

# The State of the Mobile Economy, 2014: Its Impact and Future

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## EXECUTIVE SUMMARY



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The global mobile economy totals \$1.6 trillion, according to recent estimates.<sup>1</sup> Overall, mobile revenues for the companies that provide services and applications are expected to rise to \$2 trillion by 2017. The mobile economy now constitutes around two percent of global Gross Domestic Product (GDP), and its emergence has been facilitated by technological and scientific breakthroughs and billions of dollars invested in research and development.<sup>2</sup>

Mobile devices allow people and businesses to stay in touch around the clock. They have enabled new forms of learning, health care, economic development, and governance innovations. Mobile technology has sparked the growth of entirely new industries and revolutionized both business practices and societal improvements worldwide. The resulting boom has created economic opportunities for billions of people.<sup>3</sup>

In the developing world, micro-entrepreneurs contribute to economic growth by improving access to financial capital, providing better market information, and reaching new consumers.<sup>4</sup> Many of the inventors who played a crucial role in the development of mobile devices and services started out working by themselves or in small organizations. Protected by intellectual property rules, they came up with advances in hardware and software that propelled the overall ecosystem.<sup>5</sup>

But it is hard to realize the promise of the mobile economy unless all have the chance to share in its benefits. People in rural areas sometimes do not have access to mobile networks and this makes it difficult to use mHealth or mLearning platforms or engage in mobile money transactions. They are not able to reap the virtues of the mobile revolution when they face problems in terms of service availability or insufficient mobile infrastructure.

This report looks at mobile innovation, investment, and invention around the globe. There are significant differences across nations in how much they invest in innovation, create new ideas, and provide legal protections that are important for small inventors and mobile start-ups. I use World

Bank and World Intellectual Property Organization data to identify which nations excel at investing in research and development and filing patents. In addition, I take advantage of a *Time* magazine poll conducted in coordination with Qualcomm Incorporated, which surveyed people in 17 countries in order to determine their views regarding invention and economic growth.

Among the most important findings of this research are the following:

*1. Mobile technology adds significantly to economic growth each year.*

- a) International economic data demonstrate that mobile technology adds up to 0.39 percent to GDP and hundreds of thousands of new jobs.
- b) There are multiplier effects in the developed and developing worlds from investment in mobile infrastructure.
- c) Having fast mobile networks and promoting an innovation-based environment are vital for the global economy.
- d) Global standards organizations and global intellectual property processes propel growth.
- e) New applications in mHealth and mLearning and the emergence of the “Internet of Things” are transforming life for many people and demonstrate the importance of a robust mobile infrastructure.

*2. People and businesses in various countries invest in R & D at different rates and these investment levels affect the ability to design and build new products and services.*

- a) Those in Israel, Finland, and South Korea are the top investors in R & D as a proportion of their GDP.
- b) Patent filings by Chinese residents and companies operating in China have increased dramatically over the past decade and they now file more patents than any other country, followed by the United States and Japan.

*3. The global public thinks invention and entrepreneurship are important for delivering societal benefits and economic development.*

- a) The countries with the highest percentage of citizens who think of themselves as inventors are from South Korea, Kenya, and South Africa and these attitudes affect the innovation atmosphere in those places.
- b) China, Kenya, and India represent the nations with the largest number of people believing that invention is important for society.
- c) South Korea, China, and Indonesia have the greatest number of individuals who think that invention drives economic growth.
- d) Indonesia, South Korea, and China are the countries with the largest percentage believing that the lack of government protection for inventor rights is the biggest barrier to innovation.

## THE MOBILE SECTOR: CONTRIBUTIONS TO ECONOMIC GROWTH

One of the reasons that many countries invest in mobile infrastructure and encourage mobile usage is its contributions to economic growth. There is significant impact regardless of whether one looks at mobile, broadband, or mobile broadband. For example, an analysis by economists Harald Gruber and Pantelis Koutroumpis, found that national growth improves significantly based on mobile usage. Looking at 192 nations from 1990 to 2007, they found increasing returns in terms of productivity and growth based on the use of mobile devices. For high income nations, mobile technology added 0.20 percent annually to GDP, while in low income countries, it contributed 0.11 percent. They also looked at mobile infrastructure investment and found that it paid off in economic growth. Nations that invested saw GDP gains of 0.39 percent in high income places and 0.19 percent among low income places.<sup>6</sup>

A number of studies have looked at the economic impact of mobile for specific countries, and found a significant tie. For example, the consulting firm LECG undertook an analysis of India and found that “an investment of US\$20 billion in 3G networks over the next five years will benefit India’s economy by more than US\$70 billion and create up to 14 million jobs.” And in China, it said that, “the current and future economic benefits from Chinese operators’ proposed investment of \$59 billion is likely to exceed \$110 billion.”<sup>7</sup>

This finding was echoed by an Analysis Mason project. It demonstrated that an “increase in broadband penetration of 1% will contribute INR 162 bn, or 0.11% to Indian GDP in 2015. The report also argued that allocating an “additional 5 MHz of 3G spectrum will increase BB penetration by 3.3% of the population and enhance GDP by INR 538 bn in 2015.”<sup>8</sup>

Raul L. Katz and his colleagues looked at the economic benefits of broadband investment in Germany. They found that “there will be gains of 968,000 jobs and 170.9 billion Euros added to the economy over 10 years. This amounts to 0.60 annual growth in GDP during the period from 2010 to 2020.”<sup>9</sup>

In examining the European market in general, the GSM Association found that mobile investment was key to higher economic growth. Its report argued that it “could generate approximately €60bn to €120bn in value annually to 2015 - equivalent to 0.5% to 1.0% of GDP -or €340bn-€750bn in aggregate between 2010 and 2015.”<sup>10</sup>

