improve their digital service delivery.

Second, redefine the industry's perception of what it takes to be called a bank. FinTechs not only offer bank-like services, including receiving financial transactions and making loans, they also innovate faster and are able to rapidly grow their customer base. Unlike traditional banks, they have the flexibility to provide cheap and accessible products and services and are quicker to tailor their service offering based on changes to behavioral consumer data.

Third, become an intricate part of the banking sector, while distinguishing itself from traditional banks under international regulatory guidelines.

ASIA

ASIA'S TRADITIONAL BANKING SECTOR

Asian banks were resistant to the effects of the 2008-2009 global financial crisis due to relatively fewer financial linkages with Europe and the United States, as well as lower levels of debt. As a result, they outperformed the global banking sector. Emerging middle class income, and stable macroeconomic fundamentals were further contributing factors.

Headwinds created by the crisis also enabled a number of local banks to gain greater market share as they replaced deleveraging foreign banks that withdrew.

The region's banking sector has become competitive, making great strides in innovative technologies.

BKASH, BANGLADESH—PROMOTING FINANCIAL INCLUSION THROUGH MOBILE PAYMENTS

Home to 160 million people, Bangladesh has an extremely low banking penetration rate, with over 70 percent of its population having no access to a bank account. Its banking sector lacks adequate technology to reach the poor, which translates into a unique opportunity for bKash, a mobile money platform.

bKash Limited, a subsidiary of BRAC Bank Limited (Bangladesh) was launched in 2011 to provide mobile financial services, including payments and money transfers, to both the unbanked and banked populations of Bangladesh. Upon registration, each bKash user receives a mobile wallet that serves as a bank account.

Through bKash's vast agent network of over 90,000 retail points, users are able to deposit electronic money into their bKash accounts, receive disbursements, including salaries, loans, and domestic remittances, cash-out the electronic money, and perform peer-to-peer transactions. bKash's main goal is to serve lower income households in the country by offering free registration and cashing-in services. It also provides users with the cheapest handset in the world (approximately \$15) for accessing bKash's simple user interface.

Currently, despite more than 20 mobile financial service licenses approved by the central bank of Bangladesh, bKash has a clear monopoly, commanding over 80 percent of mobile banking transactions made in Bangladesh. bKash is now used by over 17 million Bangladeshis and handles more than 70 million transactions a day, according to the company. bKash CEO Kamal Quadir attributes the company's fast growth to its focus on providing mobile financial services through mobile platforms.

In 2013, the IFC made a \$10 million equity investment in bKash to help the company expand its distribution network. According to the Consultative Group to Assist the Poor, a global partnership of 34 leading organizations, 22 percent of Bangladesh's adults use mobile money and over 80 percent of transactions are made through bKash, partnering with MasterCard and Western Union. bKash announced in April 2016 that its account holders now have access to international remittances on their mobile phones, a breakthrough that will benefit 22 million people living in the eighth largest country for remittances in the world.

UNDERSTANDING BIG DATA

According to the International Data Corporation, global Internet traffic will rise to 44 Zettabytes (ZB) in 2020, ten times what it was in 2013 (a Zettabyte is one trillion Gigabytes.) FinTechs are using their ability to draw insights from vast amounts of consumer data, while applying innovative solutions to monetize this data.

Two types of data analytics that help banks to minimize regulatory compliance costs and identify risky consumers are: (1) Know Your Customer analytics, which provide a history of how customers have interacted with financial products and services; and (2) Anti-money laundering and counter financing of terrorism AML-CFT applications, which use a combination of descriptive analytics and statistical techniques to prevent fraudulent activities. The second technique is termed diagnostic analytics for its ability to identify possible reasons for certain behavior or outcomes by highlighting customer habits and trends. The combination of block-chain and big data will soon create a financial ecosystem that can identify trends, track end-to-end data, make judicious decisions based on this data, and use the entire data set for financial forecasts.

However, shadow banking remains a major source of financing for corporates and individuals due to limited access to bank loans. For China, shadow banking made up 40% to 70% of GDP in 2017, from 35% at the end of 2015, according to *Bloomberg*.

The value of wealth management products more than tripled between the end of 2015 and three years earlier.¹⁶⁰ Part of this expansion can be linked to FinTech innovations, especially its impact on payments. Traditional banks are eager to capitalize on these innovations.

In India there is a consolidated banking sector with well-developed digital offerings. Banks encourage customers to manage their finances using mobile phones.

FINTECH MARKET PENETRATION AND ITS IMPACT ON TRADITIONAL BANKS IN ASIA

Digital payments used in advanced countries now reach Asia's middle-class through international and local debit and credit card networks such as India's Rupay and China's UnionPay, among others. To gain a competitive edge and respond to the growing middle-class demand to access the e-commerce space, Asian banks turned to digital technologies offered by FinTech companies.¹⁶¹ They proactively sought ways to reduce costs and meet customer needs, choosing to partner rather than compete with FinTechs. Asian governments and regulators have been similarly supportive, encouraging FinTechs to provide funding to small businesses, and innovative solutions to banks.¹⁶²

These solutions have however not adequately served unbanked or poorer households who use less formal retail outlets like street vendors and local markets and have less access to bankcards or Point of Sale devices to make payments.

In Asia, both banks and FinTechs benefit from a symbiotic relationship. While FinTechs view banks as a gateway into a panoply of markets, banks turn to FinTechs to stay current in the rapid unfolding of financial innovations, while keep abreast of sudden shifts in regulatory mandates, and gaining access to big data to help improve their customer relationships.

EMERGING PATHS FOR ASIA'S TRADITIONAL BANKS AND FINTECHS

Asian banks' successful partnerships with FinTechs allow them to connect to new customers through the digital space, a less costly way to gain market share particularly in locations where they have a limited supply of physical distribution channels.¹⁶³ Banks can gain access to a market like China where foreign banks have a combined market share of less than two percent.

India, one of the pioneers of digital banking in Asia has successfully created an environment for FinTech innovative solutions to flourish and feed into the established traditional banking sector. India's banking sector does however refer closely to the central bank for regulation guidance with regards to FinTechs, slowing down service dissemination into the market.

FinTechs must thus find ways to test their latest innovative solutions through a Proof of Concept process required by financial institutions. Every successful Proof of Concept provides a benchmark for the industry, allowing FinTechs to offer their products to overseas markets.¹⁶⁴

AFRICA

ROLE OF TRADITIONAL BANKING IN AFRICA

Other than South Africa's developed financial sector, the footprints of banks in neighboring African countries have historically been low, especially in the rural areas. Bank penetration in Sub-Saharan Africa is below 35 percent.¹⁶⁵ Approximately 80 percent of Africa's 1 billion population¹⁶⁶ lack access to formal banking services.

Africa's banking sector is held back by currency fluctuations, and in particular a low supply of products for savings, insurance, credit, and payment transactions to large segments of populations in these countries. There is a prevalent perception that banking is for the rich, in a continent where financial services such as opening a bank account can be painfully bureaucratic.

Poor infrastructure, including inadequate roads, electricity, intergovernmental data connectivity, and utilities also hampers access to bank branches and ATMs.¹⁶⁷

In contrast, although 389 million people live on less than \$1.90 a day (based on 2013 data), the continent has one of the highest mobile penetration rates in the world.¹⁶⁸ This is making the region a fertile backdrop for the emergence of FinTech. The FinTech industry took off in the wake of the global financial crisis in 2008¹⁶⁹, despite barriers such as poor infrastructure, and limited Internet penetration.¹⁷⁰

FINTECH MARKET PENETRATION AND ITS IMPACT ON TRADITIONAL BANKS IN SUB-SAHARAN AFRICA

Africa's FinTech revolution owes its success to the industry's deep understanding of customers at grass-root levels and adequately meeting their needs. The industry is attracting ample attention from venture capitalists with funding of the tech sector expected to rise from \$414 million in 2014 to \$608 million in

2018, according to the Financial Times. It has giving rise to small business solutions like Rainfin backed by Barclays bank, which is currently the largest peer-to-peer (P2P) lending business in South Africa with transactions of more than one million rand per day.

However, FinTech solutions are often country specific and serve rather narrow niche markets. With a weak distribution strategy, a FinTech solution may work successfully in one country but fail miserably in another. M-Pesa is a perfect example where its operations took off in Kenya but failed to launch in South Africa. Founded in 2007 by Safaricom, M-Pesa allows subscribed users to perform traditional banking services using their mobile phones.

The service boasts 19 million mobile subscribers in Kenya and 6 million in Tanzania, compared to a mere 76,000 active users in South Africa out of only one million subscribers (based on 2015 data).¹⁷¹ M-Pesa's timing and deployment strategies in Kenya and Tanzania were impeccable. Safaricom seized the opportunity to enter both markets based on its position as the dominant mobile network operator. It further deployed a vast agent distribution network.¹⁷²

M-Pesa's difficulty to replicate its success story in South Africa was based on three factors: (1) An inadequate distribution network; (2) low mobile network subscription rates; and (3) South Africa's stricter digital wallet regulations.

M-Pesa's low adoption rate in India (operated by Vodafone, a network with 173 million customers) is another example of the difficulties to replicate its success. Only 370,000 users subscribed to the service in September 2014, after more than two years of operation.¹⁷³

In 2012, Safaricom and the Commercial Bank of Africa launched M-Shwari, which provides mobile bank accounts offering savings and micro-credit products. M-Shwari, succeeded in rapid market penetration in Kenya¹⁷⁴ and expanded to other countries, including Tanzania.

SCENARIOS FOR AFRICA'S TRADITIONAL BANKS AND FINTECHS

South Africa's well-regulated banking sector and aggressive digital banking roadmap is already

developing its own system of innovative FinTech solutions, which represents a major entry barrier for venture capital-backed FinTechs.¹⁷⁵ Banks in the rest of Africa are in direct competition with FinTech solutions, unlike Asia where both work harmoniously.

The pace of the FinTech industry in Sub-Saharan Africa is somewhat dictated by existing mobile network operators and their relationships with central banks. To enter a new market, depending on the country, mobile network operators like Safaricom must either file a bank license, which can take months to obtain, or find an alternative route into the banking sector. Both options are expensive, and represent an obstacle for FinTechs to make a major impact on the continent.

The outlook for FinTechs in Africa remains unclear. Traditional banks remain internationally accepted entities for cross-border transactions.¹⁷⁶ However, what

is clear is that FinTech companies offering global financial solutions, such as big data will play a pivotal role in boosting the traditional banking sector.

CONCLUSION

FinTechs have had a positive impact in Asia's banking sector, giving it access to a larger market at a lower cost. Countries such as China and India have successfully created an environment for assisting FinTech innovative solutions to flourish and integrate with the traditional banking sector.

In contrast, domestic FinTech innovations in Africa, often deployed by mobile network operators, operate separately from and are often in direct competition with banks. This is changing however, as illustrated by the success of M-Shwari, demonstrating the potential for integrated services. ■

CHAPTER 9

Digital Financial Services: Challenges and Opportunities for Emerging Market Banks

By Matthew Saal, Susan Starnes, and Thomas Rehermann

A digital transformation is taking place in the financial services industry, with a host of non-bank innovators offering both customer facing and back office financial technology products and services. This transformation includes emerging market economies, and in many places offers a viable digital alternative to traditional banks, which have left significant populations underbanked. This note explores the challenges and opportunities that financial technology innovations present for banks in these nations.

The digital transformation that has upended industries from retail and media to transport and business-to-business commerce is now sweeping the financial services industry. This was inevitable, as ubiquitous computing power, pervasive connectivity, mass data storage, and advanced analytical tools can easily and efficiently be applied to financial services. After all, money was already extensively (though not exclusively) created, used, stored, processed, and delivered electronically.

Immediacy and personalization have become the norm for consumer goods and services. Consumers have rapidly become accustomed to making purchases with a touch of their finger wherever they may be, receiving tailored recommendations, choosing customized products, and enjoying delivery of almost any item directly to their front door. Businesses failing to adapt quickly to these technological developments can fail dramatically, and many have already done so, including Tower Records, Borders Books, Blockbuster Video, and countless travel agents and brick-and-mortar retailers. Consumers' new expectations apply to financial services as well.

Technology has transformed business-to-business and within-business interactions, too, enabling reconfiguration of design, production, marketing, delivery, and service functions through distributed supply chains, freelance design, outsourced manufacturing, and contract warehousing and delivery. These reconfigurations

are mediated by online marketplaces and distributors, and assisted by back-end support operations and data analysis that together drive better risk assessment, faster fulfillment and more efficient customer service.

The same types of disruptive market innovations and reconstituted value chains are now emerging in the financial services industry.¹⁷⁷ This poses distinct challenges for incumbent providers such as banks, finance companies, microfinance institutions, and insurance companies, as financial technology—or FinTech—innovators enter their markets. Incumbents, too, can benefit from these developments, which will enable them to broaden financial access, introduce new products and services, and serve customers more efficiently by deploying new technologies internally or in partnership with external innovators.

DIGITAL TRANSFORMATION IN FINANCIAL SERVICES

Although financial services have been computerized for decades, with products such as retail brokerage using digital channels for some 20 years, a more radical transformation of the industry was delayed due to market advantages of traditional financial services providers. These included the established trust of customers, regulatory barriers to entry in banking and insurance, and supervisory approaches that created a bias to internalizing all or most of the value chain.

The 2008 financial crisis reduced trust in financial institutions, and the regulatory response to the crisis, including increased capital requirements and compliance costs, and made it more difficult and expensive for banks to lend.¹⁷⁸ Paradoxically, this created an opportunity for less regulated, technology enabled non-banks to thrive. They could offer financial services more cheaply and efficiently than incumbents burdened with legacy infrastructure and regulation.

In addition, digital transformations of other industries made customers more trusting of and comfortable with tech-based financial solutions. It also increased their demand for immediacy and customized products and services. Some of the most prominent FinTech companies are meeting these consumer demands with low cost, convenient ways to transfer money, borrow, and invest.

The impact of FinTech on financial services, however, goes beyond retail and customer-facing applications and services to include all elements of the financial services production process. The transformations in other industries demonstrated how increased availability of data and speed of information transmission could address key issues in contracting and monitoring that had determined the structures of firms and the degree of internalization of activities. For example, the ability to send designs across the world and monitor the quality of production has enabled the separation of design and marketing from manufacturing and logistics in companies such as Apple and Nike.

Yet commercial banks are still internalizing almost all aspects of channels, product design, and operations as well as a fair amount of private infrastructure (with call centers being an occasional exception, though many such operations were offshored rather than outsourced).

New FinTech entrants can optimize a single link of the financial services value chain to provide a bank-beating solution that can connect to the rest of the financial ecosystem. That might mean delivering services directly to users' mobile devices instead of using bank branches, dispensing with proprietary communication lines by using encrypted Internet transmissions, or avoiding the cost of data centers by utilizing cloud computing.

There are FinTechs offering point solutions in product areas such as payments, remittances, savings and investments, personal financial management, trade and

invoice finance, small and medium-sized enterprises (SMEs), lending, and insurance.

Innovations are also directed at processes such as Anti-Money Laundering-Know Your Customer (AML-KYC) compliance, credit scoring, underwriting and risk management, customer service, collections and recovery, capital markets activities, asset securitization, middle- and back-office reporting, trade processing, and connectivity between banking systems.

While this note largely takes a functional or product oriented approach, the potential also exists for innovative technologies to change the scope of what is possible in financial services and disrupt traditional intermediation roles. Technologies with radically transformative potential include digital identities and currencies, distributed ledgers, big data, artificial intelligence, and machine learning. These are already being incorporated into specific products and solutions in familiar institutions, but may in time fundamentally transform financial intermediation.

IMPACT ON FINANCIAL SERVICES VALUE CHAINS

Some FinTechs aim to operate separately from—and compete directly with—banks. Others offer solutions to banks. Virtually all of them need to connect to other financial services and to existing infrastructure (for funds transfers, for example). And banks, whether they want to or not, will be dragged into this age of reconfiguration by market forces and, in some cases, by government interoperability mandates.

Where unitary proprietary bank systems once precluded connection to external solutions, interoperability that will help FinTechs to carve off profitable slices of banks' businesses is now mandated in some jurisdictions, notably the European Union.¹⁷⁹ The digital transformation of financial services is likely to result in more competition, with significant portions of banks' products and profitability at risk. Barriers to entry may have risen in terms of core bank compliance costs, but regulators' willingness to countenance non-bank competitors in product areas traditionally dominated by banks has increased, and the economics of banking have shifted. Cloud infrastructure and mobile channels mean that the provision of financial services no longer

requires high fixed-cost mainframe data centers and branch networks, so costs are more variable.

While there may be consolidation in certain lines of business that have very large scale or network economies, at the same time it is increasingly easy for niche providers to offer tailored solutions to a particular market and be profitable with a much smaller asset base. Fintechs have taken market share in high margin slices of banking such as remittances and asset management, and technology-enabled challenger banks have emerged as serious contenders in a number of markets.

