

## The Metamorphosis to a Knowledge-Based Society: Rwanda

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Rwanda's economy has continued to grow at comparably good rates, averaging 8 percent per annum, despite the global recessionary period that started in 2008. The country's continuing growth in the midst of the global downturn can be attributed to its good governance and sound fiscal discipline, as well as to the commitment from both its public and private sectors to build a more equitable country.

In the World Bank's *Doing Business 2012* report,<sup>1</sup> Rwanda is ranked number one in East Africa with respect to starting up a business, registering property, protecting investors' interests, enforcing contracts, and obtaining access to credit. The 2012 *Global Competitiveness Report*, published by the World Economic Forum,<sup>2</sup> ranked Rwanda the most competitive economy among the East Africa Community countries and third in sub-Saharan Africa. Rwanda also received the top ranking in East Africa, and 7th in the continent, among countries with active mobile broadband subscriptions per 100 inhabitants in 2011 in the United Nations Broadband Commission report.<sup>3</sup>

Unlike most African nations, Rwanda has limited natural resources. This limitation presents an opportunity for Rwanda to take an approach to development that differs from that of its neighbors—an approach where information and communication technologies (ICTs) form the linchpin of its plans to fundamentally transform its economy. At the beginning of the decade, Rwanda drew up a blueprint—dubbed Vision 2020—for how to achieve this goal. Adopted in 2000, Vision 2020 outlines several initiatives, programs, and strategies for transforming Rwanda into a middle-income country and transitioning its agrarian economy into an information-rich, knowledge-based one by 2020.

Over the past decade, the government and the private sector have invested massively in building the right infrastructure, skills, and institutional frameworks to provide an environment that is conducive to meeting this target: from the establishment of higher institutions of learning to the laying of fiber-optic cable nationwide, this landlocked country is overcoming all obstacles and moving forward.

The fact that the country is landlocked alone poses challenges for a nation with big ambitions. But the distance from Rwanda to the coast—both from Mombasa in neighboring Kenya and from Dar es Salaam in Tanzania—was circumvented by connecting to two submarine cables (the Eastern Africa Submarine Cable System, or EASSY, through Uganda to Kenya in Mombasa and The East African Marine System, or TEAMS, submarine cable through Tanzania at the Dar es Salaam coast). This is crucial because it creates the redundancies that ensure high-quality, reliable connections with no, or minimum, interruptions even when a fiber-optic cable has been inadvertently cut by road construction or farming activities. The advantages

of this approach have been witnessed most recently when the Mombasa submarine landing site experienced fiber-optic cable cuts that tampered with Internet usage in Kenya and neighboring Uganda, but Internet usage was maintained in Rwanda because of the redundancy from the Tanzanian coast. Besides laying the national fiber backbone, which is underground, Rwanda has also rolled out fiber on its electricity national grid network. This creates extra coverage above ground and reduces the risk of cut cables that tends to haunt underground cable networks.

In addition, Rwanda has differentiated itself by adopting an approach that translates into putting forth a framework that goes beyond merely utilizing ICTs as enablers for socioeconomic development. The country also strongly emphasizes the need to explore how to become the ICT service provider for the region and the continent at large. Naturally this requires strong, harmonious policy and regulatory frameworks to supplement the infrastructure already in place.

### **POLICY FRAMEWORKS AND ACHIEVEMENTS**

In order to transform Rwanda into a knowledge-based economy, the government integrated ICTs into its Vision 2020 to enable it to leapfrog the key stages of industrialization. The aim was to transform the agro-based economy into a service-oriented, information-rich, and knowledge-based one that is globally competitive. Rwanda's unique experience is driven by the strong partnership among the regulatory, policy, and implementing bodies, which are all under the charge of the Ministry of Youth and ICT.

The national ICT strategy and plan—commonly known as the National Information Communication Infrastructure Plan (the NICI Plan)—was adopted by Rwanda in 2000, under the auspices of the United Nations Economic Commission for Africa, as a holistic approach to using ICTs for development. Each of four five-year phases (NICI spans 20 years in total) characterizes this strategy and is aligned with the country's overall development goals and vision.

#### **NICI I: The creation of an enabling environment**

The first phase, NICI I, effectively focused on creating an environment conducive to using ICTs as tools for development in Rwanda by putting in place effective implementation and coordination mechanisms. These included, but were not limited to, the appropriate institutional, legal, and regulatory frameworks that would support rapid development of Rwanda's ICT sector, liberalize the telecommunications industry, and reduce entry barriers to the telecommunications market.