For the United States, a Deloitte analysis “estimated \$25-\$53 billion investment in 4G mobile wireless technology in the US is projected, using standard GDP multipliers for the industry, to create \$73-\$151 billion in GDP growth and between 371,000 and 771,000 new jobs.”<sup>11</sup> Deloitte also estimates that small- and medium-sized enterprises with Internet access in different countries experienced an average 11 percent productivity gain, and that extending Internet access to current levels in developed countries could enhance productivity by as much as 25 percent in developed economies. The consulting firm argues that the resulting economic activity will generate \$2.2 trillion in additional GDP, a 72 percent increase in the GDP growth rate and more than 140 million new jobs.<sup>12</sup>

Similar trends are apparent in the developing world. GSM research demonstrates that the mobile economy is likely to add \$729 billion to Asian Pacific GDP by 2020. It is anticipated that two million jobs will be created and there will be \$131 billion in new tax revenues. In the case of India, analysts have found that “states with 10 per cent higher than average mobile phone penetration enjoy an annual average growth rate 1.2 per cent higher than those with a lower teledensity.” This leads research leader Rajat Kathuria of the ICRIER to conclude that: “telecommunications is a critical building block for the country’s economic development. Our work also shows that the real benefits of

telecommunications only start when a region passes a threshold penetration rate of about 25 percent. Many areas have still not attained that level, which indicates the importance of increasing teledensity as soon as possible.”<sup>13</sup>

Research by Deloitte for Facebook and Internet.org suggests that if there were universal Internet access around the world that would connect the two-thirds (or five billion) of the people without online access, it would “increase productivity by as much as 25 percent, generating \$2.2 trillion in GDP and more than 140 million new jobs, lifting 160 million people out of poverty.”<sup>14</sup>

## THE IMPORTANCE OF ENTREPRENEURSHIP

Entrepreneurship is part of the mobile economy story. In many places around the world, individual proprietors or small firms operate storefronts, sell merchandise online, or develop apps for mobile transactions. They connect sellers and purchasers, and create jobs and economic activity in the process.

Table 1 lists the top countries in terms of launching new firms, based on International Finance Corporation and World Bank entrepreneurship data.<sup>15</sup> The United Kingdom is the most highly ranked nation with 455,600 new firms, followed by Russia (442,165), South Africa (217,624), Australia (185,009), and Hong Kong (150,165). These are the places that have constructed the business, investment, and regulatory climate for new firm creation.

TABLE 1: COUNTRIES WITH LARGEST NUMBER OF NEW BUSINESSES	
United Kingdom	455,600
Russia	442,165
South Africa	217,624
Australia	185,009
Hong Kong	150,165
France	121,538
India	99,587
Spain	84,399
Nigeria	81,144
Italy	75,645

*Source: International Finance Corporation and World Bank Entrepreneurship Database, 2012*

In locales such as Egypt, Nigeria, and Indonesia, these kinds of micro-entrepreneurs generate 38 percent of GDP.<sup>16</sup> Many businesses are small in scope and serve customers on a particular street or in a neighborhood, including firms that transport people, provide food, clean clothes, or transfer money for those without bank accounts.

Mobile plays a particularly important role in helping female entrepreneurs. A report entitled “Transforming Women’s Livelihoods Through Mobile Broadband” interviewed more than 1,000 working women across five developing countries and found that 80 percent use their mobile phone for work and consider their phone an important tool to help themselves and their families.<sup>17</sup> According to a World Bank analysis of ways to maximize mobile, software applications have become one of the greatest sectors for entrepreneurship and the promotion of economic growth.<sup>18</sup>

## EXTENDING MOBILE INFRASTRUCTURE

In order for entrepreneurs to launch businesses in the 21<sup>st</sup> century, they need access to information, the ability to communicate, and mobile platforms to market and sell their products or services. By 2016, it is estimated that 80 percent of global broadband subscriptions will be through mobile devices.<sup>19</sup> There now are more mobile devices in use than desktop computers and this development has dramatically altered the way people operate businesses.

The growing reliance on mobile devices means that entrepreneurs need mobile infrastructure that helps them reach customers. Marketing and distribution often takes place through smartphones and tablets so businesses need high-speed networks that allow them to reach a global clientele. In certain sectors, customers are just as likely to come from Germany, Japan, or Indonesia as the United States.

In addition, having fast mobile networks is crucial to mHealth, mLearning, smart appliances, smart meters, and global financial inclusion. Taking advantage of the opportunities provided by mobile technology requires networks that have sufficient capacity and robustness to handle those kinds of applications. Some places lack sufficient spectrum to support the growing use of wireless devices. For example, a Credit Suisse report estimated that North American mobile networks are nearing capacity in certain locales due to dramatic increases in video streaming and other bandwidth-intensive applications.

With mobile broadband traffic rising rapidly, it is vital that networks be fully built out with sufficient capacity to support the surge in traffic.<sup>20</sup> Right now, consumer and business demand is growing faster than the available bandwidth. It is challenging to find sufficient spectrum to support wireless transmissions. We need to extend mobile infrastructure so that users can take advantage of the digital revolution that is taking place.

Right now, consumer and business demand is growing faster than the available bandwidth.

The need for better infrastructure is not limited to the developed world, but also is relevant for developing nations. A study of mCommerce in China found that it is growing in importance. Using survey data from the Ministry of Commerce there, researchers argued “m-commerce in China enjoys relatively great communication reach” and that the “costs of communications do not seem to be a major barrier for m-commerce growth.”<sup>21</sup>

It also is vital to improve access to these networks for underserved populations. It will be hard to realize the promise of the mobile economy unless all have the chance to share in its benefits. People in rural areas sometimes do not have access to mobile networks and this makes it difficult for them to access mHealth or mLearning platforms or engage in financial transactions. They are not able to reap the benefits of the mobile revolution if they face problems in terms of infrastructure or service availability.