The reconfiguration of value chains is also crossing industry boundaries. SoFi, an online personal finance company offers career coaching, while Holvi, a Finnish-based financial startup, provides bookkeeping services and cash flow tracking.¹⁸⁰ Similarly, data analytics company Atsora, a Polish provider of SME financial management tools, offers its products to SMEs through banks and in turn leverages the data to create cash flow based scoring the banks can use to lend.¹⁸¹

As the financial services industry becomes increasingly contestable, decomposable, and reconfigurable, the capacity to innovate will be a key success factor. Banks that learn to adopt new technologies, adapt their products and processes, and become more adept at delivering tailored solutions to their customers will succeed. Given banks' preoccupation with the global financial crisis and regulatory requirements, non-bank innovators have been leading, or have acted as catalysts for, the digital transformation of financial services.

Yet incumbents are increasingly catching on. Just as brick-and-mortar giants Wal-Mart and Target responded to the online threat from Amazon with strengthened online presences of their own as well as modified physical channels such as pick-up locations, almost every financial services provider, from banks to credit unions, now has Internet and mobile channels, and many are adopting new technologies across products and processes as well. FinTech innovations can help banks deliver enhanced risk assessment, reduce transaction costs, make operational back offices more efficient, lower fixed asset investment requirements, and enter new markets. At the same time, banks can help FinTech innovators address their target markets. Adoption of new technologies by incumbents has been aided by the

use of standardized Application Program Interfaces (APIs) and the availability of plug-and-play third-party technologies, as well as an increasing willingness to partner to deliver value to a jointly shared client base. While sharing customers is difficult, collaboration has been increasing.

FinTechs have come to realize that most will not reach scale without leveraging the customer base and capital that banks have already accumulated, while banks now acknowledge that internal product innovation processes do not always meet customer expectations in terms of time to market or quality.¹⁸² Both can benefit from partnerships that reconfigure financial services value chains.

WHAT IS DIFFERENT IN EMERGING MARKET ECONOMIES?

E-commerce, online media, and new models in transport are making inroads in developing economies. Financial services transformation is also underway—and in some countries has outpaced the adoption of technology-driven business models in other industries. Mobile money adoption in Kenya and Bangladesh is an example. Still, there are specific challenges for the digital transformation of financial services and

CHALLENGES FOR BANKS AND FINTECH COMPANIES IN EMERGING MARKETS

- 1. Low levels of formal financial services** (cash dominance in transactions, informal credit and savings)
- 2. Lower income and financial literacy levels** (low value transactions, smaller fees, need for user education)
- 3. Underdeveloped technology and venture capital ecosystems** (shortage of skilled tech/finance entrepreneurs, small markets, limited revenue potential)
- 4. Relatively weak infrastructure** (underdeveloped payment systems, customer credit data, legal enforcement mechanisms for payment obligations, power, telco/Internet coverage).

the development of FinTech in most emerging market countries. Four key challenges that have affected the digital transformation of financial services in these markets, relative to advanced economies, are:

- Low penetration of formal financial services
- Low income and financial literacy levels
- Underdeveloped technology ecosystems
- Weak infrastructure

Not all of these factors are present to the same degree across emerging market economies, but they shape the landscape for the provision of financial services both by banks and FinTechs, as well as the interactions between those two types of financial service providers.

THE BANKING-FINTECH DYNAMIC DEVELOPMENT SPACE: A CROSS-COUNTRY COMPARISON

To provide a more quantitative comparison across countries, in Figure 1 we use two indicators as proxies for these four challenges: We measure formal banking penetration (representing the first two challenges, and displayed along the y-axis) and venture capital (VC) investment relative to GDP (representing the last two challenges, and displayed along the x-axis). The bubble sizes correspond to the estimated number of unbanked in each country.

Taking the average venture capital penetration and the least-squares trend line for the interaction of the two variables as dividing lines, we get the four quadrants shown in Figure 1:

Quadrant I (Upper Left): “Bank Dominance”

This quadrant includes economies in which the traditional banking sector is already well established and will likely continue to dominate the market. In-sector competition may create a positive dynamic of service innovation among banks. Examples include Alior, Idea, and mBank in Poland.¹⁸³

With only nascent local tech ecosystems, innovation may come from foreign FinTechs. Regulators may seek to create an open environment for non-bank entry in order to foster competition and product and service innovation, but entrenched local banks enjoy a “home field” advantage.

Quadrant II (Upper Right): “Partnering”

In this quadrant banks are well entrenched and serve most of the population. However, the strong tech ecosystem will support innovations offering new value propositions or seeking to take market share from incumbents.

Banks can in turn leverage technology to compete. Some FinTechs will scale up on their own, while others will partner with banks for better access to customers, capital, payments systems, or other operating assets.

Examples include OnDeck Capital, which partnered with JPMorganChase for customer origination and balance sheet placement while providing the loan decision making and servicing, and TransferWise, which markets itself as a bank disruptor while partnering with banks for distribution.

Quadrant III (Lower Right): “Tech Dominance”

Countries in this quadrant have well developed tech ecosystems, while banks have left large segments of the market underserved. This has created an opportunity for non-bank innovators to enter the financial services market.

The regulatory environment and the extent to which it is open to the FinTech sector varies across countries. This is a key variable in determining the balance between FinTech and more traditional banks. China, for example, has been relatively open to big tech companies entering financial services. Ant Financial, a Chinese FinTech, has more than 450 million clients, ten times the number served by any one of the world’s largest banks and equivalent to about 60 percent of the number of bank accounts in China.¹⁸⁴ India, on the other hand, has introduced new types of financial services licenses while continuing to require that these new services be conducted by licensed and regulated institutions.

This regulatory environment has resulted in more cross-sector convergence as some tech companies obtain financial services licenses while others partner with banks, and banks seek new functionality via partnerships with FinTechs.

Quadrant IV (Lower Left): “Race to the Finish”

Here we see low levels of bank penetration and underdeveloped technology ecosystems. Telecom

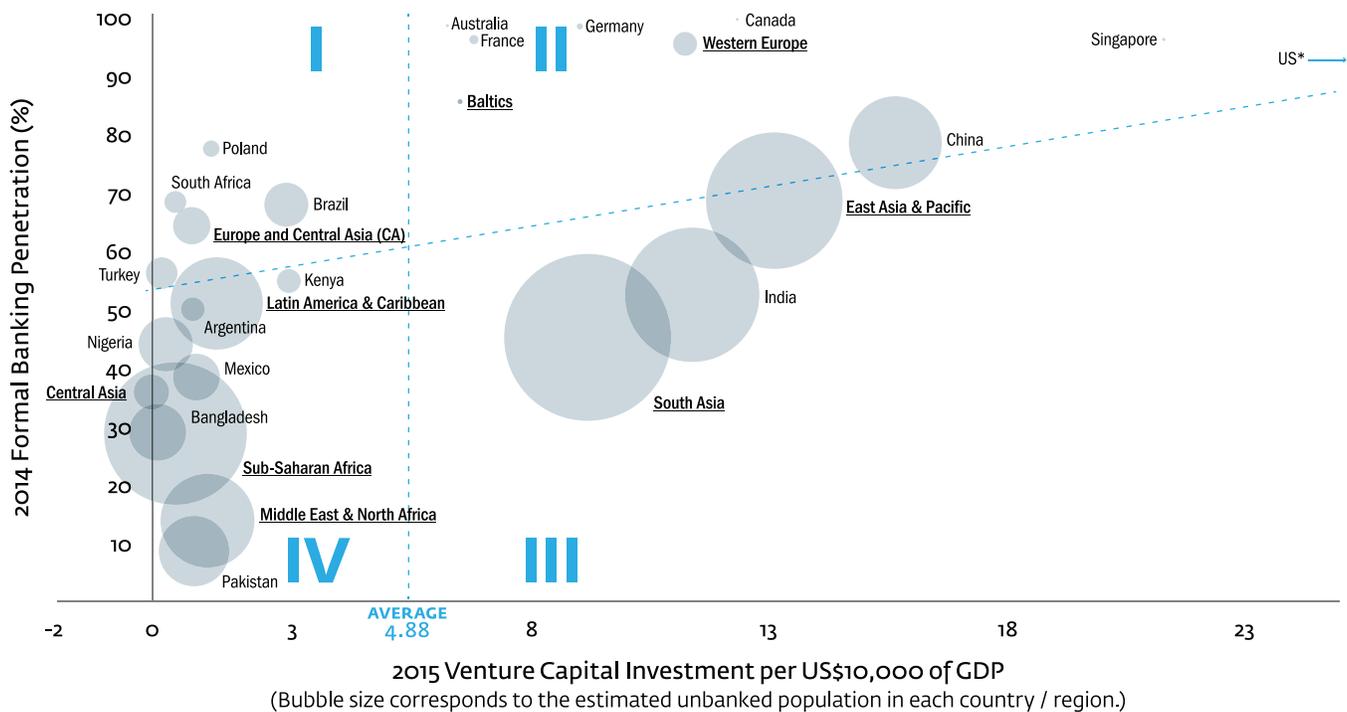


FIGURE 1 The Banking-FinTech Development Space

Source: IFC staff calculations; World Development Indicators, The World Bank, 2016; Global Findex, The World Bank; PitchBook Data, Inc. 2016. The values for the US are outside the shown scale, i.e. 50 for x-axis and 94% for y-axis.

companies tend to be the most significant local tech players, and in some countries have led the digitalization of the financial industry through mobile money products. However, banks have a chance to catch up if they choose to adopt innovations before the telecom firms corner the market.

For example, in Peru the Association of Banks, along with individual banks, mobile phone companies, and the government launched BIM (billetera movil or mobile wallet) in 2015 as a mobile money platform for interoperable services offered by both financial institutions and mobile phone companies.¹⁸⁵

This created an opportunity for banks to innovate alongside telecoms in providing digital financial services.

EMERGING MARKET BANKS: CHALLENGES AND OPPORTUNITIES IN QUADRANTS III AND IV

Most developing countries fall into Quadrants III and IV are characterized by lower levels of both funding for technology innovation and of banking penetration.

Three country examples illustrate the dynamics of Tech Dominance and Race to the Finish in selected countries.

Example 1: “Tech Dominance” (Quadrant III)—China

Although China’s average income is relatively low, the size of its middle class is roughly similar to the population of Europe.

This, coupled with China’s advanced educational system and its active participation in global supply chains, has resulted in a strong tech ecosystem including large local tech firms, strong engineering and business skillsets, and active private equity and venture capital investors. Thus, the challenge of developing technology and VC ecosystems has largely been overcome in China.

Investment in financial infrastructure such as China UnionPay—the only authorized interbank network in China—has also created a different set of initial conditions relative to the infrastructure challenges noted above. There were 5.4 billion outstanding payment cards

issued in China by the end of 2015, or about four per person.¹⁸⁶ Purchasing volume by payment cards grew to \$8.4 trillion in 2015, equivalent to 77 percent of GDP.¹⁸⁷ China's non-bank payment institutions handle 54 percent of transactions, compared with 46 percent by traditional lenders.¹⁸⁸

China's retail loan penetration rate is around 20 percent, among the lowest in the world.¹⁸⁹ Its banking sector prioritized state-owned enterprises and influential borrowers over SMEs and the wider retail market.

Responding to the market gap, over two thousand peer-to-peer lending platforms are in operation in the country, with the volume of peer-to-peer transactions as high as RMB 252.8 billion (USD 37 billion) in value by the end 2014, and that figure quadrupled in 2015.¹⁹⁰

However, a number of prominent platform failures resulted in new regulation on loan sizes and required custodian arrangements for investor funds. Growth slowed in the first half of 2016, with more than 500 platforms closing down. Further consolidation is likely as compliance costs kick in and unsound platforms are weeded out.¹⁹¹

The large and growing middle-income segment created market momentum and critical mass for service providers who can leverage that base of activity to serve poorer segments as well. As a result, China's alternative finance sector, which includes not only the peer-to-peer lenders but also big tech companies active in financial services and other FinTechs, rapidly outpaced most developed and developing markets. While peer-to-peer transactions will continue to grow, tech companies will play a bigger role in the financial sector.

In 2015 alone, Alibaba's online payment platform, Alipay, had 451 million annual active users and 153 million daily transactions.¹⁹² Alibaba's Ant Financial has become the largest FinTech company in the world by market value.¹⁹³ Beyond online payments, the tech giants of China expanded their reach to lending services in 2016. Tencent, Alibaba and Baidu established WeBank, MYBank and Baixin bank respectively, with the aim of helping SMEs gain easier access to capital.¹⁹⁴

While tech companies seem to have the growth edge relative to banks, there is evidence that banks

are waking up to the innovation imperative and the underserved market of SMEs and innovators.¹⁹⁵ At the same time, retail depositors have learned that promises of high returns from some peer-to-peer lenders were too good to be true.

Although FinTechs linked to tech businesses like Tencent, Alibaba, and Baidu are building significant financial services brands, it may prove challenging for a broad range of standalone startups to develop sufficient client trust to compete at scale with China's tech giants or traditional banks.

Example 2: "Tech Dominance" (Quadrant III)—India

Like China, India has a world-class tech industry set against the backdrop of a financial services industry that does not yet serve the mass market and small enterprises. A robust tech sector based on world-leading software and information technology companies has developed over recent decades. This has created a tech ecosystem, including skills and capital, that is supporting a burgeoning FinTech sector, including innovators in payments, digital small enterprise and retail lending, personal financial management, and insurance.

India's tech sector had been held back by regulation that limited unlicensed entities from performing banking activities while maintaining high barriers to obtaining a banking license. However, new regulations announced in 2014 will enable tech companies to compete. Many FinTechs have already obtained or sought licenses.

Important advances in infrastructure, especially digital identity that can be linked to bank accounts, have provided an opportunity to reduce the cost of customer on-boarding and ongoing compliance. This enables financial institutions to reach hundreds of millions of new customers. These advances in regulation and infrastructure are paving the way for increased provision of financial services from both traditional and non-traditional providers.

The demonetization of notes announced in November 2016 has accelerated the shift from paper to electronic payments and added momentum to the technology-driven transformation of financial services in India.

Payments banks were conceptualized by the Reserve Bank of India in 2014 as a new model to

increase access to financial services for unbanked or underbanked groups such as small businesses, low-income households and migrant workers. The two main differences between a payments bank and a traditional bank are that the former can only accept deposits of up to 100,000 Rupees (\$1,550) per account and are not allowed to issue loans or credit cards.¹⁹⁶

Low-cost, paperless operation through mobile phones could allow payments banks to address market segments characterized by low value/high volume transaction. In 2015, the Reserve Bank granted eleven companies, including the country's biggest mobile service providers, "in-principle" licenses to launch payments banks.¹⁹⁷

The first live payments bank was launched in January 2017 by Airtel, a mobile network operator. India's largest digital goods and mobile commerce platform, Paytm aims to have its new payments bank open 200 million banking and mobile wallet accounts within the coming year.¹⁹⁸

A key element of the support infrastructure needed to reach more customers has been provided by the Unique Identification Authority of India (UIDAI). This government agency, which is the world's largest national identification number project, has enrolled more than a billion residents of India since September 2010.¹⁹⁹ UIDAI issues Aadhaar identification numbers, collecting demographic, biometric and other details during enrollment. The Aadhaar number can be used for paperless identity verification when opening a financial account, reducing the risk of identity fraud.

This allows banks to fulfill their Know Your Customer, or KYC, requirements for hundreds of millions of new customers. Aadhaar-enabled e-KYC processes could halve costs and time relative to paper-heavy processes.²⁰⁰ Some 34 banks have used e-KYC to open over three million bank accounts across the country, contributing to a fourfold year-on-year increase in India's mobile banking transaction value by the end of December 2015.²⁰¹

The identity infrastructure can be linked to the payments infrastructure of the National Payments Corporation of India to access funds and route payments to an individual's phone or bank account. The Aadhaar Enabled Payment System allows the individual to use Aadhaar data for authentication

rather than a debit card, in order to perform financial transactions at a banking correspondent. The Unified Payments Interface allows a bank account to be linked to phones and apps.

At the start of 2017 the government launched an interoperable payment app, Bharat Interface for Money, which became a popular download.²⁰² DigiLocker, a platform for issuing and verifying digitally signed documents and certificates, was recently integrated with UIDAI and will allow further streamlining of financial services.

This "India Stack" of technology built upon Aadhaar will improve credit availability as well. Lenders can link a customer's identity to digital transaction data, enabling more efficient credit appraisals, and use the payments and document functions for efficient underwriting, processing, disbursing and loan collection.²⁰³

India has a large SME funding gap that is as much about market size (the number of towns and cities dwarfs the branch numbers of even the largest banks) as it is about traditional banks' reluctance to lend except to known borrowers who have sufficient collateral.

As in some of the developed markets (Quadrant II), there has been strong growth of non-bank alternative lenders addressing this gap in small firm financing with innovative digital solutions, quicker turnaround, analytics and credit-scoring driven underwriting and cost effective customer acquisition.

These include NeoGrowth, LendingKart, and Capital Float, technology platforms that lend to SMEs across the country. These lenders use cash flow data, digital transaction history, and other non-traditional information to build credit profiles.

