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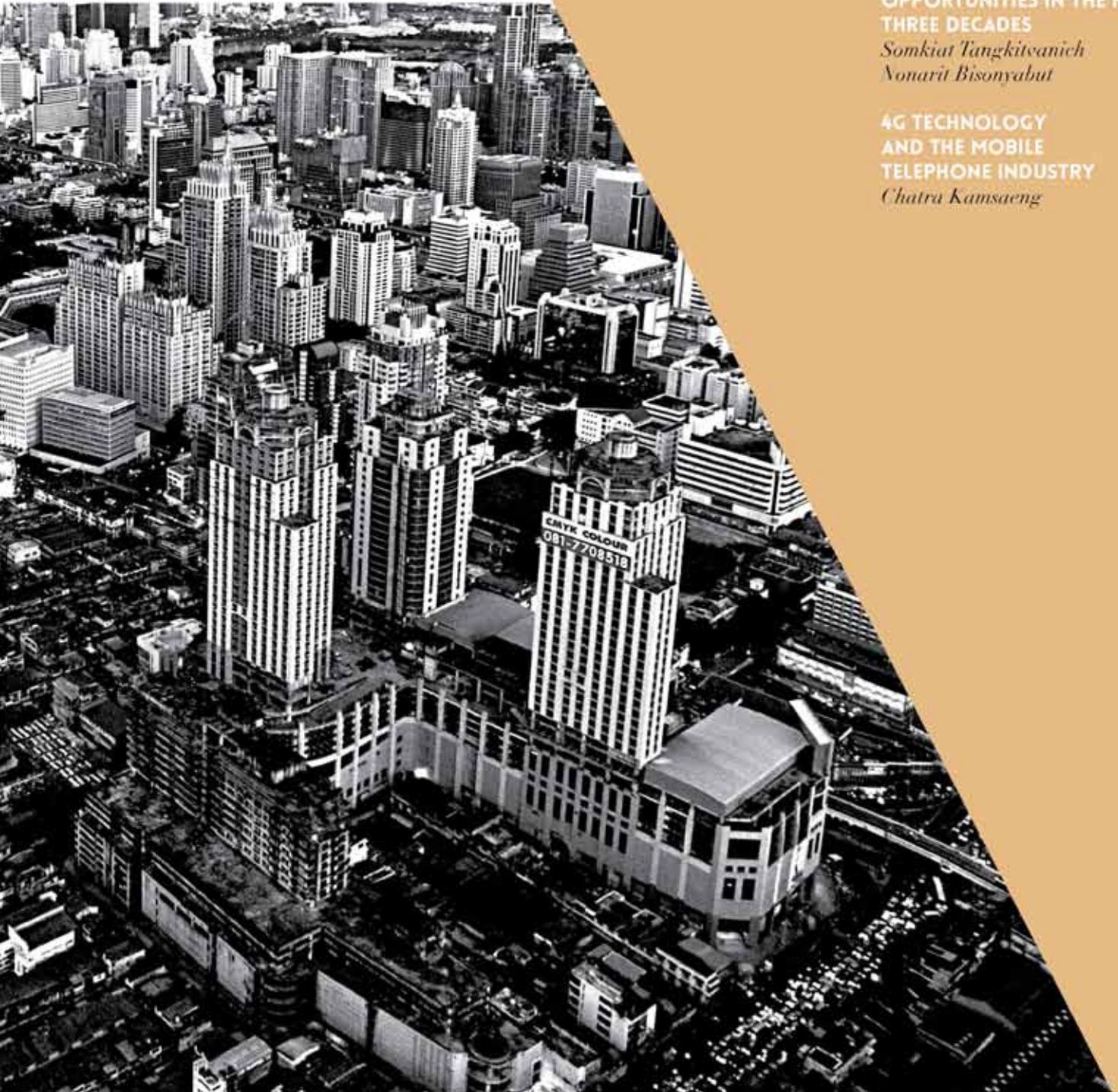
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TOWARD HIGH-QUALITY
GROWTH: THAILAND'S
CHALLENGES AND
OPPORTUNITIES IN THE NEXT
THREE DECADES

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4G TECHNOLOGY
AND THE MOBILE
TELEPHONE INDUSTRY

Chatra Kamsaeng



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CONTENTS

TOWARD HIGH-QUALITY GROWTH: THAILAND'S CHALLENGES AND OPPORTUNITIES IN THE NEXT THREE DECADES

*Somkiat Tangkitvanich
Nonarit Bisonyabut*

-PAGE 3

4G TECHNOLOGY AND THE MOBILE TELEPHONE INDUSTRY

Chatra Kamsaeng

-PAGE 16



TOWARD HIGH-QUALITY GROWTH: THAILAND'S CHALLENGES AND OPPORTUNITIES IN THE NEXT THREE DECADES*

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1. INTRODUCTION

In this article, a set of strategies will be presented for achieving long-term high-quality economic growth in Thailand. Here, high-quality refers to growth that is dynamic, stable, socially fair and environmentally sustainable. Challenges and opportunities for the country in the next three decades will also be discussed.