The mobile revolution has spread because of advances in microchips, cellular communications, batteries, and antennas. Invention is crucial for the continued growth of the mobile economy. There are many aspects to fostering an environment that makes this possible and we can see that countries that have dedicated resources and encouraged activity as it relates to securing and valuing intellectual property have and will benefit. Having a vibrant mobile ecosystem depends on the continued ingenuity of designers and manufacturers. Only by

developing faster and more efficient means of handling transactions and accessing information can the global mobile economy continue to thrive.

## MODERNIZING AND EXTENDING HEALTH CARE

Telecommunications infrastructure is crucial for the economy, but it also is vital for health care and education. Each of these sectors is important for the future, but suffers from being labor intensive, having high costs, and needing modernization in order to bring benefits to more people. This is particularly true in the developing world due to the centrality of health care and education for overall well-being and prosperity.

In the health care area, access, affordability, and quality are problems around the world as large numbers of individuals do not receive the medical services that they need. Mobile technology offers ways to help with these challenges. Through mobile health applications, sensors, medical devices, and remote patient monitoring products, there are avenues through which health care delivery can be improved. Mobile technologies help lower costs by facilitating the delivery of care and connecting people to their health care providers. Applications allow both patients and providers to have access to reference materials, lab tests, and medical records using mobile devices.<sup>22</sup>

Health care currently features costly service delivery and often has patients who have difficulty accessing needed services. With mHealth's particular combination of improving access and enabling greater productivity, mobile technology helps to improve service delivery.

Innovations in this area, for example, have made it possible for professionals to improve access to quality care.<sup>23</sup> The World Health Organization tracks mHealth initiatives around the globe. WHO researchers found that 84 percent of the 114 countries surveyed provide mobile health services. The most common was health care call centers (59 percent), followed by emergency phone consultations (55 percent), managing disasters (54 percent), and telemedicine (49 percent).<sup>24</sup>

Research by the Boston Consulting Group and Telenor Group meanwhile found that "mHealth can reduce the costs of medical care among the elderly by 25 percent [and] double access to physicians by those living in rural areas."<sup>25</sup> mHealth has made a huge difference in the developing world and helped bring health care to underserved areas.

Around 80 percent of American doctors use mobile devices in their medical practice.<sup>26</sup> According to research by Andrea Downing Peck, doctors rely upon their smartphones to "search for drug and treatment reference materials, learn about new research, diagnose diseases, and educate patients." Ready access to information makes them more efficient and effective in their operations.

In addition to the benefits that mHealth provide to health care practitioners, studies have found that mHealth solutions have a positive impact on health care budgets. For example, an analysis by PriceWaterhouseCoopers of the European Union estimated that use of mHealth devices would save the EU around 99 billion euros and add 93 billion euros to the region's GDP by 2017. According to these researchers, three-quarters of this savings would come from the public sector, while one-quarter would represent private sector savings. These analysts

concluded there would be significant savings in terms of wellness and prevention programs, diagnosis, treatment, and patient monitoring.<sup>27</sup>

## **STRENGTHENING EDUCATION AND PROVIDING ACCESS TO LEARNING TOOLS**

Education is a major driver of economic prosperity. A UNESCO report finds that “a \$1 investment in education could bring a \$10-15 return in economic growth.”<sup>28</sup> If low income students improved their basic reading skills, around 171 million people would rise out of poverty. This would result in a 12 percent decrease in poverty.<sup>29</sup> Each year of education per person has been found to improve GDP by 0.37 percent.<sup>30</sup>

Mobile provides great benefit through learning applications. It represents a new way of interconnecting teachers, tutors, students, peer groups and can utilize social networks, gaming innovations, new technologies, and mobile content creators in order to share information and knowledge. It also provides new platforms for reaching the millions of children and adolescents who are currently not enrolled in school. Researchers calculate that mobile can enable 180 million students to further their education over the next five years in developing countries.<sup>31</sup>

In a report authored by researchers Gwo-Jen Hwang and Hsun-Fang Chang, mobile applications for learning about the cultural history of China were studied. They used a pre- and post-test analysis and found that “the average learning achievement of the experimental group is significantly better than that of the control group.”<sup>32</sup>

Another project compared mLearning between urban and rural areas in developing nations. The authors found that “students in the rural village, seriously lacking educational resources and technology exposure, may have benefited substantially more from mobile technologies than urban school students.” They argued that mobile devices in rural areas helped students because it gave them access to information that their higher socioeconomic status peers already had.<sup>33</sup>

In the United States, third grade students in one elementary school were divided into two groups, one that used flashcards to learn multiplication while the other used mobile learning platforms. The researchers found that the mobile learners outperformed their fellow students and showed a “medium-sized performance advantage.”<sup>34</sup>

Ambient Insight has undertaken a review of mobile learning growth rates around the world.<sup>35</sup> China, India, and Indonesia are projected to have the greatest growth from 2010 to 2015 based on current market developments (See Table 2). They are followed by Brazil, Bangladesh, and Nigeria.