Others, such as KredX, are creating digital platforms for invoice finance.²⁰⁴ Lenders must either obtain a license or book the loans through a bank or Non-Banking Financial Company (NBFC); thus a number of tech companies have partnered with licensed institutions. Since the new lending platforms lack a low-cost deposit base, most of these lenders are funded by banks and institutional investors. Peer-to-peer lending, which serves a combination of retail and micro/small and medium enterprise borrowers, has also been growing rapidly. Currently covered only by the Negotiable Instruments

Act, these lenders may be put under a new non-bank finance company category of Reserve Bank licensing.²⁰⁵

In November 2016 the Indian government announced the demonetization of large denomination bills, with the aim of combatting tax fraud, counterfeiting, and corruption. This removed 86 percent of currency in circulation, spurring a sharp increase in electronic payments, including interbank fund transfers, retail bankcard, and mobile wallet transactions.²⁰⁶

Mobile banking and digital payments service providers such as FreeCharge, Ola Money, Oxigen, and Paytm, as well as bank offerings including ICICI Pockets and Axis Bank's LIME have benefitted. Whether this momentum will persist after new cash notes come into circulation remains to be seen, but even a return to the previous trend will mean a continued shift to electronic payments. In March 2017 Amazon was awarded a mobile wallet license, adding another big player to the market²⁰⁷, and in May 2017, SoftBank announced a \$1.4 billion investment into Paytm, joining previous investor Ant Financial in helping to expand the company, which aims to serve 500 million customers in three years.²⁰⁸

With its investment in digital identification, tiered licensing for financial services, and other innovations in financial infrastructure, India has addressed Challenges 3 and 4 (Box 1), creating an opportunity for financial services providers to focus on Challenges 1 and 2, reaching low-income customers with targeted and tailored information and services.²⁰⁹

Some are actively partnering with FinTechs to expand services and reach and improve efficiency. For example, Fullerton India, an SME-focused credit provider, has partnered with Creditvidya, a startup that leverages alternative data for credit scoring, to perform automated authentication and verification checks to improve the efficiency of Fullerton's loan processing.²¹⁰

Given the market gaps and the strong tech ecosystem in India, FinTechs and new forms of banks have strong potential to dominate significant market segments. The viability of some of the current business models, however, has yet to be proved, and policy driven changes to pricing, market conditions, and permitted activities will continue to present challenges to standalone tech players. It seems fitting that this market, whose tech

companies enabled so much of the business process outsourcing and offshoring that has changed corporate operations in developed markets, is now demonstrating how banks can partner with FinTechs to reconfigure product delivery in the home market.

Example 3: "Race to the Finish" (Quadrant IV)—Kenya

An early adaptor of mobile money,²¹¹ Kenya appears in Quadrant IV just below Quadrant I, highlighting the expanded reach of its financial sector thanks to Kenya's mobile-money system, M-PESA, which was launched in 2007 by Safaricom, the country's largest mobile-network operator. Mobile transactions are transforming Kenya's payments system; they hit a record \$33 billion in 2016 and accounted for 67 percent of transactions tracked by the National Payments System.²¹²

In November 2012 Safaricom, together with Commercial Bank of Africa (CBA), introduced M-Shwari, leveraging the M-Pesa network to provide deposit and lending products directly onto a phone handset. M-Shwari grew rapidly; by 2014 it had been able to mobilize deposits of \$1.5 billion and had disbursed loans of \$277.2 million. CBA's market share of deposits rose to 6 percent in 2015 from 4.7 percent in 2012, and its share of the total number of bank accounts grew to 37 percent (12.9 million accounts) from 7 percent in 2012 (1.1 million accounts).

CBA's contribution to opening bank accounts represented close to 12 million of the total 19 million new accounts in Kenya from 2012-2015, and Equity bank accounted for another 5 million.²¹³ While M-Pesa provided the pipes for CBA's growth, the capture of value-add in financial services appeared to shift back to the banking sector.

M-Pesa has enabled a number of other advances. Innovators have built on top of the payments infrastructure provided by M-Pesa, developing merchant acquisition networks and innovative pay-as-you-go models for durable goods such as solar lights and panels. That business model innovation has now been replicated in other markets and regions, enabling microleasing of devices that can be remotely controlled and paid for.

This has resulted in a follow-on financial innovation as the solar hardware companies have become de

facto leasing companies. Once a device is paid off it can become collateral for further general purpose lending. More recently, the entry of FinTechs using mobile phone data for credit scoring to extend micro-loans (Tala and Branch, for example) may shift the innovation lead back to the technology side.

In another play for the market, Safaricom has recently eliminated fees on low value transactions and reduced the minimum transfer amount from ten to one Kenya shilling with M-Pesa Kadogo. This essentially makes mobile money a costless cash replacement, and potentially positions Safaricom at the center of the merchant payment ecosystem.

It is still not clear who will dominate the provision of financial services in Kenya. For now, consumers are benefiting from reduced prices and increased availability of services, and a recent study has demonstrated the contribution of mobile money to poverty reduction through increased financial resilience and improved labor prospects.²¹⁴

The availability of the core payments infrastructure has enabled reconfiguration of the value chain from one in which the banking system provided savings, loan, and payments products to one in which an external payment infrastructure is interwoven into banks' products and services.

This has underpinned the success of new financial products as well as new business models in other sectors such as pay-as-you-go solar. It has also spurred development of the local innovation ecosystem, as demonstrated by a thriving community of startups, accelerators, and venture capitalists.

OPPORTUNITIES FOR EMERGING MARKET BANKS

Globally, the digital transformation of banking services allows an expansion of access by leveraging digital channels and customer information, and a reconfiguration of product and process value chains to offer new products and serve customers more efficiently. In this new context, each of the four challenges facing emerging market digital financial transformation, as enumerated in the box on page 57, also presents opportunities.

1. Low levels of formal financial services:

Innovations such as mobile money can take hold more completely in emerging markets where there is a strong need and no incumbent service to displace. Building on the mobile money ecosystem, innovators in emerging markets have leapfrogged conventional financial infrastructures to offer a range of financial services engineered to sustainably service dispersed or low-income populations.

2. Low income levels:

Operating bank branches is expensive in emerging and developed markets alike, and the shift to digital channels helps reach more customers at lower cost across markets. The imperative for complete digital transformation from front-end customer channels, through the credit and payments engines, to servicing and processing is greater, though, in emerging markets where financial access is a goal.

In wealthier markets, mobile channels and improved processing efficiency are add-on benefits to help meet customer expectations and improve profitability. Among low-income communities, however, these are must-have features that enable the sustainable provision of financial services to lower income consumers.

3. Underdeveloped technology and VC ecosystems:

Flying under the radar of the global tech/venture capital community can create space for local innovators to serve their markets while the giants are looking elsewhere. For banks, this can also create opportunities if they can lead in introducing unique local value propositions, as CBA did with m-Shwari in Kenya.

4. Weak infrastructure:

While forward thinking regulators in some countries have created an environment favorable to digital financial services, whether by offering a flexible regulatory environment (Kenya) that allowed non-bank infrastructure to develop, or investing in critical identity and payments infrastructure and a tiered licensing system (India), in many countries much work remains to be done.

Where general-purpose financial infrastructure is lacking, the networks and infrastructure of incumbent

banks retain significant value. The opportunity for banks is to leverage their position of already having payments, identity and trust assets in place as new infrastructure comes on-line. Banks can leverage their capital, customer bases, and brands to expand rapidly in partnership with Fintechs that can help fill gaps in banks' channels, product sets, and processing capabilities.

CONCLUSION

While the final structure of a digitally transformed financial services sector could take different forms, the degree to which banks continue to play a role will depend on a combination of initial conditions and adaptability.

In markets where the formal banking system is well-entrenched and had been providing reasonable services to the mass market, banks may continue to play a dominant role—even where the technology ecosystem can support significant FinTech incursions. In markets where the banking sector has lagged, FinTechs have a greater chance of taking over functions and market share.

In countries where the tech ecosystem is relatively weak, with only isolated solutions such as mobile money being offered by tech companies, banks have thus far been able to catch up. Kenya is an example where an extensive FinTech infrastructure for payments was put in place by a telecommunications company, but the financial services value add has been reclaimed by banks. Even so, an array of new entrants leveraging that technology infrastructure may shift a portion of financial services out of the banking sector.

China and India offer examples of different potential outcomes in markets where broad penetration of formal banking was low, leaving a large underserved market, while the tech ecosystems were strong. In China, where the regulator has permitted significant innovation outside the banking system, a huge number

of marketplace lenders has emerged, and a number of tech companies have made significant inroads into financial services, notably in payments and investments. India has also seen a proliferation of new lenders and payment offerings.

While the marketplace lending and wallet booms in these countries may not be sustained, the big tech companies in China are well positioned to play a significant role in financial services going forward. In India, the banking regulator has taken a more conservative approach: innovators must partner with banks or obtain one of the tiered licenses now available. Convergence may be the result. As the infrastructure for digital financial services is rolled out, banks are increasingly partnering with innovators even as tech players are looking to obtain payments bank or other licenses.

Across all Quadrants in our mapping, technology enables expanded reach and the reconfiguration of product delivery in the financial sector, as it has in other industries. Market position and regulatory privilege provide a window in which banks can continue to lead in the provision of financial services in the digital age, but this window will only remain open as long as they innovate to provide what customers need. Banks don't need to accomplish all this innovation by themselves.

Banks have an opportunity to learn from the experiences of the automobile, electronics, retail, and other industries where product design, production, branding, marketing, delivery, and servicing no longer take place within a single corporate entity, but value chains have been constructed to optimize the best solution at each link.

As markets develop, more will shift to Quadrant II, in which banks partner with technology innovators to provide enhanced products and services to an ever wider customer base. ■

CHAPTER 10

Precision Farming Enables Climate-Smart Agribusiness

By Igal Aisenberg

Emerging market countries, particularly India and nations in Sub-Saharan Africa, can benefit from advanced farming technologies that mitigate the effects of climate change and protect environmental resources. Water scarcity is an issue that can be overcome by adopting climate-smart technologies such as micro-irrigation. There are several precision agriculture investment opportunities available to the private sector, including agricultural extension via digital advisory services, drip irrigation, solar pumps, and crop and soil monitoring.

Existing and developing technologies will have a major role in food production and food security in emerging markets. According to the International Food Policy Research Institute (IFPRI), the largest yield gain potential across the world's key staple crops—maize, rice, and wheat—in percentage terms are in Africa, South Asia, and parts of Latin America. In a comprehensive attempt to identify the drivers of yield increase, IFPRI's selection of technologies included:²¹⁵

- No- and low-till farming
- Precision agriculture
- Soil fertility management (including nitrogen use)
- Drip and sprinkler irrigation
- Drought and heat tolerant seeds
- Crop protection

While IFPRI's interim conclusions rank no-till farming as the practice most conducive to yield increase in the three crops tested, it notes that the interaction of multiple practices applied simultaneously will almost certainly produce the best results

Along the same lines, field tests over the past 30 years showed that applying soluble or liquid fertilizers through drip systems contributed to input saving, direct plant utilization, and reduced chemical pollution.

Despite the definitive advantages of these technologies

(Figure 2), there is near zero adoption of drought tolerant seeds and little adoption of precision agriculture tools, drip irrigation, and sprinkler irrigation in Sub-Saharan Africa and most of India.²¹⁶

INDIA'S POTENTIAL MODEL FOR CHANGE

Building capabilities to sustain the adoption of more precise farming practices, rather than the full implementation of single factors, will produce the quantum leap necessary in India and Sub-Saharan Africa. (In fact, building access to crop and site-specific

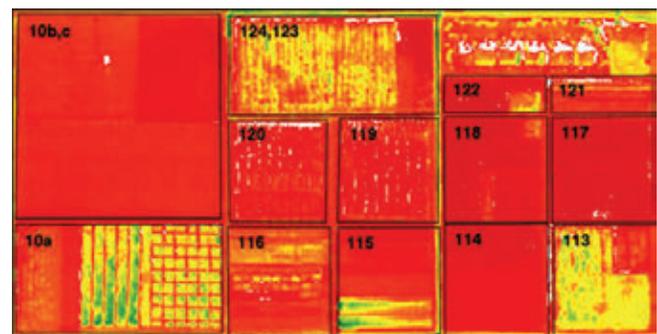


FIGURE 1 Soil and Crop Monitoring: Measuring the Water Deficit

The image shows water deficits in individual fields, measured by a NASA aircraft flying over the Maricopa Agricultural Center in Arizona, USA. Green and blue colors indicate wet soil; red indicates dry soil. Source: NASA, <https://earthobservatory.nasa.gov/IOTD/view.php?id=1139>

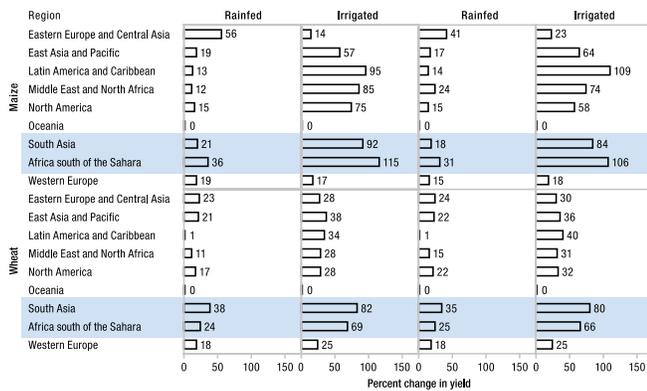


FIGURE 2 Yield Increase Response to No-Till and Irrigation Under Less-Hot (left) and Hotter (right) Climate Change—2050

Source: IFPRI, 2014.

technical knowledge and developing management capabilities is a precondition to improving yields anywhere in the world.) In that context, some of India’s leading states may provide important lessons to be applied elsewhere.

India is an agricultural giant with 194 million hectares of gross-cropped area, 66 million hectares of net irrigated area, and 127 agro-climatic zones. India’s central and state governments have been proactive in addressing obstacles to the agricultural sector, which employs about half of the workforce and accounts for almost 7 percent of GDP. Despite robust subsidies for electricity, micro-irrigation, and fertilizers, rates of adoption for these technologies have been low, except in Gujarat.

The lack of efficient knowledge dissemination tools is pervasive in India’s agriculture sector. Despite government efforts to provide agronomic support, most farmers remain far from adopting available technologies due to a lack of effective transfer mechanisms. The model implemented by the Gujarat Green Revolution Company (GGRC) integrates input subsidies, primarily for micro-irrigation and fertilizers, with manufacturers’ on-farm support and equipment performance warranty, both prerequisites to qualify as certified suppliers.

Gujarat’s Micro Irrigation Scheme gained popularity through the provision of electricity connections on a priority basis to those farmers who adopt Micro

Irrigation Systems, or MIS. Unique features of the scheme include bank loan support for farmers and insurance coverage for both the system and the farmer for one year. The strength of the scheme lies in its flexibility and transparency, including discretion for participating farmers to choose the type of MIS they prefer.

Farmers can also choose the area to be covered under MIS and the suppliers who install it, provide agronomical services for one year, and maintain the system for a period of five years. The scheme enabled the transition of over one million hectares to MIS in the last decade.²¹⁷

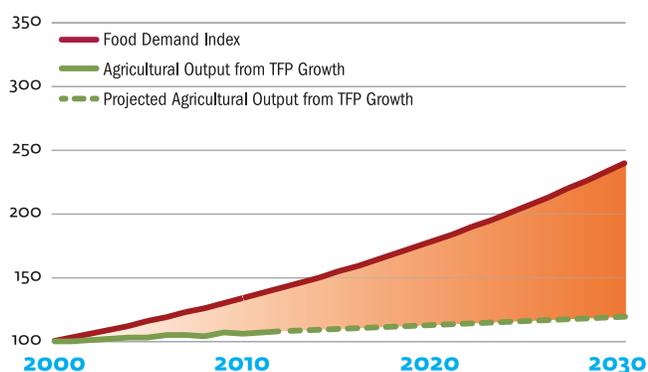
As part of the effort to re-energize the second Green Revolution campaign, Gujarat’s model is now being emulated by other states. In parallel, community projects supported by local governments group together thousands of small farmers to overcome the inherent disadvantages of scale (for example, Karnataka’s Ramthal Community Irrigation²¹⁸ and Tamil Nadu’s Community Collaborative Water Management initiatives).²¹⁹ Given the appropriate financial and human resources, Gujarat, Karnataka, and Tamil Nadu offer critical lessons that may be applicable in some Sub-Saharan African countries.

KEY BARRIERS AND THE PRIVATE SECTOR ROLE

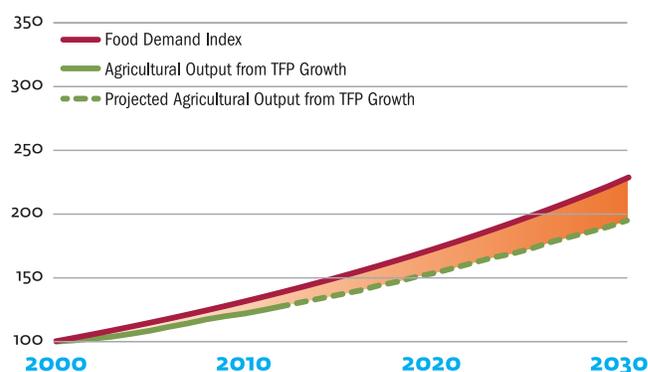
IFPRI’s agronomic assessment of potential drivers point to necessary but insufficient factors to increase yields. Public and private initiatives must address additional local and regional factors that constrain investments at the farm level, including:

- Infrastructure transportation to serve domestic markets, intra-regional trade and export
- Cold-chain transportation and storage
- Extension services that research and disseminate agricultural knowledge
- Modern test-lab facilities and capabilities
- Smartphone networks to support digital communication in rural areas
- Adequate commercial financing
- Safe and predictable power and water supply

The public and the private sector can work together in partnership to disseminate technology, knowledge, and inputs. Public extension networks can set a



14% of total **Sub-Saharan Africa** demand can be met by maintaining the current TFP growth rate.