#### **NICI II: The development of ICT infrastructure**

The second phase of the plan, NICI II, concentrated on establishing critical national ICT infrastructure. Huge

investments have been made in developing world-class ICT infrastructure. The results are highlighted below:

- A high-speed fiber-optic backbone network now interconnects all districts and border points of the country. This network interconnects all government institutions and other private enterprises located in Kigali as part of the Kigali Metropolitan Network. In addition, Rwanda acquired international capacity equivalent to 2.5 gigabytes (GB), connecting to two international routes through submarine fiber-optic cables.
- Mobile phone/data coverage for Rwanda's population reached 96 percent in 2011 both through the efforts of aggressive public investment and the introduction of transparent competition among private-sector telecommunications operators.
- A state-of-the-art Tier 3 Data Center, the first of its kind in the region, offers 99.98 percent reliability and cloud services.
- The Karisimbi ICT infrastructure project is equipped with a communications, navigation surveillance, and automated traffic management system to ease the flow of air traffic and reduce the risk of flight delays and cancellations in the busy airspace of the Common Market for Eastern and Southern Africa/ East African Community region.
- The establishment of a digital terrestrial television (DTT) transmission system boosts television, radio, and telecommunication coverage and the deployment of digital television transmitters have improved nationwide television coverage—to 95 percent coverage of the nation's physical territory—hence satisfying citizens' rights to access to information.
- Multipurpose community telecenters, public information kiosks, and ICT buses have been deployed across the country to increase access to ICTs, provide ICT literacy training, and raise ICT awareness, among other services. The establishment of an innovation center provides an ecosystem in which startups combine innovation and entrepreneurship to produce homegrown solutions for local challenges along with globally scalable knowledge.

#### *Enhanced service-delivery programs*

Owing to the robust ICT infrastructure that has been put in place, the government has been able to improve operational efficiency in the public sector. ICT initiatives that foster development in key economic sectors and

that greatly improve Rwanda's service-delivery system have been established. These initiatives fall into three main categories:

- In business:
  - business incubators and career development support services;
  - online trade information portals;
  - online tax calculators;
  - a credit reference bureau;
  - a land administration and management information system;
  - an electronic case management system for legal cases;
  - online business registration;
  - a smart national identification system; and
  - improvements in online banking and the e-transaction regulatory system.
- In agriculture:
  - E-Soko—a mobile market information solution that allows farmers and consumers to access market information for agricultural products; and
  - the agricultural management information system.
- In healthcare:
  - Open MRS—an open-source medical records system that facilitates nationwide tracking of patient data;
  - TRACnet—a system that allows the central collection and storage of clinical health information;
  - Mobile e-Health—a system used by community health workers to collect data for Open MRS and TRACnet systems; and
  - telemedicine facilities connecting hospitals in rural areas to referral hospitals in urban areas.

#### *The impact of ICTs on foreign direct investment in Rwanda*

With the huge investments in ICT infrastructure, over US\$540 million in foreign direct investment (FDI) has been attracted to the ICT sector. This has led to an influx of foreign institutions setting up operations in Rwanda. Among these are VISA, Inc., the multinational financial services and global payment systems giant that set up its Rwandan offices in late 2011; and Airtel, the fourth-largest telecommunications company in the world, which began operations in March 2012.

#### **NICI III: Service development**

The third phase of the plan, NICI III (also known as the NICI-2015 Plan), is focusing on the development of services by leveraging ICTs to improve service delivery to Rwandan citizens. NICI III's overarching goal focuses on accelerating service development through ICTs,

thereby facilitating sustainable economic competitiveness and increasing ICTs' contribution to GDP. In this phase, emphasis is placed on five focus areas that will accelerate service development and fuel economic growth:

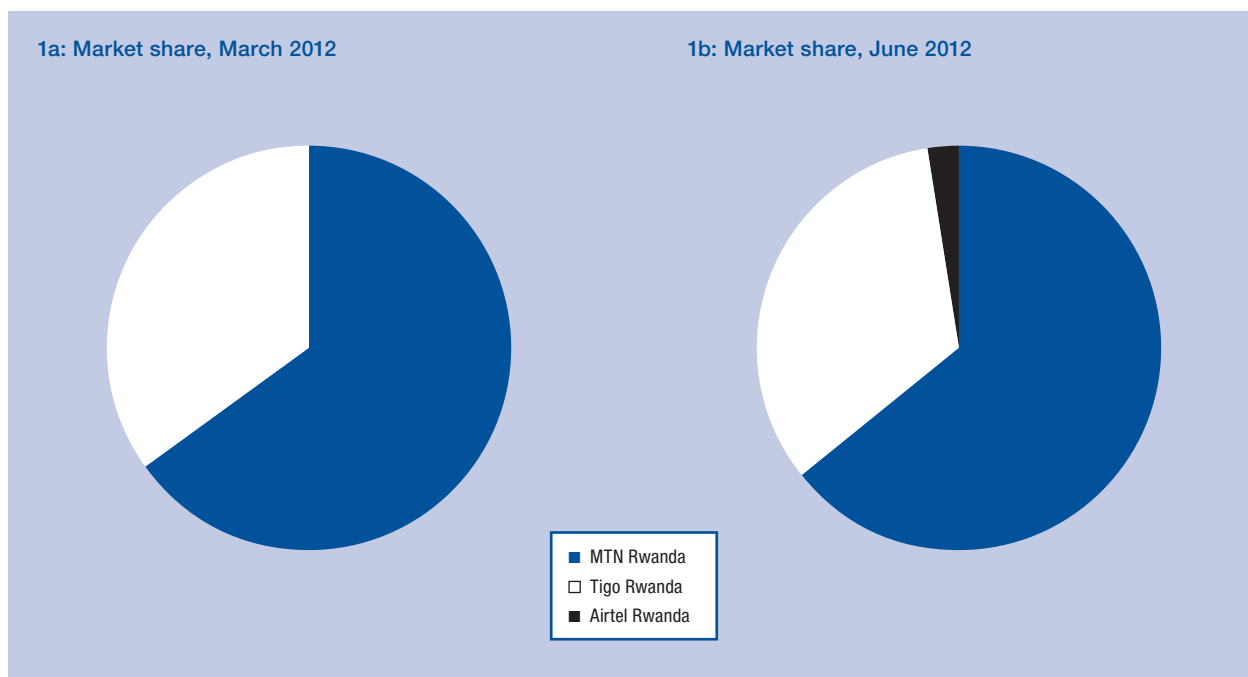
- **Skills development:** developing high-quality skills and a competent knowledge base for workers;
- **Private-sector development:** developing a vibrant, competitive, and innovative ICT sector and ICT-enabled private sector;
- **Community development:** empowering and transforming communities through improved access to information and services;
- **E-government:** improving government operational efficiency and service delivery; and
- **Cyber security:** securing Rwanda's cyberspace and information assets.

With the establishment of the Kigali Free Trade Zone, Rwanda again looks at moving forward and fast-tracking development in all sectors. The zone will be home to various industries, including an ICT park. It will provide tax incentives for businesses situated there, especially those targeting the export market—these incentives include a 0 percent corporate tax value-added tax exemption, a 0 percent import duty, and a 100 percent research and development costs write-off, among other advantages. At the core of the technology park will be Carnegie Mellon University, a world-class university with which the government of Rwanda has partnered to establish a center of excellence that will develop much-needed, highly skilled ICT professionals. The technology park, which will be heavily oriented toward research and development, is envisioned to foster key clusters in ICTs, including business process outsourcing, cloud computing, ICT education and training, e-government, cyber security, and mobile solutions.

#### **The composition of the ICT industry**

Rwanda's ICT private sector is classified into eight categories under the ICT Chamber in the Private Sector Federation. Although the industry is still young, it is growing quickly, both domestically, with new business registrations from fresh ICT graduates, and with foreign multinationals. The composition of the industry can be categorized according to different business lines: software developers, telecommunication and Internet service providers, broadcasters, information technology equipment resellers, ICT capacity-building businesses, system integrators under ICT solutions providers, and, of course, cyber café operators. These different business

**Figure 1: Telecommunications market share, incumbent Internet service providers**



Source: ITU World Telecommunications/ICT Indicators Database 2012; Ookla Net Index 2012.

lines are organized as associations, with forums to share experiences and challenges that may face them all. Cross-cutting ICT issues within the associations are represented by the ICT Chamber; for matters that pertain to the general business environment and are not unique to ICTs, the Private Sector Federation is engaged. Although the most vibrant of these business lines or associations are the telecommunications and Internet service providers groups, the industry continues to evolve.