**TABLE 2: COUNTRIES WITH THE HIGHEST MOBILE LEARNING GROWTH RATES (PERCENTAGE)**

China	60-65
India	60-65
Indonesia	60-65
Brazil	55-60
Bangladesh	50-55
Nigeria	45-50
Pakistan	40-45
South Africa	40-45
Malaysia	35-40
Mexico	25-30

*Source: Sam Adkins, "The Worldwide Market for Mobile Learning Products and Services," Ambient Insight, September, 2011*

Overall, there is a significant connection between mLearning and economic growth. According to the World Economic Forum, "no socio-economic factor is a better indicator of a nation's economic success than its investment in education and mLearning offers fascinating opportunities to systemically redefine the way that individuals and communities can contribute to society."<sup>36</sup>

This is the case with science, technology, engineering, and math (STEM) education. According to the European Centre for the Development of Vocational Training, "85 to 95% of jobs will require ICT skills by 2020." Those who have skills in this area will create new products and services, and help to propel the overall economy. Mobile technology is a vital part of giving students STEM skills. It also reduces disparities based on gender, race, and ethnicity.

## **IMPROVING GOVERNMENT EFFECTIVENESS BY REDUCING CORRUPTION AND BOOSTING TRANSPARENCY**

Poor government performance is a major problem in most parts of the world. The public sector can be costly and overly bureaucratic and often times needs to modernize its structure and operations. In a number of nations, corruption is a substantial issue and imposes an invisible tax on individuals and businesses as a requirement to get government services or contracts.

Mobile government helps improve effectiveness by reducing corruption and boosting transparency and accountability. Many countries are devoting considerable efforts to using technology that improves transparency and accountability, and encourage people to get more involved in the political process. Mobile furthermore is enabling the delivery of service to citizens.

There are a number of anti-corruption programs around the world that make use of mobile technology. For example, the Technology for Transparency Network relies upon social media to fight corruption. According to its website, "in Kenya, [the mobile firm] Mzalendo seeks to make information more accessible from the proceedings of the country's parliament. In Jordan, [the company] Ishki aims to involve citizens in developing solutions to

civic problems. Vota Inteligente [is a Chilean site that] promotes government transparency by informing Chilean citizens about corruption and policy debates through the use of social media."<sup>37</sup>

In India, the website [www.IPaidABribe.com](http://www.IPaidABribe.com) fights corruption by publicizing specific acts of bribery. Citizens can report specific individuals, locations, and amounts for their countrymen to read. The site aggregates the data and lets people know which government officials or which geographic jurisdictions are most likely to request bribes in return for various government services.

There have been encouraging efforts to get more people involved in the political process through mobile devices. In the United Kingdom, there is an app called "PoliticsDirect" that "locates the mobile user's geographical location to find their local MP, MEPs, Councillors, Council and relevant information about them such as voting record and expenses."<sup>38</sup> This is a way to hold officials accountable and improve the responsiveness of the political system.

In Haiti, voters use their phones to "access information, confirm voter registration status and obtain information on the location of polling centers."<sup>39</sup> This helps get more people involved in politics and is designed to increase voter turnout.

Work by Charles Gibson and his colleagues at the University of California at San Diego shows how cellphones have been deployed to reduce electoral fraud in Afghanistan and Uganda. People use their phones to take pictures of local election tallies and send those results to a central headquarters. This makes it more difficult for officials to misreport results or steal ballot materials. Gibson found that mobile technology helped to reduce electoral fraud by 25 percent and cut the theft of ballot materials by 60 percent.<sup>40</sup> Using technology to crowdsource accountability makes it more difficult for politicians to engage in fraud without others becoming aware.

## THE EMERGING "INTERNET OF THINGS"

In addition to government performance, mobile connectivity is crucial in what is coming to be known as the "Internet of Things." This is a term that writer Kevin Ashton coined to describe the emergence of machine-to-machine communications linked through high-speed networks and cloud-based solutions.<sup>41</sup> The global expansion of sensors, remote devices, and smart appliances has accelerated and is creating new opportunities for connecting people and devices.

For example, smart objects enable manufacturers to track their supply chains more effectively. Through digital tags attached to particular items, managers can see where their supplies are and whether they have the inventories needed to build particular products. This type of connectivity, when used in conjunction with the Global Positioning System (GPS), can be transformative in a number of different areas. Consultant Nam Pham has analyzed the situation and concluded that "with the increased adoption of mobile phones throughout the world and the growth of phones with GPS positioning capabilities, mobile phones and networks are now an essential tool for things like agriculture, transportation/logistics and emergency response and disaster management, as well as providing important tools and information to protect and aid individuals."<sup>42</sup>

Smart appliances help consumers keep track of their heating and security needs. For example, consumers can use mobile devices to set their thermostats or turn on their home security systems. They can make sure that dish washers run at optimal times from the standpoint of saving energy and refrigerators keep products cool. Smart meters show people how they are consuming energy and what the cost is at various points in time.

Motor vehicles now are equipped with GPS chips that monitor engine performance and make sure that the cars are operating at peak efficiency. Smart cars can help people park in tight spaces and anticipate possible accidents through early warning systems.

Wearable devices are becoming more ubiquitous. People are wearing computerized watches, glasses, and accessories that keep people connected around the clock. Innovators are integrating devices into people's lives rather than having computers that function as separate devices

As the world evolves from human-to-human computing to machine-to-machine communications, mobile devices will affect how people employ technology and make their lives easier. Instead of people having to give a computer command in order to do various things, computers automatically will perform tasks that humans have indicated they want, such as lowering the room temperature at night in order to save energy or turn on a home security system when residents are away.