74% of total **South and Southeast Asia** demand can be met by maintaining the current TFP growth rate.

FIGURE 3 Food Demand Compared to Agricultural Output from Total Factor Productivity (TFP) Growth in Sub-Saharan Africa and South & South East Asia—2000–2030

TFP measures changes in the efficiency with which all inputs are transformed into outputs; here understood as farmers who use inputs more precisely and efficiently, or adopt improved cultivation and livestock practices. Source: Global Harvest Initiative, 2015 Global Agricultural Productivity Report, 2015, pp. 12-13. www.globalharvestinitiative.org/GAP/2015_GAP_Report.pdf

competitive stage through policies and programs, and private extension systems can directly support projects. The private sector can also fund research, commercial financing, insurance, digital knowledge dissemination, crop quality assurance and more.

Yet there is no substitute to public investment in physical infrastructure in roads, communication, and power, as well as institutional reforms that enable fair land consolidation, reduce bureaucratic barriers and unequivocally fight corruption. In that context, both Sub-Saharan Africa and India face challenges that inhibit private investment.

SMART AND PRECISE AGRICULTURE INVESTMENT OPPORTUNITIES

Can the most food-insecure countries dramatically increase their farming productivity with minimal impact on the environment? A qualified “Yes” is the answer broadly agreed upon, as are the necessary measures to achieve that goal.

Climate-smart agriculture is necessary to achieving the goal, and precision agriculture—at the appropriate level in food insecure countries—can also be a powerful tool when applied appropriately, based on local crop and site specific conditions.

The reality is that it is still possible to farm relatively effectively and competitively with little precision technology.

Consequently, the adoption of new techniques in less developed areas should start with a basic, affordable, and effective mix of technologies and practices. In a multiple-variables scenario, where all means are important, close examination invariably teaches that they are not all equally important.

Identifying the low hanging fruit is critical to setting a complex project in motion, certainly more so when the private sector is involved. And return on investment is a dominant factor.

The immediate benefits for small-scale farmers and potential investment opportunities from the introduction of such a mix of inputs, technologies, and capabilities in Sub-Saharan Africa and India include:

- 1. Agricultural Extension via Digital Advisory Services:** “Technology alone is not a silver bullet,” according to the Gujarat Green Revolution Company. Adoption of best practices is critical, and digital communication is necessary to bridge the technology gap. Basic smartphones can bring digital agronomic support provided by human advisors to millions of farmers.

Reaching out to millions while keeping the trust of person-to-person advice is the challenge of effective adoption. Communication should flow between advisors and individual farmers, and it should support crop planning and management on a *constant* basis. Agro-advisory networks are crucial in the Indian and Sub-Saharan African agriculture sectors, given that the choice of inputs and methods of cultivation determine both the financial viability of farms and the optimal conservation of land, water, and energy. Public support would be particularly beneficial for allowing platform building, including data platforms. Private engagement could then be increased via competition on the platform and extended reach of farmers through it.

No- and low-till farming greatly reduce soil disturbance, which reduces soil erosion, builds soil organic matter, and helps reduce machine energy cost and pollution. It must be done properly to avoid weed propagation. The accumulated and frustrating experience in Sub-Saharan Africa and other parts of the world show that introduction and implementation *do not* equal adoption. Digital Advisory Services, or DAS, can be the standard tool for existing extension networks and holds the key to adoption and, unlike other inputs, requires no investment from farmers.

Agricultural extension plays a key role in technology dissemination, and the private sector is increasingly active in this domain. Today, Digital Advisory Services are either part of the offering of input providers or stand-alone for profit, typically start-up platforms. In the first case and with few exceptions, existing *free* DAS is a differentiation tool to promote the use of manufacturers' core products. In the second case of for-profit stand-alone platforms, farmers are the revenue generators, and its application to small farms in food-insecure areas is far-fetched.

A recent assessment of privately supplied farmer advisory services examined the situation in ten countries. Four of the case studies came from India. In these instances, the study identified considerable benefits from extension by commercial actors. Their

advice helped improve yields, natural resource management, consistency of produce quality, and net farm profits.²²⁰ The opportunity for investors may be found in *free and brand-neutral platforms* that produce *non-prescribing* analytics that enrich human advisors. Free-of-charge systems should drive mass utilization and Big Data value for large agribusiness players. At a later stage, investors may benefit from Big Data's appeal to mass communication and advertising platforms. The main barriers to DAS adoption are limited digital infrastructure and illiteracy, areas where India has significant advantages over most of Sub-Saharan Africa.

- 2. Drip irrigation:** In addition to its advantages over other types of irrigation for improving yields, drip irrigation is the best delivery system for soluble fertilizers. It also drastically reduces the propagation of weeds and the need for herbicides. The private sector is well prepared to lead here. Foreign—principally Israeli—and local leading brands dominate the established micro irrigation market in India. Additionally, local adjacent large firms are considering or have already entered it. The introduction of drip and micro irrigation is estimated to cover no more than 10 percent (approximately \$1 billion) of its over 40 million hectares' potential. Heavy governmental support seems to be granted for the foreseeable future, and absent technologic breakthroughs, investment in the sector should consider acquisition of or partnership with incumbent firms.

Sub-Saharan Africa, with a few exceptions including South Africa, is a relatively new frontier for micro irrigation, with no established market or market leaders. The main barriers to adoption are capital expenditure financing and advisory services. Despite the numerous obstacles to the technology, the gap between a growing population and inefficient agriculture makes the region an attractive opportunity for long term investors.

- 3. Solar Pumps:** Solar pumps that lift well water to feed drip systems are a benefit multiplier. Yet the introduction of solar pumps is slow despite their zero-carbon footprint and low-maintenance photovoltaic technology. According to official

estimates, over twenty million well pumps operate today in India, roughly split between electric and diesel.²²¹ At a solar unit cost ranging from \$1,500 to \$10,000 for multiple farmers, this potential multi-billion dollar market is already a target for local and foreign manufacturers

The initial cost of solar technology coupled with the established maturity of electric and diesel pumps (and subsidized electricity) are among the major barriers to solar pump adoption. Changes to subsidy policies now underway may help pave the way for mass adoption and hence further increase the role of private firms contributing to the proliferation of solar pumps.

- 4. Soil and Crop Monitoring:** Imagery-equipped drones are often technically and financially affordable for small farmer communities or regional operations. Accurate regional weather forecasts can provide data relevant to the spread of diseases and pests. Monitoring and Predictive technologies seem applicable while algorithm-based prescriptive systems may not suit most of the necessary support. Drones' sensing is particularly suited for small plots and contract farming. Small farms can benefit from quality and timely information that can drive corrective actions and prevent crop failures due to defective irrigation and fertilization.

Contract farming is typically carried out by financially capable companies that depend on small suppliers. Early detection and correction of soil and crop deficiencies is a win-win proposition for both farmers and off-takers. If purchased and operated by large agri-businesses, the investment in drones and imagery analysis can be factored into the produce price paid to farmers. Investments by cooperatives of farmers supported by soft credit may reap similar benefits. Extending the usage of equipment for soil and crop monitoring to farming cooperatives and contract farms also benefits from new forms of capex utilization led by the private sector, now spreading from developed countries into emerging markets.²²²

These technologies by no means discount the crucial role played by quality seeds, judicious pest and disease control, and other ground-based or remote sensors, all of which can be adopted by better informed farmers. New technologies aimed at optimizing input utilization—for example robots, variable rate seeding, and irrigation—are being developed and their introduction to small scale farms may be applicable in the future. At present, every solution should be integrated and should have basic characteristics:

- Easy-to-use systems: simple and fast setup, yet accurate enough to provide advice focused on the farmer's needs.
- Minimum requirements for support and maintenance: minimal dependence on farm-specific communication infrastructure and in-field hardware.
- Flexible digital interfaces: easy and free building capability for users.

CONCLUSION

Climate smart farming techniques can increase agricultural productivity and farmer income, make rural communities more resilient, and mitigate climate change. Precision agriculture is part of the solution to feeding a population that is growing faster than available land supply, while also ensuring the sustainable use of water and energy. Per capita agricultural output in Sub-Saharan Africa and India is far below potential, mainly due to outdated technologies and practices that result in low productivity and overdependence on nature.

Given the proper regulatory environment and institutional support, foreign and local private corporations seem willing to explore the opportunity and invest where needed. Small-scale farming, which is not inherently conducive to capital intensive modernization or the easy adoption of updated agronomic knowledge and methods, should be considered a challenge that we can meet. ■

CHAPTER 11

From Farm to Fork: Private Enterprise Can Reduce Food Loss Through Climate-Smart Agriculture

By Anthony Mills

More than a billion tons of food are lost annually across global food supply chains. Spillage, spoilage, insects, and rodents cause this post-harvest loss. Addressing it is a daunting challenge due to the complexity of the many factors involved. But it is a worthwhile challenge because of the potential benefits, including improved food security, nutrition, economic productivity, and response to climate change. Poor or nonexistent public infrastructure is often an underlying cause of food not being transported or processed effectively. And climate change damages existing infrastructure and increases losses. Despite the numerous environmental, economic, and socio-cultural barriers involved, there are many examples of private sector enterprises that have tackled post-harvest loss successfully. They focus on education, collaboration, and markets.

In developing countries, losses in food supply chains of fruits, vegetables, and grains take place predominantly during production, post-harvest handling, storage, and processing stages (Figures 1 and 2). Spillage and biological degradation of crops are the primary causes of losses, with biological degradation usually responsible for the vast majority of them. Spillage is mainly a problem during harvesting, transportation, and processing, while biological degradation occurs at all stages, particularly during storage operations.

Biological degradation includes bacterial and fungal decomposition, insect infestations and rodent damage. Managing any of these factors requires in-depth knowledge of what promotes them, what constrains them, and which technologies can be employed cost-effectively to maintain the quality of the produce.

Obtaining the required knowledge on biological degradation and using it to reduce post-harvest losses is challenging, particularly in developing countries. And careful scrutiny of potential benefits and pitfalls is required to answer critical questions: How much food could practically be saved, and at what cost? And who would benefit from the savings?

Estimates of the amount of food lost are staggering. Some analyses estimate that one-third of global food production—or about 1.3 billion tons—is lost annually.²²³ Losses of that magnitude compromise not only global food security, but also the world's climate via greenhouse gas emissions.

Indeed, the production and biological degradation of 1.3 billion tons of food results in emissions of more than 4 billion tons of carbon dioxide equivalent. That is greater than the annual combined emissions of all countries other than China and the United States.²²⁴

There are also considerable economic costs related to post-harvest food loss. For example, the value of grains lost annually in Sub-Saharan Africa alone has been estimated at \$4 billion (Figure 3). This exceeds the value of total food aid in that region over the last decade. So it is not surprising that reducing food loss has been hailed as an important way to increase food security, increase income streams for smallholder farmers, and mitigate climate change. Solutions to the problem of food loss, however, are complex and elusive. Each country, region, farmer, and food supply chain has a unique set of problems and potential solutions.

Importantly, the variability of post-harvest loss across regions and supply chains makes it challenging to quantify accurately, particularly as losses in quality are difficult to estimate. Despite this uncertainty, it is clear that smallholder farmers in developing countries stand to benefit the most from reducing food losses.

While large commercial farms tend to have the knowledge and finance need to reduce post-harvest losses, most smallholder farmers do not. By deploying various technologies and techniques, large farmers can reduce losses to below 2 percent of their harvest, while the majority of smallholder farmers in developing countries regularly lose more than half of their crops to spillage, spoilage, insects, and rodents.²²⁵

TECHNOLOGY AND PROFITS TO THE RESCUE?

The technologies available for reducing post-harvest food losses are varied and depend on the crop type and the main factor to be averted, among other things. In some cases, simple adjustments such as changing the containers used to transport crops can significantly reduce spoilage and spillage. In other cases, investments into new storage and processing solutions are required.

These include metal silos, sealed bags, threshing plants, and packaging facilities.²²⁶ The benefits of

the technologies available are clear, but effective implementation can be difficult and depends on a wide range of factors.

Indeed, despite the proven efficacy of the technologies introduced to Sub-Saharan Africa, there has been a ‘deplorable lack of success’ according to a recent review of loss-reduction projects. Technologies are frequently abandoned by small-holder farmers, particularly after being introduced by donor projects.²²⁷ It is important to understand why this occurs and to apply lessons learned that can inform future approaches.

Viewing value chain steps in isolation. One reason for the lack of success in the past is that single solutions have been proposed and problems have been tackled in isolation. What is often needed instead are multiple interventions across the value chain. Although most losses occur during storage and milling, each step in the chain can and often does result in significant losses that warrant remedies (Figure 1).²²⁸

Furthermore, addressing only one step in the value chain is usually unlikely to achieve a major loss reduction. A cold storage chain is a good example of where the chain is only as strong as its weakest link, and a simple intervention in one link is likely to be of little value if other links remain weak. Assessing the

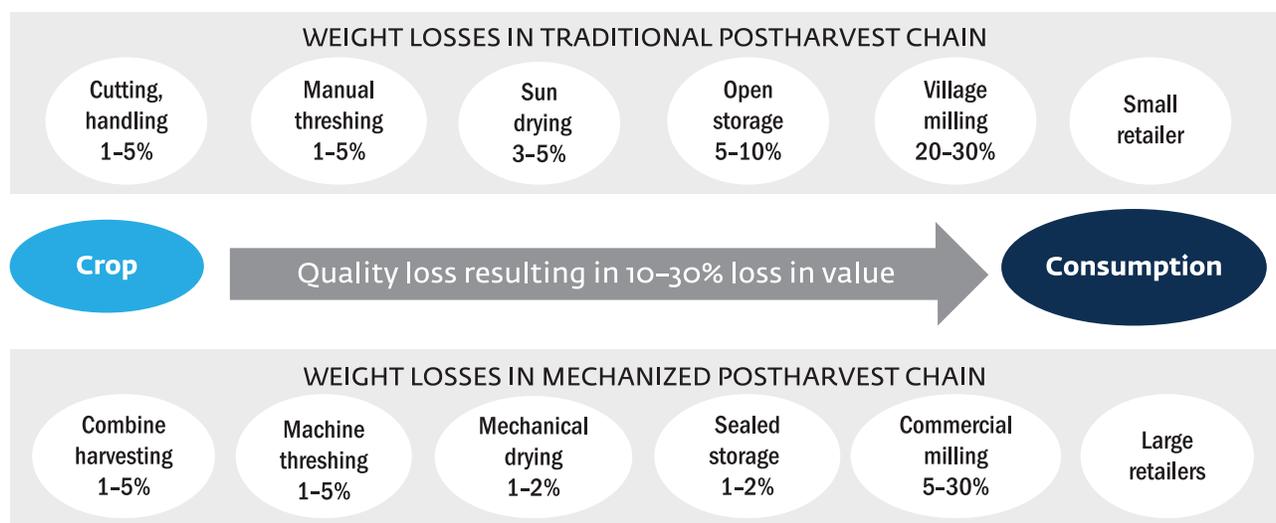


FIGURE 1 Estimated Losses From the Post-Harvest Chain for Rice in South Asia

Source: Hodges, Rick J., Jean C. Buzby, and Ben Bennett. 2011. “Postharvest losses and waste in developed and less developed countries – Opportunities to improve resource use.” *Journal of Agricultural Science*.