**The development of the telecommunication industry**

The telecommunication industry is dominated by three mobile phone operators: MTN Rwanda, Tigo Rwanda, and Airtel, with a combined mobile phone penetration rate of 47.5 percent as of August 2012, and over 10 licensed Internet service providers.

Total investment in the telecommunications sector in 2011 was over US\$46 million; it exceeded US\$36 million for the first six months of 2012.

*Telecommunication market share*

MTN Rwanda is leading in terms of mobile subscribers, with 63.7 percent of the market share, followed by Tigo, which has 33.9 percent. Airtel Rwanda, which began operating in March 2012, has the lowest market share— 2.4 percent, as illustrated in Figure 1.

*Network performance and coverage*

All three operators are making the investments necessary to upgrade their respective networks and be

competitive. The coverage for each network is depicted in Table 1.

**Table 1: Coverage of operators, June 2012**

Operator	Geographical coverage (%)	Population coverage (%)
MTN Rwanda	97.9	97.7
Tigo Rwanda	78.7	97.1
Airtel Rwanda	3.0	9.0

Source: PMO, 2012.

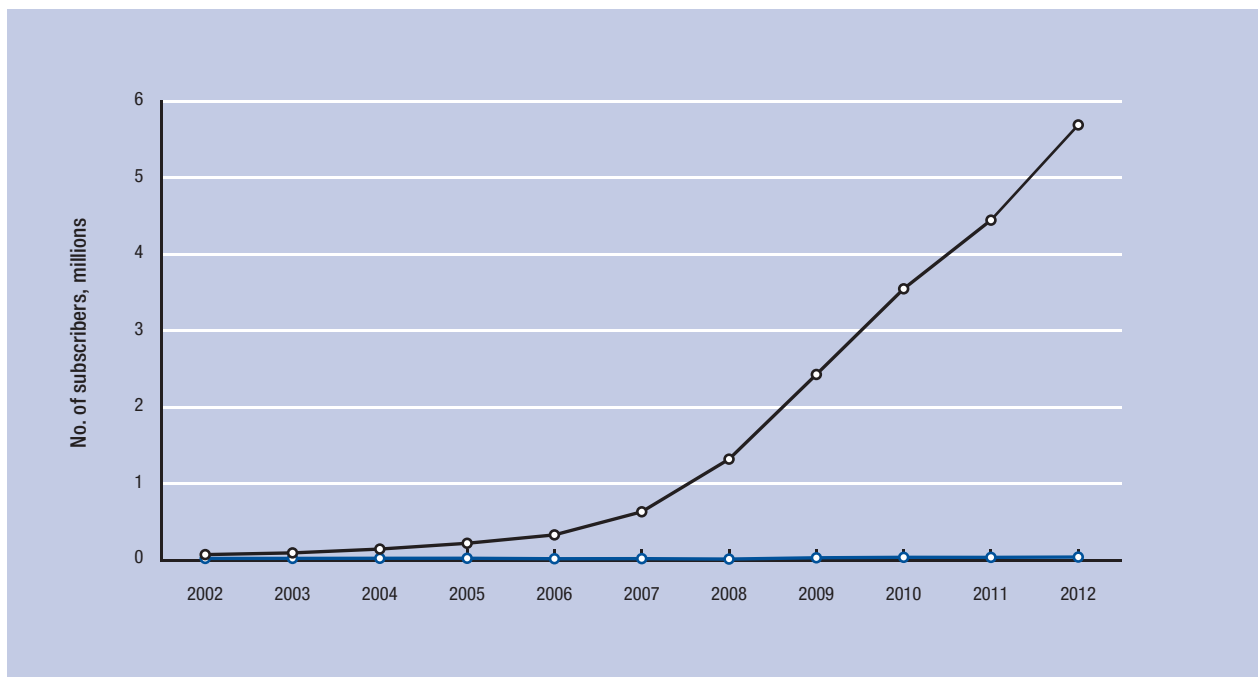
*Trend of fixed and mobile subscribers*

In a clear indicator of the success of the adoption of ICTs, the mobile phone penetration rate of Rwanda rose meteorically between 2002 and 2012. Figure 2 shows the trend in the numbers of both fixed line and mobile subscribers from the year 2002 to June 2012, and illustrates how phone penetration took off in 2007. Between June 2012 and October 2012 alone, mobile teledensity has risen from 44.4 percent to 47.5 percent.