Once mobile devices are embedded in people's lives, it becomes easier to create networks that serve human needs without requiring active intervention on the part of people. Sensors will make subtle adjustments in appliances based on owners' preferences, and that will expedite greater service and efficiency. It is little wonder that analysts have high expectations for the "Internet of Things." According to Maravedis, "20% of mobile carriers say M2M will be a number one source of revenue growth 2013-2017."<sup>43</sup>

## THE ROLE OF IDEAS AND STANDARDS

Past advances in the mobile economy have been powered by developments regarding microchips, antennas, batteries, scrolling, and networking. The miniaturization of chips and their rising processing power have allowed mobile devices to shrink dramatically. Improved battery life helps people spend more time on the go rather than tethered to an outlet. Faster cellular networks enable Internet browsing and wireless delivery of many new services.<sup>44</sup> None of these advances would have made a difference without key breakthroughs in the use of spectrum and radio-frequency technology.

The result of all these changes is that phones small enough to fit into a shirt pocket possess computing power that would have been unimaginable two decades ago. Engineering advances have led to devices that have greater power but take up far less space. This has opened the door to innovation in many different fields from banking, transportation and information management to still emerging innovations in education, health care, disaster management, and global development.

The consultative processes of voluntary standards-setting organizations have served as key tools to facilitate improvements in interoperability, global roaming, manufacturing, and design. Standards groups have helped to build consensus around the best ideas and the corresponding technological solutions that form the basis for high

quality, interoperable networks and devices. It would be commercially impractical for mobile networks to operate without technical standards that allow devices to function across an array of technologies, multiple platforms and numerous geographical lines. Experts from numerous companies have put tremendous time, energy, and resources into evaluating what ideas are most promising for global interoperability. Within these organizations, supermajorities are required before specifications are approved, published and incorporated into products by implementers. Once certain approaches have been agreed upon and adopted on a widespread scale, companies and inventors have a common basis for commercializing their products.

Global standardization of technical standards and associated work by standards setting organizations (SSO) has been crucial, as have been policies that ensure access to the standardized technologies. Standardization allows the industry to grow in an efficient and effective manner, and has resulted in a robust, competitive marketplace. These favorable attributes of SSO's have resulted in the inclusion of more and more complex functions in products, at lower and lower prices, greatly benefiting society.

Research by Daniel Spulber of Northwestern University documents the importance of technology standards for innovation and long-term economic performance. He argues that having agreed-upon standards does not hold up innovation but rather provides the foundation for new products and devices.<sup>45</sup> Alexander Galetovic, Stephen Haber, and Ross Levine also challenge the “hold up” hypothesis. They suggest that consumer prices have declined in industries where there is agreement about the underlying technology.<sup>46</sup>

## RANKINGS BASED ON RESEARCH & DEVELOPMENT EXPENDITURES

There are various ways in which countries encourage creativity and invention. One avenue is through public and private R & D funding as a percent of GDP. The World Bank has R & D spending data that compares investments designed to produce new ideas (see <http://data.worldbank.org/indicator>). Researchers have to be careful in interpreting these data. Companies often are strategic in where they file first. They may decide to file in the market that has the greatest commercial importance, where they expect the speediest issuance, or where their business competitors are most active. Studying the locales where patent applications are filed is not be a perfect indicator regarding the home jurisdiction of the inventor. But these data help analysts see where patents have been filed and what the longer-term trends are geographically.

In most nations, R & D spending arises from a variety of sources: government agencies, business investments, universities, or non-profit organizations. Table 3 lists areas in terms of their R & D expenditures as a percentage of GDP. That allows us to determine those places investing the greatest proportion of their financial resources in research and development.

The place devoting the greatest financial effort is Israel (at 4.4 percent of GDP), followed by Finland (3.88 percent), South Korea (3.74 percent), Sweden (3.4 percent), and Japan (3.36 percent). These are locales where governments and/or companies place a high premium on science and technical knowledge. Their leaders understand the economic virtues of science and technology and their role in international trade and development. As a result, they invest in R & D in order to propel their overall economies.

**TABLE 3: TOP PLACES IN RESEARCH & DEVELOPMENT EXPENDITURES AS PERCENTAGE OF GROSS DOMESTIC PRODUCT**

Israel	4.4
Finland	3.88
South Korea	3.74
Sweden	3.4
Japan	3.36
Denmark	3.06
Switzerland	2.99
United States	2.9
Germany	2.82
Austria	2.76
Iceland	2.64
Singapore	2.43
Australia	2.37
France	2.25
Slovenia	2.11
Belgium	1.99
Netherlands	1.83
Canada	1.8
Ireland	1.79
United Kingdom	1.76
China	1.7

*Source: World Bank Patent and Intellectual Property Use Data, 2010*

## TOP COUNTRIES IN TERMS OF PATENT FILINGS

It is not enough to invest in scientific discovery. Countries need people who create new ideas and bring those inventions to the marketplace. This includes tangible items such as equipment, products, and hardware, but also intangible contributions through design, software, and new inventions. There are many activities and conditions that go into commercializing inventions.

Inventors are crucial to this process because without an original idea, there is nothing to market or sell. For this reason, it is crucial to look at patent filings because they tap into the idea formation that is so crucial to long-term economic development. People patent ideas that they believe are novel and innovative, and have some hope of contributing to society and the economy as a whole. Without strong enforceable patents, neither inventors nor their financial backers could risk investing the years and billions of dollars in research it has taken to create today's wireless technologies. The authors of the U.S. Constitution gave Congress the power to grant inventors

exclusive rights to their discoveries for a limited time “to promote the progress of science and useful arts.” IP-heavy industries now account for 35 percent of U.S. gross domestic products, according to the Economics and Statistics Administration and the U.S. Patent and Trademark Office.<sup>47</sup>

The World Bank aggregated filings from the World Intellectual Property Organization database. It covers “world-wide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention - a product or process that provides a new way of doing something or offers a new technical solution to a problem.”<sup>48</sup>

Table 4 examines places registering the largest number of patent filings. China is number one (with 526,412 applications), followed by the United States (503,582), Japan (342,610), South Korea (178,924), and Germany (59,444). Other nations that generate a lot of filings include India (42,291), Russia (41,414), Canada (35,111), Australia (25,526), and Brazil (22,686). Some of these filings are coming from people who live in those particular locales, while others arise from companies that choose to file there for business reasons.