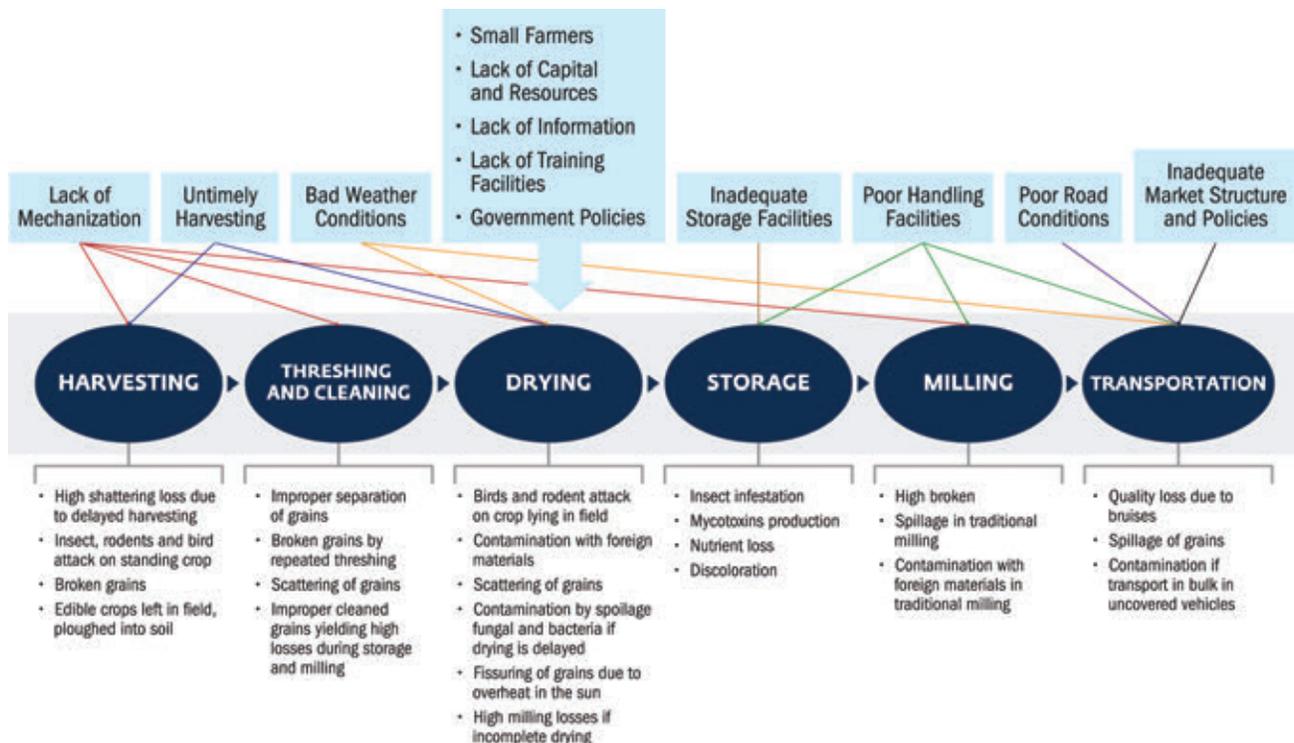


FIGURE 2 Factors Potentially Resulting in Post-Harvest Losses in Grain Supply Chains in Developing Countries

Source: Kumar, Deepak and Prasanta Kalita. 2017. "Reducing postharvest losses during storage of grain crops to strengthen food security in developing countries, Foods." ADM Institute for the Prevention of Postharvest Loss.

value chain of each crop as a whole is consequently of critical importance prior to any intervention aiming at reducing post-harvest losses.

Ignoring the need for economies of scale. There are many technologies available to assist in reducing post-harvest losses (Figure 2).²²⁹ These include metal silos, new transport systems, packaging facilities and processing plants. Such technologies, however, require economies of scale, large volumes of produce, and capital investment, and, therefore, are not readily available to the smallholder farmer.

Even ostensibly low-cost options such as hermetically sealed bags have been perceived to be unaffordable by many small farmers due to cash flow constraints, particularly at the time of the year when the purchase of bags is required.²³⁰

Socio-cultural problems. Cultural norms and societal perceptions also impede the uptake of low-cost technologies that can reduce food losses. These factors

are often simple, yet they can require years to uncover unless there is a detailed social survey conducted before introducing a technology. There may also be a need for ongoing technical support and education.

Three examples highlight these problems. First, metal silos for storing grain have not been used in some areas of Africa because due to a strong cultural imperative to store grain in the home. Second, in some countries it has been difficult for smallholder farmers to accept that hermetically sealed bags for storing grain should have a higher price than traditional sack-cloth bags. Some farmers in Tanzania, for example, are unable to comprehend price differences between bags that seem outwardly similar.²³¹

And third, although diatomaceous earth dust²³² kills insects by causing their cuticles to dry out, is non-toxic to humans, and has long been used in China to protect grain from insects, it's likely that some farmers will need to be persuaded to mix their hard-won grain with what is, in essence, a blend of earth and ancient algae.

Socio-cultural barriers to food loss remedies often seem obvious and easy to solve in retrospect, yet identifying them can be difficult.

It is increasingly recognized that, in addition to traditional economic models, the use of behavioural models— generated from within the relatively new behavioural sciences —are essential for guiding the adoption of new technologies by communities.²³³

Climate change, pests and infrastructure. The expected impacts of climate change across Sub-Saharan Africa include increased frequency and severity of both droughts and floods. Crop growing seasons are also likely to shorten and air temperatures will inevitably increase. All of these impacts are likely to increase post-harvest food losses in numerous ways, with potentially disastrous consequences for food security and human health. Three examples highlight the dangers of climate change.

First, bacterial and fungal spoilage of crops in storage will greatly increase in environments that become moister and warmer. Spoilage not only reduces income and food availability, but may also result in severe negative impacts on human health.

For example, when fungi spoil grains they release dangerous mycotoxins which are subsequently ingested by consumers. The effects of mycotoxins on human health and productivity can be extreme and should be seen as a matter of grave concern by all participants in the value chain.²³⁴

Second, insect and rodent outbreaks are also expected to increase as rainfall becomes more erratic. This is a result of intense rainfall events causing wetter than normal soils. The combination of wet topsoils and warm temperatures promotes the reproduction of insect pests that attack crops both in the fields and in storage.

Growth and reproduction of rodents are also promoted by flushes of vegetation that arise on wet topsoils. Plagues of rodents can easily arise in such circumstances. If the vegetation then dies back following climate change-induced dry spells and intense heat, rodents will tend to leave the fields and move into human habitations looking for food. Traditional storage systems in Africa are often not rodent-proof and, consequently, large losses of stored crops can be expected during such plagues.

And third, floods and landslides frequently damage infrastructure used along food supply chains. A simple

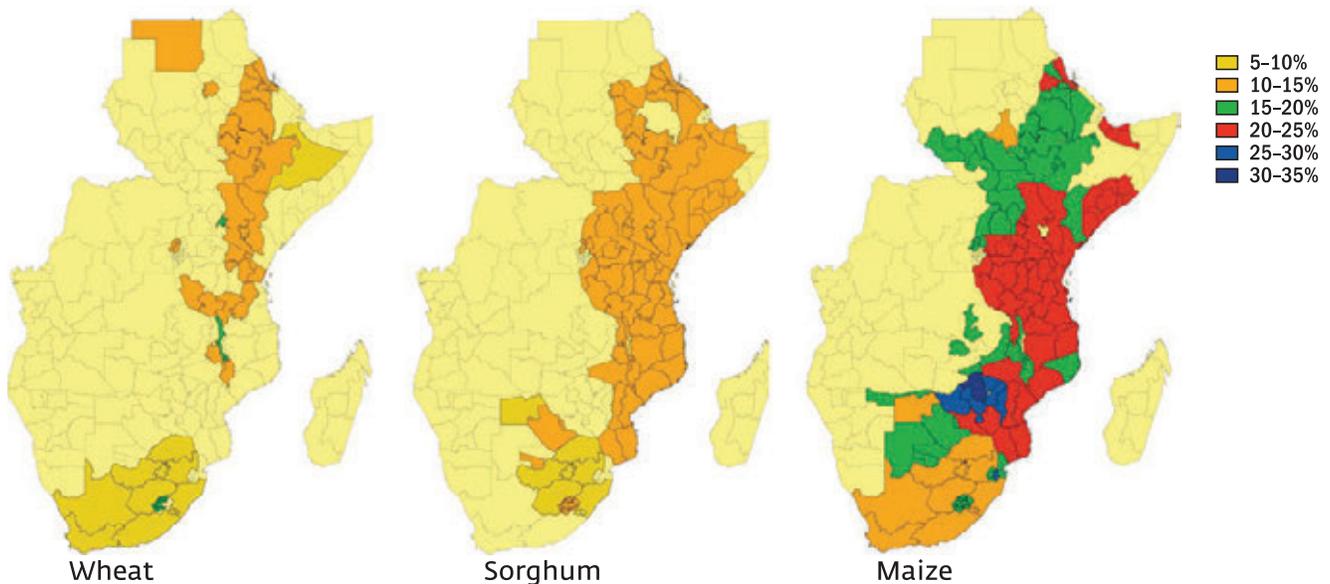


FIGURE 3 Estimated Cumulative Post-Harvest Weight Loss in 2007 in % from Production of Wheat, Sorghum, and Maize For Countries in East And Southern Africa

Source: Hodges, Buzby, and Bennett. 2011.

example is a road network used to access markets and crop storage facilities. Poor infrastructure in developing countries already constrains transport and storage of food, and is often identified as the main factor underlying post-harvest food losses there.²³⁵ Climate change-induced flooding is thus a danger that threatens to greatly undermine food security not only through damage to agricultural productivity but also by increasing post-harvest losses.

The examples described here are just a few of the numerous effects of climate change on food supply chains. Such effects will warrant careful analysis by any entities wishing to resolve post-harvest losses in developing countries. Climate-smart interventions will need to be honed for each effect.

While climate change affects post-harvest losses, the converse is also true, as noted above. Food products carry an embedded carbon footprint, and food loss increases this footprint unnecessarily. Additional land, water, and agricultural inputs are needed to produce food that is ultimately wasted.

Indeed, at a global scale, producing food that is subsequently lost requires an estimated 1.4 billion extra hectares of agricultural cropland, land that could be and should be supporting carbon-absorbing forests. Moreover, food waste that ends up in landfill sites produces methane, a greenhouse gas with approximately twenty times more impact on global warming than carbon dioxide. Reducing post-harvest food losses, therefore, has considerable potential for contributing meaningfully to reducing greenhouse gases in the atmosphere.

Lack of knowledge and skills. Technologies to reduce post-harvest losses, whether they are simple like hermetically sealed bags or complex like large processing and packaging facilities, require knowledge and skills to implement. As one study noted, even the simple technologies for reducing post-harvest losses are ‘precision-oriented’ requiring ‘careful attention to small details’.²³⁶ Providers of new technologies in Sub-Saharan Africa have often found that the use of the technology is effective at the outset but that the efficacy and hence adoption of the technologies decline through time. This is often because ‘attention to small details’—such as ensuring hermetically sealed bags remain

fully sealed—tends to decline in time unless technical support from the supplier is ongoing.

Inadequate knowledge and skills also often impede non-technical solutions to food loss. Warehousing, which includes warehouse receipt systems (WRS) and related inventory credit, is an example.²³⁷ It allows farmers to store crops in a centralised, managed warehouse and receive a transferable receipt. This provides farmers with much-needed liquidity, and stores crops effectively. However, despite their apparent simplicity, such systems have only been functioning well in several countries in Sub-Saharan Africa.

Although it remains unclear why such systems have had only limited success, the most likely explanation is that stakeholders involved in warehousing and warehouse receipts financing lack sufficient knowledge and have not been trained well enough to navigate the complexities of fluctuating market prices of the stored stocks.²³⁸ Furthermore, the large throughputs of crops that are required to make warehouse operations economically viable often cannot be achieved by smallholder farmers.

For small-scale operations, inventory credit may be a preferable system; here, crop harvests are offered as a guarantee for a cash loan. Microcredit can be issued against relatively small volumes of crops produced by smallholder farmers, while larger loans can be designed to be accessible to farmer associations.

Although a lack of access to sufficient—or indeed any—credit frequently prevents smallholder farmers from purchasing suitable technologies for reducing post-harvest food losses, in many cases simple skills in managing cash and taking investment decisions are the main barriers. For example, the purchase of hermetically sealed bags for storing grain was found to be a sensible as well as affordable investment for smallholder farmers in Tanzania, but very few farmers opted to buy them when the first became available.

This was primarily due to the fact that farmers’ cash reserves were lowest at the end of the growing season when the bags were needed, and also that a return on the investment two to three years after the purchase was a foreign and unwelcome concept. The farmers viewed the investment in a more favourable light once the distributors of the technology had invested

time into explaining both the long-term benefits of the investment and the advantages of purchasing the bags at the beginning of the growing season when the expenditure was more affordable.

SUCCESSFUL NAVIGATION THROUGH THE MAZE OF PHL

Navigating the complex array of problems described above is a daunting prospect for any private sector entity wishing to contribute to solving the problem of post-harvest loss in a particular food supply chain. As noted earlier, interventions are often required along numerous links in the chain. Economies of scale need to be created.

All social and cultural barriers need to be assessed and appropriate interventions devised. Furthermore, skills and knowledge need to be imparted to ensure that all interventions can be sustainably managed and maintained through time. Innovative solutions to insufficient and ailing public infrastructure, including ways to connect remote smallholder farmers in a cost-effective manner to markets, also need to be devised.

Finally, the impacts of climate change on spoilage, pests and infrastructure will need to be modelled and taken into account when designing all responses to reduce food loss. For example, technologies and infrastructure employed will need to be climate-proofed. Despite the complexity of post-harvest loss, the private sector has risen to the challenge in many different food supply chains and countries. Examples are discussed below, from grain and fruit production in Ghana to vegetable production in the Philippines and coffee production in South America. The common themes emerging from these success stories include the following.

First, there is a strong focus on educating all actors in the value chain on the importance of reducing post-harvest loss and how to employ solutions that do so. Second, there is an emphasis on effective communication and collaboration among different sets of actors. Collaboration among producers as well as between producers and buyers in particular has been found to greatly reduce costs by shortening the value chain and improving the transfer of appropriate technologies across the shortened chain. And third, there is a strong commitment to a market-orientated approach, as opposed

to using local cooperatives. While a market-orientated approach ensures that actors are accountable for all costs, the use of local cooperatives frequently leads to a lack of accountability and associated unnecessary expenditures.

Investments in the grain and fruit supply chains in Ghana. Two companies in Ghana, Premium Foods and Blue Sky Inc., demonstrate how education, communication, collaboration, and a market-orientated culture can combine effectively to reduce food loss in two different supply chains. Premium Foods has invested in an agribusiness centre that includes grain drying, shelling, and storage facilities that are integrally linked with farmer organizations, banks, business service providers, and input suppliers.²³⁹

Smallholder farmers using the agribusiness centre pay for extension services and receive training on a wide range of agronomic subjects. The centre receives grain from the farmers before it has been dried. The grain is then processed and sold by the centre. Loans from the input suppliers to farmers are paid off by the centre.

Post-harvest loss is greatly reduced as a result of the shorter time period required to dry the grain compared with traditional methods. The reduction in drying time is also a climate-smart agricultural approach because drying grain is increasingly difficult for farmers under climate change conditions, which include increasingly erratic and intense rainfall events.

Blue Sky, a fruit processor, was established by an investor with strong ties to supermarkets in Europe.²⁴⁰ The company works closely with smallholder farmers and provides free training, free technical support, and interest-free loans. Fair Trade and Ethical Trade Organic certification are also facilitated by Blue Sky. The farmers are paid promptly and receive prices for their fruit. The prices are agreed upon annually, they are higher than the costs of production, and they are adjusted for inflation.

The company also reduced post-harvest loss by constructing a local road network that links fields and processing plants, moving the production of fruits closer to the processing plants, establishing a juice processing plant, building packaging facilities, and managing the logistics of airfreight to ensure that their fresh-cut fruit arrives on the shelves of European supermarkets within 48 hours after harvesting. Since its establishment in

1998, Blue Sky has grown by scaling up its Ghanaian operations and replicating its model in Brazil, Egypt, and South Africa. In 2010 the company sold 3,800 tonnes of processed fruit and generated sales of \$24 million from its Ghanaian operations alone.

Twinning commercial farmers with smallholder farmers in the Philippines. The Northern Mindanao Vegetable Producers Association, or NorMinVeggies, is a new type of market facilitator linking smallholder vegetable producers in the Philippines to supermarket chains, hotels, fast food chains and export markets.²⁴¹

The association was established in 1999 by a group of farmers determined to capitalize on the emergence of supermarkets across this Pacific archipelago. The farmers comprised two distinct groups: smallholder and mid-size farmers. Prior to the formation of the association, only the mid-size farmers had access to capital, technical advice and technological solutions for PHL. Over time, the smallholder farmers learned new agronomic techniques and commercial approaches from the mid-sized farmers.

The benefit for all farmers was that production of all 12 different types of vegetables consistently reached critical volumes that enabled NorMinVeggies to negotiate from a position of strength with the supermarkets. To control quality, the association introduced quality assurance schemes, production schedules and traceability systems. These were rigorously adhered to, with lead farmers coaching other farmers and acting as quality managers. PHL on smallholder farms was up to 25% greater before the association introduced quality controls. By 2011 more than 5,000 farmers were operating under the umbrella of NorMinVeggies.

Coffee value chain in Central America. Beginning in 2003, this project funded by the Inter-American Development Bank has selectively targeted cooperatives of smallholder coffee producers who grew coffee at more than 1,200 meters above sea level, a requirement for speciality coffee.²⁴² The model implemented by the project had three core components: access to markets, access to training and coordination, and building collaboration across the value chain.

The bank also provided the project cooperatives with matching funds for investments in infrastructure such

WAREHOUSE FINANCING IN TANZANIA

Tanzania's economy relies heavily on agriculture, and climate change is already affecting the productivity levels of key commodities. Tanzania is committed to increasing yields through Climate Smart Agriculture by offering better input supplies (seeds, chemicals, fertilizers, etc.), precision farming techniques, and improved irrigation systems to smallholder farmers. It also seeks to protect smallholder farmers against climate related risks, increase productivity levels through crop insurance, and the use of warehouse receipts through approved efficient storage facilities. These allow the agricultural supply chain to improve post-harvest practices—improved transport and storage facilities, better farm management, improved harvesting techniques, etc.—which will reduce crop losses and help maximize the portion of the harvested output delivered to markets.