*Internet penetration rate*

From 2008 to 2010, there was an exponential increase of Internet penetration, made possible by the increase of competition in the telecommunication sector. In 2011, we observed a slight decrease in Internet penetration because of the revocation of the mobile license of one of the operators, Rwandatel.

Figure 2: Trends of fixed and mobile subscribers, 2002–12



Source: Rwanda Utilities Regulatory Authority (RURA).

### HUMAN CAPACITY BUILDING

In line with Vision 2020, the government of Rwanda is committed to investing in human capital. This translates into nurturing a strong skills base and fostering an environment that promotes knowledge and skills transfer between academia and industry.

#### Carnegie Mellon University-Rwanda

One of the approaches to knowledge creation and transfer can be seen in the induction of Carnegie Mellon University (CMU) in Rwanda as a means to transform graduate education. With a history of excellence in higher education, and as a global thought leader in technology innovation, Carnegie Mellon is the first US research institution offering degrees in Africa with an in-country presence and resident faculty—transporting first-class education to the Rwandan education scene. CMU's presence will dramatically transform the knowledge base in the country and incorporate capacity building.

#### ICTs in education

The government of Rwanda has implemented numerous ICT initiatives in education that are transforming the field. These initiatives include training in ICTs for primary and secondary school teachers; scholarships in science and technology; the ICT Training & Research Institute at Kigali Institute of Science and Technology (KIST); the Educational Management Information System, and the Rwanda Development Gateway—an information portal that includes education information.

The One Laptop per Child initiative is aimed at familiarizing Rwandan schoolchildren with computers and preparing them to gain quality skills through ICT-based innovative education content. This ongoing program has already distributed more than 110,000 laptops in primary schools across the country.

At tertiary-level institutions, the National Electronic Distance Education and Training Programme complements campus-based education by deploying electronic message technologies, in addition to the tele-education program at the Kigali Institute of Education and African Virtual University at KIST.

#### ICT innovation center: The Knowledge Lab (kLab)

In tandem with Rwanda's journey to becoming a knowledge-based economy, the government—in partnership with the private sector and the Japan International Cooperation Agency—have put in place kLab, an ICT innovation center with the mission of promoting and supporting the development of innovative ICT solutions by nurturing a community of entrepreneurs facilitated by experienced mentors.

kLab brings like-minded innovators together and provides the resources needed to explore and exchange their ideas—resulting in innovative solutions to local problems. kLab hosts coding competitions, seminars, classes, and other community-led events. Similar initiatives across the world have shown that the synergy created through such an environment is a critical aspect in the growth of a healthy ICT sector.

## CHALLENGES AND THE WAY FORWARD

Despite the tremendous progress that has been made, the ICT sector continues to encounter challenges that hinder its development. Among these challenges are:

- **The limited availability and high costs of energy:**

The nation is known as the “land of a thousand hills.” This geographical configuration has posed challenges to the penetration of the national grid network and has led to limited electricity availability in those places that are not easily accessible. The high costs of electricity have stemmed from its limited generation, which has—in the past—depended on hydro generation. Coupled with high transmission costs and legacy power management systems, these factors have led to the high costs of energy in Rwanda.

The challenge has been understood and measures are being taken to address it, beginning with a huge campaign for alternative energy sources such as solar and biomass fuels, among others. The potential of employing new mechanisms of transmission and distribution management through a SMART electricity grid and energy market design are also being considered.

- **A shortage of highly skilled ICT personnel:** The shortage of highly skilled ICT personnel has resulted in key investment opportunities being missed. As early 1997, three years after the country’s devastating genocide, Rwanda recognized the need for technology as a driver of growth. The government thus established KIST with the sole purpose of producing highly skilled engineers to serve the nation’s development goals. However, the demand kept growing, with the result that more and more universities have been introducing ICT-focused courses. But even with all these efforts, there is still a skills gap. This gap has been identified as a consequence of the late adoption of ICTs by the students.