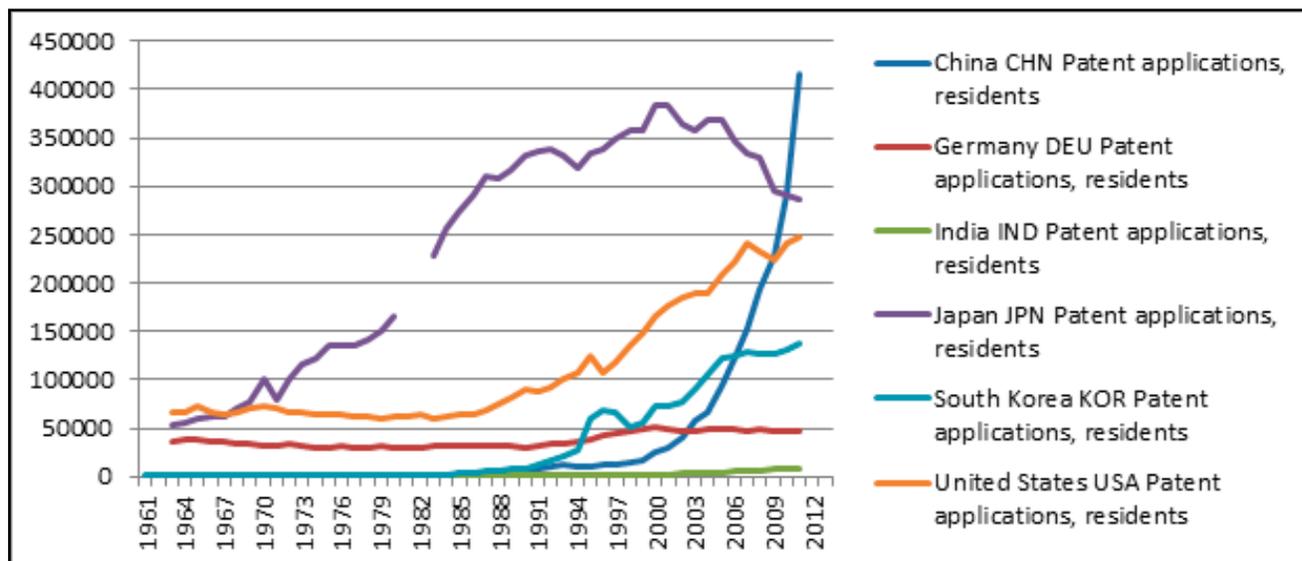
TABLE 4: TOP PLACES IN TERMS OF PATENT FILINGS	
China	526,412
United States	503,582
Japan	342,610
South Korea	178,924
Germany	59,444
India	42,291
Russia	41,414
Canada	35,111
Australia	25,526
Brazil	22,686
United Kingdom	22,259
France	16,754
Mexico	14,055
Hong Kong	13,493
Singapore	9,794
Italy	9,721
North Korea	8,057
South Africa	7,245
Israel	6,886
Malaysia	6,452

*Source: World Intellectual Property Organization data compiled in World Bank Patent and Intellectual Property Use Data, 2011*

In recent years, there have been higher numbers of patent filings in China. Both Chinese inventors and companies that operate there have generated ideas and sought patents for them. Figure 1 shows changes in patent filings between 1961 and 2011 for China, U.S., Japan, South Korea, Germany, and India. Of these nations, the most dramatic improvement has come in China. The number of Chinese patent applications annually went from a very few patent filings in the 1960s, 1970s, and 1980s to several hundred thousand in each of the last 10 years. The United States and South Korea also have risen over this time period, while Japan has fallen and Germany has been stable overtime.<sup>49</sup>

A number of these filings are focused on ICT and mobile innovation which are fast-growing sectors in China and many other parts of the world. New applications in health care, education, communications, and economic development are being developed and many inventors are filing patents in order to protect their ideas and help grow the overall economy. For example, Chinese clinics are deploying remote monitoring devices that record vital signs and transmit them electronically to doctors for review. Those patients needing medical care are referred to health providers for follow-up treatment.<sup>50</sup>