IFC's invested project entails a \$40 million credit line under the Global Warehouse Finance Program (GWFP) to CRDB Bank Plc. in Tanzania. By using warehousing receipts as collateral, CRDB can extend loans to medium-sized domestic traders and cooperatives, which typically have less financing options than global agro-exporters. By increasing access to finance in the agri-business sector, the project will help integrate Tanzanian smallholder farmers into the global food supply chain, leveraging Tanzania's existing trade channels in key export cash crops such as coffee and cashew, and other food crops. IFC has provided advisory services for collateral managers who monitor agri products in storage for CRDB, funded by the Government of Japan, to improve the monitoring techniques that can potentially contribute to reduce post-harvest losses. Japan and IFC have common objectives to reduce such losses in Sub-Saharan Africa by working with local bank partners, agricultural players including farmer cooperatives, small- and medium-sized business aggregators, processors, and traders, as well as collateral managers.

as coffee washing stations, which reduced post-harvest losses. The success of the project was evident in the increase in the number of participating producers, from 3,000 at the outset to 6,000 at the close of the project in 2009; in the increased productivity of producers; in the increase in quality of coffee produced; and in the higher prices secured as a result of having larger volumes to trade.

RECOMMENDATIONS: RUNNING THE PRIVATE SECTOR GAUNTLET WITHIN A FOOD CHAIN

It is an unfortunate reality that for every new private sector enterprise wanting to address post-harvest food loss and associated problems within a particular food supply chain in developing countries, only a small fraction will succeed and become large profitable entities over the long-term. Intense research on all the factors discussed in this note is consequently crucial before investing in such a venture.

A critical aspect of such research would be to undertake small-scale interventions—metal silos and hermetically sealed bags for storing grain, for example—that are specifically aimed at understanding the socio-cultural environment of a particular area. Once data is gathered on actual interventions (as opposed to theoretical hypotheses), investors in such technologies will be better prepared to make informed decisions.

Large banking institutions need to be aware that successful large-scale interventions to reduce post-harvest food loss in a value chain may require a combination of making sufficient finance available and ensuring that sufficient lateral thinking has been done.

A recent example from West Africa illustrates this point. The onion food supply chain in West Africa experiences considerable post-harvest loss because processing of the onions is usually undertaken hundreds of kilometres away from farms. Investors have considered the construction of processing factories closer to production areas to address the problem. Ultimately, however, such investments have tended to be constrained by unreliable power supplies.

A potential solution to overcome such a barrier to investment is a private sector investment in a large solar power plant that provides reliable electricity to both an onion processing plant and surrounding villages,

irrigated farms, clinics, and schools. Addressing post-harvest food loss in this way could lead to virtuous cycles not only for food security and nutrition, but also the economy as a whole, health of nearby communities, and education of school children. Even if interventions to address food loss are not twinned with electrical power, virtuous cycles for local economies and communities may occur when successful private sector enterprises that reduce food loss are successfully established.

The enterprises described above, from Ghana, the Philippines, and Central America, demonstrate this point. Incomes and skill sets of all the farmers involved with these enterprises increased markedly. The infrastructure and technologies supporting their food chains were modernised and maintained. Environmental management was improved, ensuring that ecosystems supporting their farming ventures were sustainably managed. And, importantly, the volume and quality of food produced for consumption within their value chains increased. Taking the above into account, what are the potential low-hanging fruit for private sector investment?

Providing appropriate technologies. Across Sub-Saharan Africa there are many successful enterprises producing food-loss reduction products such as storage containers and hermetically sealed bags. Prior to investing in such enterprises, plans for overcoming local social and economic barriers need to be studied. Capacity building of local farmers, with respect to using and financing the products, are crucial. Furthermore, technologies—and supply chains using them—need to be tailored to the infrastructure available in a particular geographic area.

Over large parts of Sub-Saharan Africa, large private sector investments in modern technologies to reduce food loss first require investments in infrastructure by the public sector. In Kenya, for example, entrepreneurs in the avocado supply chain only started investing in refrigerated containers after the government had provided appropriate port facilities to support a cold storage chain.²⁴³ Similarly, private sector companies tend to construct large warehousing facilities for grain storage in Sub-Saharan African where road networks to smallholder grain farms are relatively developed.

Establishing agribusiness centers. Agribusiness centres—those established by Premium Foods in Ghana are an

example—can help to reduce post-harvest food loss by providing farmers with appropriate technologies and extension services. Such centers can become important nexus points for individual farmers, connecting them to other farmers, agri-suppliers, and buyers.

Agricentres can also create economies of scale for smallholder farmers, they can enable transport from the field to a storage depot, and they can guide farmers on adoption of climate-smart agricultural practices. Where appropriate, agribusiness centres could partner with microfinance institutions to offer farmers inventory credit. The resulting increased liquidity from cash loans would allow farmers to wait for favorable market conditions. This would further reduce food waste as seasonal market ‘gluts’ are avoided when cash-strapped farmers are no longer forced to sell their crops at unfavourable prices.

Funding the modification of value chains. The multi-stakeholder nature of value chains makes modifying them a complex undertaking. However, there are existing NGOs and other organisations that focus on reduction of post-harvest food loss by creating sustainable food value chains. Such entities could potentially be supported by the private sector through a specialist fund that provides financing and tailored technical support. Such a fund could provide the credit for projects addressing an entire

value chain and also be a knowledge broker for best practices on reducing food losses.

CONCLUSION

For private sector investors, the examples from Ghana, the Philippines, and Central America have considerable potential for replication within food supply chains across the developing world. Intense analyses by multi-disciplinary teams will need to be conducted on socio-cultural factors, as well as consideration of appropriate technologies to address post-harvest food losses, the economic opportunities involved, and the likely climate change impacts.

Once this knowledge has been acquired, the structure and composition of potential private sector enterprises to reduce food loss can be designed. For such enterprises to be successful they will need to focus intensely on education, collaboration, and market-oriented approaches that address the many factors that reduce the supply of food traveling from farm to fork.

The economic and humanitarian rewards of doing so cannot be overstated. Billions of tons of food can potentially be saved, leading to improved food security, better nutrition, increased productivity, and greater political stability in developing countries. ■

REFERENCES

- ¹ Low income economies are currently defined by the World Bank Group as countries with a Gross National Income (GNI) per capita of \$1,005 or less; for lower middle-income economies the range is \$1,006 to \$3,955.
- ² Porter, Michael E. and Mark R. Kramer. 2011. "Creating Shared Value: How to Reinvent Capitalism - And Unleash a Wave of Innovation and Growth." *Harvard Business Review*, January–February 2011, 62-77.
- ³ Comin, Diego and Marti Mestieri Ferrer. 2013. "If Technology Has Arrived Everywhere, Why Has Income Diverged?" NBER Working Paper No. 19010.
- ⁴ Kordunsky, Anna. 2017. "In Africa, a Broadband Boom". Columbia Business School, Economics & Policy. January 20, 2017. <https://www8.gsb.columbia.edu/articles/ideas-work/africa-broadband-boom>
- ⁵ European Bank for Reconstruction and Development. 2014. "Transition Report 2014: Innovation in Transition."
- ⁶ The World Bank defines "wealth" for a given country as the sum of produced capital, natural capital, human capital and net foreign assets. In its wealth accounting, two thirds of global wealth consist of human capital, though that share is estimated at 70% within developed countries and 40% within low income countries. Innovations that increase skills or allow scarce skilled workers to work more productively is expected to be particularly conducive to wealth creation. See: "The Changing Wealth of Nations 2018", World Bank, January 30, 2018. <http://www.worldbank.org/en/news/feature/2018/01/30/the-changing-wealth-of-nations-2018>
- ⁷ Mölders, Florian, Thomas Rehermann, and Nana Esi Hammah. 2016. "How Emerging Market Leaders Can Spur Technological Gains". *EM Compass Note 15*, IFC, September 2016.
- ⁸ Comin and Ferrer. 2013.
- ⁹ "Beefing Up Mobile-Phone and Internet Penetration in Africa: Without Connectivity, Nothing Moves." *economist.com*, Special Report, Nov 9, 2017.
- ¹⁰ The World Bank. 2017. "Africa Leapfrogging Through Innovation: From Constraints to Investment Opportunities." See also: Broadman, Harry. "African Home-Grown Innovations Take Off." 2016. *EM Compass Note 7*, IFC, September 2016; and Broadman, Harry. 2016. "How to Stimulate Innovation by Africa's Private Sector." *EM Compass Note 8*, IFC, September 2016.
- ¹¹ Lankes, Hans Peter. 2017. "IFC's Development Impact, One Market at a Time." *Capital Finance International*. Summer 2017 Issue.
- ¹² IFC. 2017. "Background on IFC's Anticipated Impact Measurement and Monitoring (AIMM) System." November 2017 (internal document).
- ¹³ World Bank. 2016. "World Development Report 2016: Digital Dividends." Washington, DC.
- ¹⁴ Ibid.
- ¹⁵ Adner, Ron and Rahul Kapoor. 2016. "Right Tech, Wrong Time." *Harvard Business Review*. November 2016 Issue.
- ¹⁶ WEF (World Economic Forum). 2014. "Delivering Digital Infrastructure – Advancing the Internet Economy," in collaboration with the Boston Consulting Group.
- ¹⁷ Knight, Mark and Nora Brownell. 2010. "How Does Smart Grid Impact the Natural Monopoly Paradigm of Electricity Supply?" *Grid-Interop Forum 2010*.
- ¹⁸ Ong, Sean. 2016. "Energy Storage: Business Solutions for Emerging Markets." *EM Compass Note 23*, IFC, November 2016.
- ¹⁹ Ong. 2016.
- ²⁰ Haile, Abenet, Ariane Volk, and Thomas Rehermann. 2017. "Creating Agricultural Markets: How the Ethiopia Commodity Exchange Connects Farmers and Buyers through Partnership and Technology." *EM Compass Note 37*, IFC, April 2017.
- ²¹ GSMA. 2014. "Mobile Taxes and Fees."
- ²² Starnes, Susan, Michael Kurdyla, and Alex Alexander. 2016 "De-risking by Banks in Emerging Markets – Effects and Responses for Trade." *EM Compass Note 24*, IFC, September 2016.
- ²³ Ramachandran, Vijaya and Thomas Rehermann. 2017. "Can Blockchain Technology Address De-Risking in Emerging Markets?" *EM Compass Note 38*, IFC, March 2017.
- ²⁴ The World Bank. 2017. "Identification for Development (ID4D)." www.worldbank.org/en/programs/id4d.
- ²⁵ The World Bank. 2016. "Identification for Development: Strategic Framework." January 25, 2016.
- ²⁶ Taglioni, Daria and Deborah Winkler. 2016. "Making Global Value Chains Work for Development." World Bank Group, Trade and Development Series.
- ²⁷ Mölders, Florian. 2016. "Global Productivity Slowdown and the Role of Technology Adoption in Emerging Markets." *EM Compass Note 6*, IFC, May 2016.
- ²⁸ See also: Mölders, Florian, Thomas Rehermann, and Nana Esi Hammah, "How Emerging Market Leaders Can Spur Technological Gains." *EM Compass Note 15*, IFC, September 2016.
- ²⁹ Saleem, Qamar, Martin Hommes, and Aksinya Sorokina. 2017. "Technology-Enabled Supply Chain Finance for Small and Medium Enterprises is a Major Growth Opportunity for Banks." *EM Compass Note 39*, IFC, June 2017.

- ³⁰ Kenney, Martin and John Zysman. 2016. "The Rise of the Platform Economy." *Issues in Science and Technology*.
- ³¹ Sampere, Juan Pablo Vazquez. 2016. "Why Platform Disruption Is So Much Bigger than Product Disruption." *Harvard Business Review*, April 8, 2016, www.hbr.com.
- ³² Hallward-Driemeier, Mary and Gaurav Nayyar. 2017. "Trouble in the Making? – The Future of Manufacturing-Led Development." World Bank Group.
- ³³ The World Bank. 2017. "Africa Leapfrogging Through Innovation: From Constraints to Investment Opportunities."
- ³⁴ Deloitte. 2015. "Google's Economic Impact United Kingdom 2014."
- ³⁵ World Economic Forum. 2013. "Global Information Technology Report 2013, Digitalization for Economic Growth and Job Creation: Regional and Industry Perspectives."
- ³⁶ See: Bekele Haile, Abenet, Ariane Volk, and Thomas Rehermann. 2017. "Creating Agricultural Markets: How the Ethiopia Commodity Exchange Connects Farmers and Buyers through Partnership and Technology." *EM Compass Note 37*, IFC, April 2017; Aisenberg, Igal. 2017. "Precision Farming Enables Climate-Smart Agribusiness." *EM Compass Note 46*, IFC, October 2017.
- ³⁷ Saal, Matthew, Susan Starnes, and Thomas Rehermann. 2017. "Digital Financial Services: Challenges and Opportunities for Emerging Market Banks." *EM Compass Note 42*, IFC, August 2017.
- ³⁸ Del Carpio Ponce, Paola. 2018. "Modelo Peru: A Mobile Money Platform Offering Interoperability Towards Financial Inclusion." *EM Compass Note 51*, IFC, April 2018.
- ³⁹ GSMA. 2017. "The Mobile Economy 2017."
- ⁴⁰ Niforos, Marina. 2017. "Blockchain in Development - A New Mechanism of 'Trust?'" *EM Compass Note 40*, IFC, July 2017.
- ⁴¹ The World Bank. 2017. "Africa Leapfrogging Through Innovation: From Constraints to Investment Opportunities."
- ⁴² Bergström, Anna, et al. 2015. "mHealth: Can Mobile Technology Improve Health in Low- and Middle-Income Countries?" *UCL Public Policy Briefing*.
- ⁴³ Iwaya, L.H., et al. 2011. "Mobile health in emerging countries: a survey of research initiatives in Brazil." *International Journal of Medical Informatics*.
- ⁴⁴ PWC. 2013. "Socioeconomic Impact of mHealth: An Assessment Report for Brazil and Mexico." Report commissioned by the GSMA.
- ⁴⁵ Del Carpio Ponce, Paola. 2018.
- ⁴⁶ World Development Report 2016: Digital Dividends. World Bank Group, pp. 288-291.
- ⁴⁷ World Economic Forum (WEF). 2014. "Delivering Digital Infrastructure – Advancing the Internet Economy" in collaboration with the Boston Consulting Group.
- ⁴⁸ World Economic Forum. 2017. "4 ways governments can develop digital infrastructure." <https://www.weforum.org/agenda/2017/09/governments-develop-digital-infrastructure-vodafone/>.
- ⁴⁹ Mills, Anthony. 2017. "From Farm to Fork: Private Enterprise Can Reduce Food Loss through Climate-Smart Agriculture." *EM Compass Note 47*, IFC, October 2017.
- ⁵⁰ Aisenberg, Igal. 2017. "Precision Farming Enables Climate-Smart Agribusiness." *EM Compass Note 46*, IFC, October 2017.
- ⁵¹ Didier, Kose, Ohnsorge, Ye, "Slowdown in Emerging Markets: Rough Patch or Prolonged Weakness?" December 2015.
- ⁵² This is also the case for potential GDP growth rates: The IMF expects a decline of the potential output growth in the medium term due to aging populations, weaker investment, and lower productivity growth. (IMF World Economic Outlook, April 2015: "Uneven Growth: Short- and Long-Term Factors").
- ⁵³ Didier, Kose, Ohnsorge, and Ye, 2015.
- ⁵⁴ Comin and Ferrer, "If Technology Has Arrived Everywhere, Why Has Income Diverged?" May 2013.
- ⁵⁵ Ibid.
- ⁵⁶ Belitz and Moelders, "International Knowledge Spillovers through High-Tech Imports and R&D of Foreign-Owned Firms," January 2016; Ang and Madsen, "International R&D Spillovers and Productivity Trends in the Asian Miracle Economies," April 2013.
- ⁵⁷ Brookings Institution, "Understanding FDI Spillover Mechanisms," November 2015.
- ⁵⁸ "Technology at Work v2.0," Citi GPS: Global Perspectives and Solutions, January 2016.
- ⁵⁹ The World Bank, "World Development Report 2016: Digital Dividends," <http://www.worldbank.org/en/publication/wdr2016>
- ⁶⁰ World Economic Forum "5 Ways of Understanding the Fourth Industrial Revolution", World Economic Forum, 2015.
- ⁶¹ World Bank, World Development Report 2016 – pp. 288-291.
- ⁶² Project Loon by Google. 2015.
- ⁶³ Yael Maguire. 2015. "Building Communications Networks in the Stratosphere."
- ⁶⁴ Microsoft. 2016. "White Space Database."
- ⁶⁵ McKinsey Global Institute 2013; "Lions Go Digital: The Internet's Transformative Potential in Africa."
- ⁶⁶ World Bank, World Development Report 2016 – pp. 104-118.
- ⁶⁷ Songambele Maarifa Centre. 2015.