This obstacle is now being solved by early ICT adoption. ICT courses are now introduced at very early stages through initiatives such as One Laptop per Child. It was also in response to this challenge that Rwanda invited CMU to set up a campus in Rwanda to provide training in highly specialized ICT courses.

- **Low broadband Internet penetration:** Although Rwanda ranks above many African countries in Internet penetration, the penetration rates by which it leads are still very low by its own standards; it is actively working to address this situation. In the end, Rwanda considers that providing affordable and stable broadband access throughout all parts of the

country is essential to its development. Rwanda’s telecommunications market is still dominated by voice-centric mobile services.

With nationwide fiber-optic coverage, the country is embarking on ensuring that last-mile access is provided to fully maximize the opportunity at hand. A study has been commissioned with the aim of mapping out Rwanda’s broadband needs across the entire country in order to bridge the digital divide through last mile broadband connectivity. The plan is to install fiber to some premises and wireless broadband for the rest.

- **Limited access to finance:** There is still a void in Rwanda’s technology sector with regard to funding, especially for early-stage companies that need angel and venture capital. The ecosystem that attracts FDI flow is nonexistent at the moment. Coupled with high lending rates, the lack of finance makes it difficult for would-be entrepreneurs to see ICTs as an avenue for establishing business. Unlike other sectors—such as financial services and real estate, which have seen a boom in venture capital flow—technology has not yet benefitted from its potential. The lending regime in Rwanda is also such that loans are given against collateral; in most cases, this is the company’s assets. This model does not fit well with ICT companies, since the assets are usually in software, which banks consider to be highly risky and do not fit well in their risk analysis models.

Working with local banks, initiatives are being launched to help financial institutions develop risk analysis models that can address the industry’s needs—particularly those that are into software development. Campaigns are also being carried out to attract venture capital firms from the region and beyond to look at the opportunities in Rwanda. One such initiative—the Rwanda Innovation Endowment Fund—seeks to facilitate startup companies in three major areas: ICTs, agriculture, and manufacturing. The initiative, which will provide funding up to US\$50,000 to qualifying projects, aims at promoting the most promising innovations with seed capital.

## CONCLUSION

Rwanda is making the remarkable journey from an agrarian economy to a knowledge-based economy with a strong focus on providing services and information. The Rwandan experience can serve as an illustration of how a nation with limited natural resources can invest in human capital and make use of ICTs to transcend economic shortcomings and emerge as a leader in its region.

The aligned vision of all stakeholders in the ICT sector, along with the partnerships with all other sectors



at the national level, will translate into ICTs acting to enable all tiers of socioeconomic development in Rwanda. The unified efforts of all sectors to adopt ICTs in their operations have made all the difference.

The country's experience has not been without challenges: bridging the knowledge and skills gap to create an information-rich, skilled society base and bridging the digital divide are two focal points of interest addressed in the ICT and education policies of Rwanda. The induction of CMU in Rwanda, along with the concerted efforts made at the tertiary level to produce quality technopreneurs, will pay off by creating a strong, highly skilled workforce. In addition, by laying a backbone of optical fiber around the country and at all border points, Rwanda has invested heavily in laying the groundwork to make sure every Rwandan has access to communication technologies. This intricate groundwork will also serve to attract more FDI to Rwanda as a means to further stimulate ICT growth in the region.

Rwanda's ambitions permeate its borders: it intends to capitalize on its central location in Africa and act as a hub for banking and financial services, as well as business process outsourcing services, leveraging on the strength of its ICT sector. With seven years to meet Vision 2020 and counting, Rwanda is already emerging as a regional ICT leader. The country confidently looks to heralding ICT growth not only in the region, but also on the continent as a whole.

## NOTES

- 1 World Bank 2011.
- 2 World Economic Forum 2012.
- 3 United Nations Broadband Commission 2012.

## REFERENCES

- PMO (Prime Minister's Office). 2012. *Brief Report on Telecom Operations*. Rwanda Utilities Regulatory Authority, December.
- United Nations Broadband Commission. 2012. *The State of Broadband 2012: Achieving Digital Inclusion for All*. 2012. Geneva: ITU and UNESCO. Available at <http://www.broadbandcommission.org/Documents/bb-annualreport2012.pdf>.
- World Bank. 2011. *Doing Business 2012*. Washington, DC: World Bank.
- World Economic Forum. 2012. *The Global Competitiveness Report 2012–2013*. Geneva: World Economic Forum.