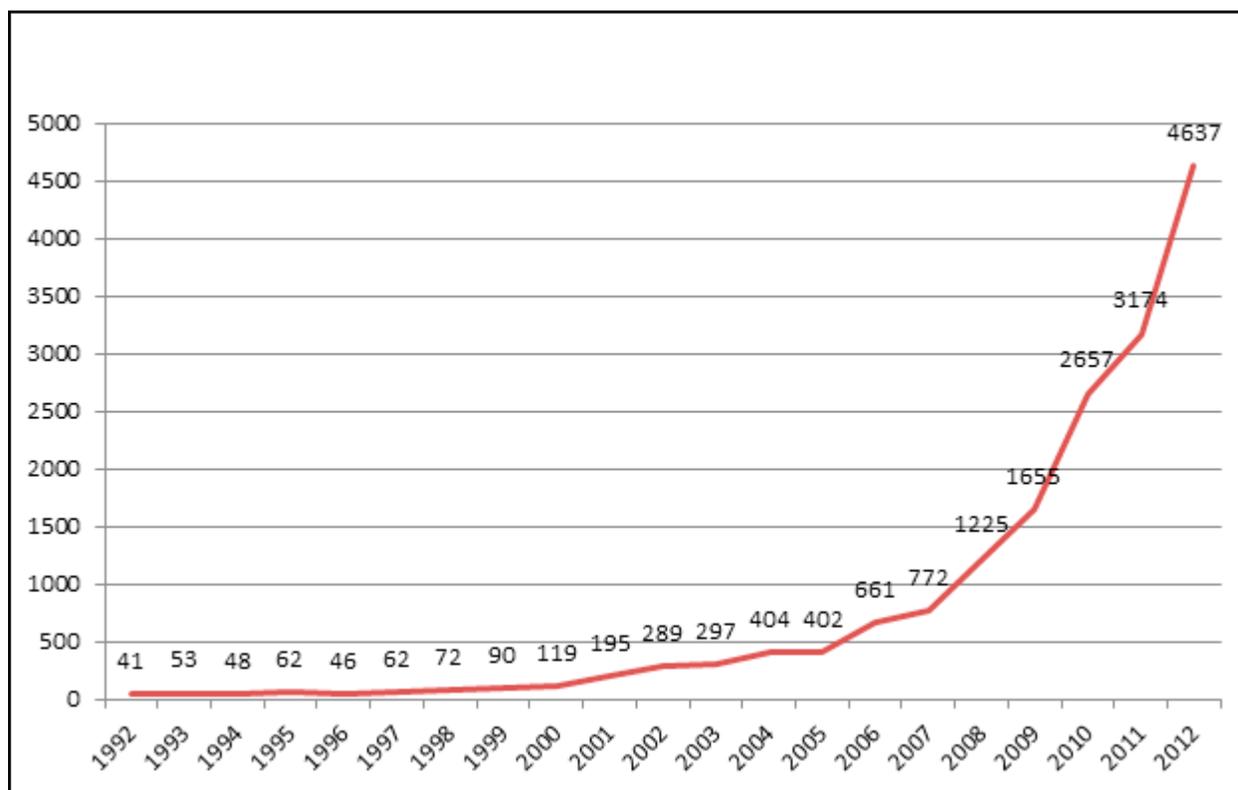
**FIGURE 1 PATENT FILINGS AROUND THE WORLD, 1961-2011**



Note: Gap in Japanese data for 1981 and 1982 from the World Bank Database.

In looking at Chinese patent filings within the United States over the past two decades, applications have also dramatically increased. Figure 2 shows the filings between 1992 and 2012, and we can see that the numbers have risen from 41 in 1992 to 4,637 in 2012. This demonstrates the attention that China is paying to patenting.

**FIGURE 2: CHINESE PATENT APPLICATIONS FILED IN THE UNITED STATES, 1992-2012**



## PUBLIC VIEWS ABOUT THE VALUE OF INVENTION IN DIFFERENT COUNTRIES

The mobile economy depends on infrastructure development and policy formulation. Yet the public also plays a role. Public attitudes about mobile innovation and how they use mobile devices affect company operations, government policy, and personal practices.

For these reasons, it is important to look at public perceptions. *Time* magazine conducted a survey of 6,133 consumers in coordination with Qualcomm Incorporated, on the topic of invention. Interviews were conducted in 17 nations to see how residents in each place view the climate for invention and economic growth. The online survey took place between September 2 and 27, 2013 with adults over the age of 18.<sup>51</sup> What consumers think matters because their views demonstrate prevailing attitudes within their particular societies. Comparing public views across nations reveals how cultures vary in impressions about invention and economic growth.

In general, people around the world think that invention has value and benefits people and that continued innovation is important to economic success. Table 5 lists the top places in terms of individuals who believe invention is important for their society. The top nations included China (at 95 percent), followed by Kenya (92 percent), India (91 percent), Sweden (89 percent), and Russia (86 percent). Differences in inventor perceptions reflect variations in how people in various nations view themselves and how much they emphasize invention. A country like China places great value on invention because its leaders understand the importance of new products for international

trade and economic development. It is one of the leading manufacturers and exporters around the globe and invention is crucial to the continuing prosperity of those activities.

TABLE 5: BELIEVE INVENTION IS IMPORTANT FOR SOCIETY (PERCENTAGE)	
China	95
Kenya	92
India	91
Sweden	89
Russia	86
South Africa	85
United States	81
Turkey	81
Brazil	80
United Kingdom	80
Australia	76
Indonesia	74
Mexico	73
United Arab Emirates	73
Germany	72
Singapore	60
South Korea	56

*Source: Time Invention Poll in Cooperation with Qualcomm, September 2-27, 2013, p. 26.*

Of course, there is a difference between seeing invention as important for society versus being an inventor oneself. Table 6 shows the percentage of people within each nation that thinks of him or herself as an inventor. The country with the highest percentage of self-perceived inventors was South Korea (at 94 percent). This is followed by Kenya (67 percent), South Africa (57 percent), Mexico (53 percent), and Indonesia (54 percent).

At the other end of the spectrum was Germany, where only 11 percent saw him or herself as inventors, followed by the United Kingdom (20 percent), Australia (22 percent), Sweden (23 percent), the United States (26 percent), and the United Arab Emirates (28 percent).

China is an interesting case because even though most of its residents place a high value on invention for its society as a whole, only about one-third of its citizens (32 percent) sees him or herself as an inventor. That suggests that people value the fruits of invention but do not see themselves as having the particular talent.