- ⁶⁸ 2012. “Final ISOC Report: Connecting the Community of Lascahobas, Haiti to the Internet.”
- ⁶⁹ ICT4D Views from the Field. 2012. “Solar-Powered Internet Connectivity a Reality in Lascahobas, Haiti.”
- ⁷⁰ Lawrence Berkeley National Laboratory. 2016. “Tracking the Sun IX”.
- ⁷¹ Steven Lacey, “Stem CTO: Lithium-Ion Battery Prices Fell 70% in the Last 18 Months”, greentechmdia.com, June 28, 2016. <https://www.greentechmedia.com/articles/read/stem-cto-weve-seen-battery-prices-fall-70-in-the-last-18-months>
- ⁷² The IFC Storage Assessment Model, developed in 2016, is intended to assess a range of off-grid and grid-connected storage + solar scenarios. For additional model details and assumptions, please contact Peter Mockel (pmockel@ifc.org) or Sean Ong (sean.ong@outlook.com).
- ⁷³ GSMA Green Power for Mobile, 2012. “Powering Telecoms: East Africa Market Analysis.”
- ⁷⁴ Kieron Monks. CNN 2016. “Watly: The computer that provides clean water, energy, internet access.”
- ⁷⁵ Wisdom Ahiataku-Togobo. Ghana Ministry of Energy. 2004. “Challenges of Solar PV for Remote Electrification in Ghana.”
- ⁷⁶ USAID 2016. “Reaching For the Roofs: One Million Solar-Powered Homes in Tanzania by 2017.”
- ⁷⁷ Edgar Meza. *PV Magazine* 2015. “Tanzania Announces One Million Solar Homes Initiative.”
- ⁷⁸ Becky Beetz. *PV Magazine* 2015. “Off Grid Electric Secures \$45 Million for Solar, Storage Deployment in Tanzania.”
- ⁷⁹ GSMA Green Power for Mobile, “Powering Telecoms: East Africa Market Analysis - Sizing the Potential for Green Telecoms in Kenya, Tanzania and Uganda”, GSMA 2012.
- ⁸⁰ James Manyika et al., “Lions go digital: The Internet’s Transformative Potential in Africa”, McKinsey Global Institute, November 2013.
- ⁸¹ Lawrence Berkeley National Laboratory. 2016. “U.S. Energy Service Company (ESCO) Industry: Recent Market Trends.”
- ⁸² GSMA Community Power from Mobile-Charging Services. 2011.
- ⁸³ Frances Cairncross. “The death of distance, a survey of telecommunications.” *The Economist*, September 30, 1995.
- ⁸⁴ International Telecommunication Union (ITU) and author’s calculations.
- ⁸⁵ These include mobile money transfer system, because much of the population remains outside of the formal financial system, as well as mobile apps that allows farmers to access information about the weather, real-time market prices, etc.
- ⁸⁶ See <http://gsmamobileeconomy.com/ssafrica/>
- ⁸⁷ See “Africa’s ICT Infrastructure: Building on the Mobile Revolution” by Mark D. J. Williams et al. World Bank (2011).
- ⁸⁸ The WB offers three types of financing instruments, 1) Investment Project Financing (“IPF”) provides IBRD loan, IDA credit/grant and guarantee financing to governments for activities that create the physical/social infrastructure necessary to reduce poverty and create sustainable development; 2) Development Policy Financing (“DPF”) provides IBRD loan, IDA credit/grant and guarantee budget support to governments for a program of policy and institutional actions to help achieve sustainable, shared growth and poverty reduction; 3) Program-for-Results links disbursement of funds directly to the delivery of defined results. For more information: <http://www.worldbank.org/en/projects-operations/products-and-services#2>
- ⁸⁹ The WB also provides financing projects related to the broader ICT portfolio, beyond the telecommunications sector, including the development of the IT industry, eGovernment, content promotion, etc.
- ⁹⁰ WB has mechanisms other than “lending projects” by which it provides regulatory assistance in the region. A first set of mechanisms are financed “internally” by the WB through various “Bank Budget” projects, including those funded by one of the six Geographic Regions in the WB or directly by the Country Management Unit (“CMU”). A second set of mechanism are funded “externally”. For example, over the 2003-2010 period, the WB executed 23 projects totaling \$5.6 million via the Public-Private Infrastructure Advisory Facility (“PPIAF”) (see <http://www.ppiaf.org/>), and 6 projects totaling \$1.3 million via the ICT for Development (“IC4D”) Korea Trust Fund (“KTF”) (see <http://www.worldbank.org/content/dam/Worldbank/document/EAP/Korea/KTF%20Booklet-web.pdf>)
- ⁹¹ The establishment of independent tower operators is a worldwide trend; many mobile operators sell off tower assets with the objective of focusing on providing mobile service and leasing the necessary tower space. This also promotes infrastructure sharing in that multiple mobile operators are more likely to lease tower space from an independent tower operator.
- ⁹² European Bank for Reconstruction and Development, “Transition Report 2014: Innovation in Transition.”
- ⁹³ Yuriy Gorodnichenko and Monika Schnitzer, “Financial Constraints and Innovation: Why Poor Countries Don’t Catch Up,” *Journal of the European Economic Association*, September 2013.
- ⁹⁴ Bakken, Henry, “Futures Trading – Origin, Development and Present Economic Status”, 1966.
- ⁹⁵ UNCTAD Report, “Emerging Commodity Exchanges: from Potential to Success”, UNCTAD,1997. UNCTAD Report, Development Impacts of Commodity Exchanges in Emerging Markets, UNCTAD, 2009.
- ⁹⁶ Gebre-Medhin, Eleni, “The Devil is in the Details - Understanding a Commodity Exchange”, *The Fortune Newspaper*, December 2006.
- ⁹⁷ ECX Report, Annual Report 2015/16, “ECX Strategy Planning Unit”, Addis Ababa,2016.
- ⁹⁸ Gebre-Medhin, Eleni, “A Market for Abdu: Creating a Commodity exchange in Ethiopia”, IFPRI, 2012.
- ⁹⁹ Ethiopia Commodity Exchange (ECX), “The Rule of the Exchange Commodity Exchange, Rev No.5/2010”, ECX, July 2010. House of People Representative (HPR), A proclamation to provide for the establishment of Ethiopia Commodity Exchange, Proclamation No. 550/2007 Federal Negarit Gazita Addis Ababa, September 4, 2007.
- ¹⁰⁰ ECX Report, “Assessment on ECX Membership Transfer”, ECX Member Development Unit, Addis Ababa, 2016.
- ¹⁰¹ Ibid.

- ¹⁰² Andersson, Camilla, Bezabih, Mintewab, Mannberg, Andrea, The Ethiopian Commodity Exchange and Spatial Price Dispersion, Environment for Development, Discussion Paper Series 16-02, January 2016, 16-02. Mihretu, M Warehouse Financing: Lessons from Ethiopia, IFC, 2012.
- ¹⁰³ Gebre-Medhin, Eleni, “A Market for Abdu: Creating a Commodity exchange in Ethiopia”, IFPRI, 2012.
- ¹⁰⁴ See ECX to Launch online trading Operations, ICF, December 12, 2013, available at <http://www.icfafrica.org/news/ecx-to-launch-online-trade-operations>
- ¹⁰⁵ See Traceability, Wikipedia.com, Accessed on January 24, 2017, at <https://en.wikipedia.org/wiki/Traceability>
- ¹⁰⁶ David Kahrmann, “ECX Launches independent food Traceability System”, USAID, 2012, Available at <https://www.usaid.gov/ethiopia/press-releases/ecx-launches-independent-food-traceability-system>
- ¹⁰⁷ Ibid.
- ¹⁰⁸ ECX Report, Annual Report 2015/16, ECX Strategy Planning Unit, Addis Ababa, 2016.
- ¹⁰⁹ Bekele, Abenet, “ECX’s Coffee Market: Traceability and New Developments”, 14th AFCA Conference & Exhibition. Dar es Salaam, February, 2016. <https://afca.coffee/conference/wp-content/uploads/presentations/14AFCCE/Abenet%20Bekele%20-%20Ethiopian%20Commodity%20Exchange%2C%20Traceability%20and%20New%20Developments.pdf>
- ¹¹⁰ Malaket Alexander, “Leveraging Supply Chain Finance for Development,” International Centre for Trade and Sustainable Development, September, 2015.
- ¹¹¹ Enrico Camerinelli, “A Study of the Business Case for Supply Chain Finance,” ACCA and Aite Group, 2014.
- ¹¹² Factor Chain International Statistics (2008-2014), <https://fci.nl/en/about-factoring/statistics>.
- ¹¹³ David Bannister, “Demica report shows strong growth for supply chain finance,” bankingtech.com, May 29, 2013, <http://www.bankingtech.com/144222/144222/>.
- ¹¹⁴ Comment by Eugenio Cavenaghi to IFC staff, 2016.
- ¹¹⁵ Ibid.
- ¹¹⁶ Comment by André Casterman to IFC staff, 2016.
- ¹¹⁷ Distributor finance is also known as buyer finance and is defined as “the provision of financing for a distributor of a large manufacturer to cover the holding of goods for resale and to bridge the liquidity gap until the receipt of funds from receivables following the sale of goods to a retailer or end-customer.” See BAFT - Euro Banking Association (EBA) - Factors Chain International (FCI) - International Chamber of Commerce (ICC) - International Trade and Forfeiting Association (ITFA), Standard definitions for techniques of supply chain finance, 2016.
- ¹¹⁸ Comment by Alexander Malaket to IFC staff, 2016.
- ¹¹⁹ Comment by André Casterman to IFC staff, 2016.
- ¹²⁰ “Banks develop blockchain platform for trade finance,” *Global Trade Review*, Dec. 17, 2015.
- ¹²¹ Comment by Eugenio Cavenaghi to IFC staff, 2016.
- ¹²² World Bank Global Findex Database. 2014. <http://www.worldbank.org/en/programs/globalindex>
- ¹²³ See classification by GSMA of commercial mobile financial services in Latin American and the Caribbean. Type I Markets (low income, low interest rates) under this classification are Bolivia, El Salvador, Guatemala, Nicaragua, and Paraguay. Under this classification, Peru is considered a “hybrid” since it has similar account penetration rates but higher GDP per capita than these markets.
- ¹²⁴ SBS (Superintendencia de Banca, Seguros y AFP). 2017. “El sistema financiero está presente en casi el 70% de los distritos del Perú.” *SBS Informa: Boletín Quincenal Nro.12*. July 2017.
- ¹²⁵ SBS (Superintendencia de Banca, Seguros y AFP). 2016. “Perú: Indicadores de inclusión financiera de los sistemas financiero, de seguros y de pensiones.” December 2016.
- ¹²⁶ SBS (Superintendencia de Banca, Seguros y AFP). 2017. “El sistema financiero está presente en casi el 70% de los distritos del Perú.” *SBS Informa: Boletín Quincenal Nro.12*. July 2017.
- ¹²⁷ ILO (International Labor Organization). “Key Indicators of the Labor Market.” ILOSTAT - ILO database of labor statistics. <http://www.ilo.org/global/statistics-and-databases/lang--en/index.htm>
- ¹²⁸ Quevedo, Vladimir and Javier Pereda. 2017. “Información sobre el uso y conocimiento del efectivo para gestión en la Banca Central.” *Revista Moneda*. BCRP (Banco Central de Reserva del Perú). March 2017.
- ¹²⁹ GSMA Intelligence. 2016. “The Mobile Economy: Latin America and the Caribbean 2016.” It must be noted that there is great variance among the region’s countries’ unique mobile subscriber penetration, going from as low as 28% in Cuba to as high as 92% in Chile, Uruguay and Argentina.
- ¹³⁰ Lewis, Robin J., John D. Villasenor, and Darrell M. West. 2017. “The 2017 Brookings Financial and Digital Inclusion Project Report: Building a Secure and Inclusive Global Financial Ecosystem.” Center for Technology Innovation at Brookings.
- ¹³¹ Ibid.
- ¹³² Jack, William and Tavneet Suri. 2014. “Risk Sharing and Transactions Costs: Evidence from Kenya’s Mobile Money Revolution.” *American Economic Review Vol. 104* (1); Alexander, Alex J., Lin Shi and Bensam Solomon. 2017. “How Fintech is Reaching the Poor in Africa and Asia: A Start-Up Perspective.” EM Compass Note 34. IFC, April 2017; McKay, Claudia and Rafe Mazer, “10 Myths About M-PESA: 2014 Update,” CGAP blog, October 1, 2014. <http://www.cgap.org/blog/10-myths-about-m-pesa-2014-update>
- ¹³³ Suri, Tavneet and William Jack. 2016. “The long-run poverty and gender impacts of mobile money.” *Development Economics Vol. 354* Issue 6317.

- ¹³⁴ World Bank. 2017. “Mobile Money: Transforming Financial Inclusion.” *Inclusive Innovations*. June 2017.
- ¹³⁵ GSMA. 2017. “The Mobile Economy 2017.”
- ¹³⁶ Antón-Díaz, Pablo, and Tomás Conde. 2017. “Modelo Peru: Unique Model, Unique Challenges, Bright Future.” *Brief 001*. Center for Financial Inclusion and Institute of International Finance.
- ¹³⁷ Banking Tech. 2015. “Ericsson to Connect Banks, Telcos and the Unbanked.” <http://www.bankingtech.com/382671/ericsson-to-connect-banks-telcos-and-the-unbanked/>
- ¹³⁸ Trivelli, Carolina. 2017. “Modelo Peru.” Interview by Paola del Carpio. (September 12, 2017).
- ¹³⁹ Bim (Billetera Móvil). “¿Cuánto cuesta usar Bim?” <https://mibim.pe/tu-billetera-movil/cuanto-cuesta-usar-bim/>
- ¹⁴⁰ Antón-Díaz, Pablo, and Tomás Conde. 2017. “Modelo Peru: Unique Model, Unique Challenges, Bright Future.” *Brief 001*. Center for Financial Inclusion and Institute of International Finance.
- ¹⁴¹ Ibid.
- ¹⁴² Carolina Trivelli is a Peruvian economist specialized in social policy, rural development, and financial inclusion issues. She is a senior researcher at the Peruvian think tank Instituto de Estudios Peruanos. She is also Chair of the Consultative Group to Assist the Poor (CGAP) housed at the World Bank, and chair of the board of Pagos Digitales Peruanos, the company that runs the interoperable platform for electronic money in Peru. Trivelli was the first Minister of Development and Social Inclusion in Peru (2011-2013).
- ¹⁴³ Cash transfer programs reach areas in Peru where there is no bank coverage at all. In these cases, the transfer is made at a central point for different areas at a certain day and time. It is costly for the government because it must contract a security company that physically transfers cash. It is also costly for users because some of them must travel very long distances.
- ¹⁴⁴ Besich, Nicolás, interview by Paola del Carpio. 2017. “Promotion and use of Bim among Juntos beneficiaries.” Videnza Consultores.
- ¹⁴⁵ Trivelli, Carolina. 2017. “Modelo Peru.” Interview by Paola del Carpio.
- ¹⁴⁶ See: Better Than Cash Alliance. 2016. “Building from a Strong Foundation: A Path Forward for digitizing Sub-national Government Payments in Peru.”
- ¹⁴⁷ FEPCMAC (Federación Peruana de Cajas Municipales de ahorro y Crédito). 2016. “Las cajas municipales y el dinero electrónico: uso de Bim.” Caso Estudio.
- ¹⁴⁸ Antón-Díaz, Pablo, and Tomás Conde. 2017. “Modelo Peru: Unique Model, Unique Challenges, Bright Future.” *Brief 001*. Center for Financial Inclusion and Institute of International Finance.
- ¹⁴⁹ Trivelli, Carolina. 2017.
- ¹⁵⁰ This information was provided by Jessica Salazar, Ecosystem Development Chief of Pagos Digitales Peruanos (PDP).
- ¹⁵¹ Better Than Cash Alliance. 2016. “Modelo Peru Webinar.” www.betterthancash.org/news/blogs-stories/modelo-peru-webinar.
- ¹⁵² Provided by Jessica Salazar, Pagos Digitales Peruanos.
- ¹⁵³ Better Than Cash Alliance. 2016. “Modelo Peru Webinar.” www.betterthancash.org/news/blogs-stories/modelo-peru-webinar.
- ¹⁵⁴ Ibid.
- ¹⁵⁵ Franco Gavonel, Maria. 2017. “Patterns and Drivers of Internal Migration Among Youth in Ethiopia, India, Peru and Vietnam.” *Young Lives Working Paper 169*. Oxford.
- ¹⁵⁶ Holtmann, Martin, “Digital Financial Services – Challenges and opportunities for Banks”, Presentation provided at the Sixteenth Annual Conference on Policy Challenges for the Financial Sector- Finance in Flux: The Technological Transformation of the Financial Sector, June 1-3, 2016, Washington, DC.
- ¹⁵⁷ Consultative Group for the Assistance of the Poor (CGAP). <http://www.cgap.org/topics/digital-financial-services>
- ¹⁵⁸ TLT, Digital banking: from revolution to evolution, TLT 2016.
- ¹⁵⁹ Julian Skan, Julian – Dickerson, James – Masood, Samad, “The Future of FinTech and Banking: Digitally disrupted or reimagined?” *Accenture* 2015.
- ¹⁶⁰ Kuen, Yap Leng, “Jump in China’s Shadow Banking Products Potentially Destabilizing”, *Thestar.com*, Feb 27, 2017; Tu, Lianting – Luo, Jun, “China Default Chain Reaction Threatens Products Worth 35% of GDP”, *Bloomberg.com*, May 29, 2016.
- ¹⁶¹ EY, “Banking in Asia-Pacific - Size Matters and Digital Drives Competition”, EY 2015.
- ¹⁶² Ibid.
- ¹⁶³ Ibid.
- ¹⁶⁴ KPMG, “FinTech in India – A Global Growth Story”, KPMG, June 2016.
- ¹⁶⁵ Demircuc-Kunt, Asli – Klapper, Leora – Singer, Dorothe – Van Oudheusden, Peter, “The Global Findex Database 2014 – Measuring Financial Inclusion Around the World”, *World Bank Policy Research Working Paper No. 7255*, World Bank, April 2015.
- ¹⁶⁶ World Bank World Development Indicators, retrieved March 8, 2017. <http://data.worldbank.org/region/sub-saharan-africa>.
- ¹⁶⁷ Beck, Thorsten – Cull, Robert, “Banking in Africa”, *CSAE Working Paper*, WPS/2013-16, First Draft August 2013, Centre for the Study of African Economies.
- ¹⁶⁸ *The Economist* stated at the end of Dec 2016 that there are almost 1 billion active phone subscriptions in Africa, where many people have multiple sim cards, which leads to the conclusion that ca. half of Africans have phones: N.N., “Mobile phones are transforming Africa”, *economist.com*, Dec 10, 2016; The GSMA estimates, similarly, for 2015 unique phone penetration rates for women to be 49% and for men

- 41%: GSMA, “The Mobile Economy in Africa 2015”, GSMA 2015.
- ¹⁶⁹ See Galat, Bonnie – Ahn, Hyung, “The World Bank Group’s Response to the Crisis: Expanded Capacity for Unfunded and Funded Support for Trade with Emerging Markets”. In: Chauffour, Jean-Pierre – Malouche, Mariem (eds.), *Trade Finance during the Great Trade Collapse, 2011*, pp 301-317; see also Ramachandran, Vijaya, “Mitigating the Effects of De-Risking in Emerging Markets to Preserve Remittance Flows”, *IFC EM Compass Note No. 22*, November 2016; Starnes, Susan – Kurdyla, Michael – Alexander, Alex J., “De-Risking by Banks in Emerging Markets – Effects and Responses for Trade”, *IFC EM Compass Note No. 24*, November 2016.
- ¹⁷⁰ Collett, Dominique, “The Unstoppable Rise of FinTech in Africa”, *Disrupt Africa* (web site), May 20, 2016; GSMA estimates that by 2020, 60% of the population in Africa still lacks access to internet services: GSMA, “The Mobile Economy in Africa 2015”, GSMA 2015.
- ¹⁷¹ N.N., “Vodafone M-Pesa Reaches 25 million Customers Milestone”, *vodafone.com*, April 25, 2016; Mbele, Lerato, “Why M-Pesa Failed in South Africa”, *bbc.com*, May 11, 2016.
- ¹⁷² Collett, Dominique, “The unstoppable rise of FinTech in Africa”, *Disrupt Africa* (web site), May 20, 2016.
- ¹⁷³ Leach, Anna, “Mobile Money: Why isn’t the M-Pesa Effect Hitting More Countries?” *The Guardian*, April 16, 2015.
- ¹⁷⁴ Cook, Tamara – McKay, Claudia, “How M-Shwari Works: The Story So Far”, Consultative Group to Assist the Poor (CGAP) and Financial Sector Deepening (FSD) Kenya, *Access to Finance Forum, Reports by CGAP and Its Partners No. 10*, April 2015. Cook, Tamara – McKay, Claudia, *Top 10 Things to Know about M-Shwari*. World Bank Blog, April 10, 2015.
- ¹⁷⁵ Gould, Elizabeth, “Africa’s Big Banks are Betting on FinTech Startups and Bitcoin to Beat Disruption”, *Quartz Africa qz.com*, February 19, 2016.
- ¹⁷⁶ N.N., “FinTech vs. Traditional Trade - Surviving the Digital Transition”, *Trade Finance Magazine Special Issue*, September 2016.
- ¹⁷⁷ See World Economic Forum, “The Future of Financial Services - How Disruptive Innovations are Reshaping the Way Financial Services are Structured, Provisioned and Consumed”, WEF, Final Report, June 2015; Manyika, James – Lund, Susan – Singer, Marc – White, Olivia – Berry, Chris, “How Digital Finance Could Boost Growth in Emerging Economies”, McKinsey Global Institute, Sept 2016; Citi GPS, “Digital Disruption – How FinTech is Forcing Banking to a Tipping Point”, Citi Global Perspectives and Solutions, March 2016; Holtmann, Martin, “Digital Financial Services – Challenges and Opportunities for Banks”, Presented at the Sixteenth Annual Conference on Policy Challenges for the Financial Sector - Finance in Flux: The Technological Transformation of the Financial Sector, June 1-3, 2016, Washington, DC; UBS, “Q-Series - Global Banks: Is FinTech a Threat or an Opportunity?” July 26, 2016; Dapp, Thomas F, “FinTech Reloaded – Traditional Banks as Digital Ecosystems”, Deutsche Bank Research, Current Issues, June 15, 2016; Kelly Sonja – Ferenzy, Dennis – McGrath, Allyse, “How Financial Institutions and Fintechs Are Partnering for Inclusion: Lessons from the Frontlines”, IIF Institute of International Finance – Center for Financial Inclusion, Accion, July 2017.
- ¹⁷⁸ Starnes, Susan – Kurdyla, Michael – Alexander, Alex J., “De-Risking by Banks in Emerging Markets – Effects and Responses for Trade”, *IFC EM Compass Note No. 24*, November 2016.
- ¹⁷⁹ Ley, Stephen – Bailey, Steven, “PSD2 Opens The Door to New Market Entrants”, *Deloitte UK*, 2015.
- ¹⁸⁰ Dietz, Miklos – Vinayak, HV – Lee, Gillian, “Bracing for Seven Critical Changes as Fintech Matures”, McKinsey & Company, November 2016.
- ¹⁸¹ Coleman, Alison, “Poland On Track To Becoming a Major European Tech Startup Hub”, *Forbes*, May 20, 2016.
- ¹⁸² Dietz, Miklos – Vinayak, HV – Lee, Gillian, “Bracing for Seven Critical Changes as Fintech Matures”, McKinsey & Company, November 2016. Foy, Henry, “Poland’s mBank Thrives on Disruption”, *Financial Times*, March 4, 2015.
- ¹⁸³ Ibid.
- ¹⁸⁴ Arnole, Martin, “How Finance is Being Taken Over by Tech”, *Financial Times*, January 17, 2017.
- ¹⁸⁵ Center for Financial Inclusion, “BiM – The First Fully-Interoperable Mobile Money Platform: Now Live in Peru”, *Center for Financial Inclusion Blog*, Feb 17, 2016.
- ¹⁸⁶ Mak, Liz, “China’s 55 Trillion Yuan Credit Card Clearing Market Now Open for Competition”, *SCMP.com (South China Morning Post)*, June 8, 2016.
- ¹⁸⁷ Cheng, Leng, “China Opens Bank Card Clearing Market”, *ShanghaiDaily.com*, June 8, 2016; BI Intelligence, “China Prepares for Open Card Payments Ecosystem”, *Businessinsider.com*, June 10, 2016.
- ¹⁸⁸ Woodhouse, Alice, “Chinese Fintechs Overtake Western Rivals in Innovation”, *SCMP.com (South China Morning Post)*, December 6, 2016.
- ¹⁸⁹ Mittal, Sachin – Lloyd, James, “The Rise of FinTech in China – Redefining Financial Services”, EY and DBS, November 2016, p. 13.
- ¹⁹⁰ Asean Today, “Unqualified P2P Chinese Platforms Under New Policy”, *Fintechnews.sg*, September 19, 2016.
- ¹⁹¹ Alois, JD, “The China P2P Lending Market is Finally Slowing”, *crowdfundinsider.com*, January 12, 2017; Asean Today, *Unqualified P2P Chinese Platforms Under New Policy*, *Fintechnews.sg*, Sep 19, 2016.
- ¹⁹² Ant Financial, “Alibaba Investors’ Day Document”, Alibaba Group, June 2016
- ¹⁹³ Reuters, “Alibaba’s Fintech Arm Says Its Focus Remains on Asia”, *Fortune.com*, Nov 1, 2016.
- ¹⁹⁴ Yuanyuan, Deng, “Alibaba, Baidu and Tencent and Their New Online Banks”, *fintechranking.com*, December 26, 2016.
- ¹⁹⁵ Chinese Bankers’ Survey 2015, China Banking Association and PWC, January 2016.
- ¹⁹⁶ Reserve Bank of India (RBI), “Guidelines for Licensing of Payments Banks”, March 2, 2015.
- ¹⁹⁷ Reserve Bank of India (RBI), “RBI Grants ‘In-Principle’ Approval to 11 Applicants for Payments Banks”, August 19, 2015.
- ¹⁹⁸ Russell, Jon, “Paytm, India’s Top Mobile Payments Firm Gets Approval to Launch Its Own Digital Bank”, *techcrunch.com*, January 3, 2017.

- ¹⁹⁹TNN, “Learning with the times: What is Aadhaar?”, *The Times of India*, Oct 4, 2010.
- ²⁰⁰Banerjee, Shweta, “Aadhaar: Digital Inclusion and Public Services in India”, World Development Report 2016 Background Paper – Digital Dividends, World Bank, Dec 2015.
- ²⁰¹Puneet Chopra – Paresh Rajde – Vivek Gupta – Priyank Mishra – Akshat Pathak, “e-KYC and the India Stack – A Transformative Blueprint for Emerging Markets”, *MicroSave*, March 2016.
- ²⁰²Goyal, Vishal –Kuman, Ishank, “UBS Evidence Lab – India Banks: Fintech Challengers Gaining Ground”, UBS Global Research, February 2, 2017.
- ²⁰³Memon, Niloufer – Goyal, Vibhor – Pande, Varad, “The Five-Minute Loan: How India Stack is Speeding Loans to Small Businesses”, *Dalberg.com* D. Blog, January 6, 2017.
- ²⁰⁴Sachitanand, Rahul, “Meet the Alternative Lending Startups”, *The Economic Times*, August 13, 2016.
- ²⁰⁵KPMG, “FinTech in India - A Global Growth Story”, KPMG, June 2016.
- ²⁰⁶D’Monte, Leslie, “India’s Cash Conundrum: How Ready is India to Go Cashless?”, *Livemint.com*, January 28, 2017.
- ²⁰⁷Russell, Jon, “Amazon Gains Wallet License to Boost its Business in India”, *Techcrunch*, April 12, 2017.
- ²⁰⁸Mundy, Simon, “India’s Paytm raises \$1.4bn from SoftBank”, *ft.com*. May 18, 2017.
- ²⁰⁹KPMG, “FinTech in India – A Global growth Story”, KPMG, June 2016. See also Committee on Digital Payments, Medium Term Recommendations to Strengthen Digital Payments Ecosystem, Report by the Ministry of Finance, Government of India, December 2016; Unified Payment Interface Crosses 1mn hits Mark – Value soars to Rs 457cr, FE Bureau, Dec 27, 2016; N.N., World’s Best Digital Bank 2016: DBS, *euromoney.com*, 2016; UBS Evidence Lab, India Banks – Fintech Challengers Gaining Ground, UBS, Feb 2, 2017.
- ²¹⁰Srinivasan, Supraja, “CreditVidya Partners with Fullerton India for Authentication Service”, *economictimes.indiatimes.com*, December 7, 2016.
- ²¹¹Cook, Tamara – McKay, Claudia, “How M-Shwari Works: The Story So Far, Consultative Group to Assist the Poor (CGAP) and Financial Sector Deepening (FSD) Kenya”, Access to Finance Forum, Reports by CGAP and Its Partners No. 10, April 2015.
- ²¹²Muthiora, Brian, “New Infographic: Mobile Money and the Digitisation of Kenya’s Retail Payments Systems”, GSMA, September 29, 2014. See for a definition of the Kenyan National Payments System and its components: <https://www.centralbank.go.ke/national-payments-system/>
- ²¹³Bank Supervision Annual Reports 2015 and 2012, Central Bank of Kenya.
- ²¹⁴Suri, Tavneet –Jack, William, “The Long-Run Poverty and Gender Impacts of Mobile Money”, *Science*, Dec 9, 2016, Vol. 354, Issue 6317, pp. 1288-1292.
- ²¹⁵“Food security in a world of natural resource scarcity: The role of agricultural technologies”, International Food Policy Research Institute, 2014.
- ²¹⁶Ibid.
- ²¹⁷Gujarat Green Revolution Company Ltd.; <http://ggrc.co.in/webui/home.aspx>.
- ²¹⁸“Government of Karnataka and 2030 WRG launch Karnataka Multi-Stakeholder Platform for Water to Drive Large-Scale Transformation in Water Resources Management”, 2030 Water Resources Group, May 23, 2017.
- ²¹⁹“Community Collaborative: Water Management - Tamil Nadu Irrigated Agriculture Modernization and Water Bodies Restoration and Management Project”, World Bank Group, June 7, 2016,
- ²²⁰Yuan Zhou and Suresh Babu, “Knowledge Driven Development: Private Extension and Global Lessons”, 2015.
- ²²¹Godyal, Anjali – Iha, Vikas, “Solar water pumps for efficient irrigation”, *Indiawaterportal.org*, Feb 18, 2017.
- ²²²Otufodunrin, Lekan, “Hello Tractor is Africa’s Uber for the farm”, *thehindu.com*, June 24, 2017.; another example is the online platform Gold Farm, established in March 2016, to connect “small and marginal farmers” in Kolar and Gadag districts in the Karnataka state within India with farm equipment manufacturers, local entrepreneurs and in collaboration with Karnataka state government providing on-demand services for farm mechanization equipment. <http://www.thehindubusinessline.com/specials/emerging-entrepreneurs/ondemand-services-taking-roots-in-farm-sector/article9444483.ece>; see also: <http://www.goldfarm.in/home/>
- ²²³Gustavsson, Jenny, Christel Cederberg, and Ulf Sonesson. 2011. “Global food losses and food waste - Extent, causes and prevention.” FAO Food and Agricultural Organization of the United Nations.
- ²²⁴These figures include emissions from associated agricultural inputs, deforestation and soil carbon declines in agricultural fields.
- ²²⁵Hodges, Rick J., Jean C. Buzby, and Ben Bennett. 2011. “Postharvest losses and waste in developed and less developed countries – Opportunities to improve resource use.” *Journal of Agricultural Science* (149) 37-45; Kumar, Deepak, and Prasanta Kalita. 2017. “Reducing postharvest losses during storage of grain crops to strengthen food security in developing countries,” *Foods* 6 (1), 8.
- ²²⁶Kumar and Kalita. 2017.
- ²²⁷Affognon, Hippolyte, Christopher Mutungi, Pascal Sanginga, and Christian Borgemeister. 2015. “Unpacking postharvest losses in Sub-Saharan Africa – A meta-analysis.” *World Development* (66) 49–68.
- ²²⁸Hodges, Buzby, and Bennett. 2011. 37-45.
- ²²⁹Kumar and Kalita. 2017.
- ²³⁰Daminger, Allison, Saugato Datta, and Dana Guichon. 2016. “Reducing post-harvest loss – A behavioral approach.” Ideas42.org.
- ²³¹Daminger, Datta, and Guichon. 2016. Manufacturers of the hermetically sealed bags have partially solved this problem by changing the appearance of the bags and providing detailed information on the benefits of hermetic sealing on the exterior of the bags.

- ²³² Mined from ancient deposits of diatoms – a form of phytoplankton.
- ²³³ Daminger, Datta, and Guichon. 2016.
- ²³⁴ Kumar and Kalita. 2017.
- ²³⁵ Rosegrant, Mark W., Eduardo Magalhaes, Rowena A. Valmonte-Santos, and Daniel Mason-D’Croz. 2016. “Returns to investment in reducing postharvest food losses and increasing agricultural productivity growth.” Paper prepared for the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, 31 July – 2 August.
- ²³⁶ Daminger, Datta, and Guichon. 2016.
- ²³⁷ World Bank. 2011. “Missing Food – The case of postharvest grain losses in Sub-Saharan Africa.” 2011. World Bank – FAO – Natural Resources Institute. World Bank Report 60371-AFR, 2011.
- ²³⁸ Ibid.
- ²³⁹ Ibid.
- ²⁴⁰ Neven, David. 2014. “Developing sustainable food value chains – Guiding principles.” FAO Food and Agricultural Organization of the United Nations, 2014.
- ²⁴¹ Ibid.
- ²⁴² Ibid.
- ²⁴³ World Economic Forum, “Enabling Trade: From Farm to Fork”, 2014.

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