**TABLE 6: THINK OF SELF AS AN INVENTOR (PERCENTAGE)**

South Korea	94
Kenya	67
South Africa	57
Mexico	53
Indonesia	54
India	42
Brazil	36
Russia	33
China	32
Singapore	28
Turkey	28
United Arab Emirates	28
United States	26
Sweden	23
Australia	22
United Kingdom	20
Germany	11

*Source: Time Invention Poll in Cooperation with Qualcomm, September 2-27, 2013, p. 20.*

Many countries, especially those that export large numbers of goods and services think of invention as a major driver of economic growth. Table 7 looks at perceptions regarding invention as a driving force in economic growth. South Korea was the top nation at 71 percent, compared to China (68 percent), Indonesia (64 percent), United Arab Emirates (62 percent), and Russia (59 percent).

Less than half of the people who live in Australia, South Africa, and Germany think that invention drives economic growth. In the United States, 57 percent feel that invention is a big driver of economic growth. These variations are important because countries that make a concerted effort to value and pursue invention see innovation as a way to improve long-term economic development. Research suggests there is an association between invention, innovation, and economic growth. Nations such as South Korea, China, and Indonesia have among the highest growth rates in the world.

**TABLE 7: SEE INVENTION AS DRIVING ECONOMIC GROWTH (PERCENTAGE)**

South Korea	71
China	68
Indonesia	64
United Arab Emirates	62
Russia	59
Turkey	59
Kenya	58
United States	57
India	56
Mexico	55
Singapore	54
Brazil	50
United Kingdom	50
Sweden	50
Germany	49
South Africa	48
Australia	47

Source: *Time Invention Poll in Cooperation with Qualcomm, September 2-27, 2013, p. 29.*

## **PUBLIC BELIEFS REGARDING BARRIERS TO INVENTION**

Despite the importance of invention, there remain many barriers to mobile innovation. They include having a poor education system that does not focus on subjects that motivate and generate inventions, not devoting enough resources to R & D, or placing little value on invention and innovation. But believing that the government does little to protect inventor rights is a major barrier because it relates directly to possible incentives or disincentives for invention. If people think their government doesn't protect inventor rights, this will surely impact the level of innovation in that particular country.

Table 8 looks at countries whose population feels the lack of government protection for inventor rights is the biggest barrier to invention. Indonesia was the top country here at 31 percent, followed by South Korea (30 percent), China (21 percent), Russia (20 percent), and Turkey (18 percent). Living in a nation that fails to protect inventor rights limits the interest of people in those locales to invent novel products or services.

**TABLE 8: BELIEVE LACK OF GOVERNMENT PROTECTION FOR INVENTOR RIGHTS IS BIGGEST BARRIER TO INVENTION (PERCENTAGE)**

Indonesia	31
South Korea	30
China	21
Russia	20
Turkey	18
India	15
Brazil	13
Germany	13
Sweden	12
Australia	12
Mexico	10
Singapore	9
United States	8
South Africa	8
United Arab Emirates	8
Kenya	8
United Kingdom	6

Source: *Time Invention Poll in Cooperation with Qualcomm, September 2-27, 2013, p. 8.*

## CONCLUSION

In looking at developments in many different areas, it is clear that the state of the mobile economy is robust. Mobile technology represents a significant part of any modern economy. Through invention and innovation, new products and services are transforming entrepreneurship, education, health care, and governance, among other areas. Having a healthy mobile ecosystem is valuable for the global economy.

Mobile innovation creates opportunities in many sectors. By expanding access to capital, marketing, distribution, and sales on a global basis, handheld devices have transformed communications and commerce, as well as and made it possible for the smallest enterprises to participate in the global economy. It is especially helpful to women and minorities outside the social and economic mainstream.

In the health care area, virtually every nation confronts challenges in terms of access, affordability, and service delivery. Medical costs are consuming a rising share of resources and many people have difficulty gaining access to quality care. Unless these issues are addressed, it will hinder economic growth in some countries (such as China and the United States) and derail economic prosperity elsewhere (such as Africa, India, and Latin America). Mobile technology offers the potential to improve access to care while also constraining cost increases. The use of medical sensors and remote monitoring devices brings health care to people who currently have difficulty gaining access to physicians.

Education is a key to future prosperity, and mobile learning brings digital content and electronic resources to a broad range of students and teachers. Smartphones and online platforms provide access for all to participate in the global economy. The very same 21<sup>st</sup> century skills that are being learned in the U.S. and other developed countries can be accessed in developing countries. This expands opportunity and broadens the pool of those who benefit from the digital revolution.

Mobile enables governments to provide valuable services for the benefit of citizens and businesses in the global economy. Mobile technology allows people to access information and services around the clock. Digital tools also help governments reduce corruption and improve transparency and accountability in the public sector.

Despite the benefits of mobile technology, though, there are barriers to innovation. People and businesses in different countries vary considerably in their R & D expenditures, investments in mobile infrastructure, and incentives for invention. Some places invest more and have more robust safeguards that promote invention and protect inventors.

Looking forward, countries need to think seriously about providing incentives for invention. Those who develop new products and services should be able to benefit from their creations. Public opinion surveys demonstrate that the global public believes clearly invention and entrepreneurship are vital for social benefits and economic development. Creating a strong ecosystem for innovation and invention should be a top priority for leaders in every country.

In addition, it is important to invest in mobile infrastructure. Wireless demand is growing dramatically and businesses need to build out their networks so that people can access video and undertake transactions online. Multimedia applications are becoming more prevalent and it requires additional bandwidth and spectrum availability in order to take advantage of those areas.

Finally, it is vital for international standards to continue to play a constructive role in interoperable networks. One of the virtues of the mobile ecosystem has been that devices connect across companies and across national boundaries. Having technical experts who work out connectivity issues and develop workable solutions has been a tremendous boon to the industry as a whole. As the world continues to globalize, it is crucial to maintain the interoperability that allows all to participate in the global system.

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