Owing to the prolonged political conflict in Thailand that has lasted for nearly a decade and recent global economic volatility, public and private sector leaders tend to pay attention mainly to short-term solutions instead of addressing structural and systemic challenges. These challenges include issues that are fundamentally important to the long-term growth of the country, such as how to escape from the “middle-income trap,” increase

the competitiveness of the Thai economy, improve the quality of education, and ensure environmental sustainability, as well as maintain monetary and fiscal discipline.

The United Nations has predicted that by 2045 the world’s population will have increased to 9 billion (United Nations, 2013). The continuous growth in the global population and increase in economic activities are bound to put enormous pressure on the environment and natural resources. Many environmental experts expect severe global climate changes to occur over the next few decades, which may trigger extreme weather events. Such changes would inevitably affect economic activities in all sectors, especially the agricultural and tourism sectors, which rely heavily on natural resources. Measures to deal with global climate change may result in international agreements to control greenhouse gas emissions that are stricter than the Kyoto Protocol.

With regard to foreign trade, within the next three decades, a number of large free trade agreements (“mega-FTA blocks”) will be established to regulate global trade instead of through the World Trade Organization (WTO). These mega-FTA

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blocks are expected to integrate many smaller current FTAs. Examples of such mega-FTA blocks are the Trans-Pacific Partnership (TPP), a free trade area between countries in the Asia-Pacific region and the Americas; the Regional Comprehensive Economic Partnership (RCEP), an agreement between countries in East Asia and the Oceania region; and the Transatlantic Trade and Investment Partnership (TTIP), a free trade area between countries in the European Union and North America.

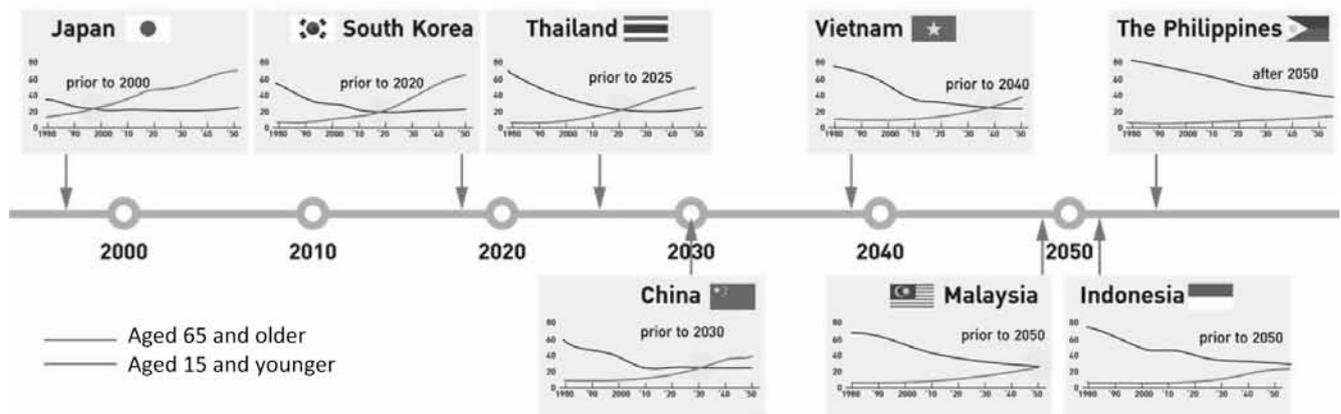
Some countries will experience higher growth rates than their peers in the same income groups. In his best selling book Ruchir Sharma called these countries “breakout nations” (Sharma, 2012). As these countries grow, it is inevitable that they will play more prominent roles on the global stage. Sharma predicted that in the per capita income group of US\$ 20,000-25,000, the breakout nations will be South Korea and the Czech Republic. In the group with per capita income between US\$ 10,000 and 15,000, the breakout nations will be Poland and Turkey. Among countries with per capita income less than US\$ 5,000, the breakout nations are the Philippines, Indonesia, India, and Nigeria. However, it is still unclear which countries in the income range between US\$ 5,000 and 10,000,

the income level which characterizes Thailand, are going to stand out. It will be argued in this article that, unless Thailand radically transforms itself, the country will not only be unable to break out but will also face a number of difficulties.

2. THAILAND IN A COMPLETELY AGED SOCIETY

Under the medium-fertility scenario, the United Nations anticipates that Thailand is going to become a completely aged society around 2025, when 20 percent of its population will be aged 60 or older. In comparison with other Asian countries, Thailand will become a completely aged society faster than most countries, except Japan and South Korea. However, both of the latter countries have already reached high-income status, while Thailand is still a developing economy. Thailand’s population aged 65 or older will be equal in number to those aged 15 or younger by 2025. On the other hand, China, Vietnam, and Malaysia are going to reach that stage in 2030, 2040, and 2050, respectively. The Philippines and Indonesia will not reach that stage even in 2050, almost three decades after Thailand (Figure 1).

Figure 1 Years when numbers of youths and seniors become equal in Asian countries



Source: Magnus (2014).

As the birth rate in Thailand declines, the country's total population is predicted to decrease to about 63.8 million by 2045, a situation which is likely to create a severe shortage of labor. In addition, as the country rapidly approaches an aged society, the result will be bankruptcy of the social security fund around the year 2045. Such an outcome could be prevented only if the fund is drastically reformed in due time. Huge fiscal burdens will also increase as the cost of health care rises, while the number of people paying taxes decreases.

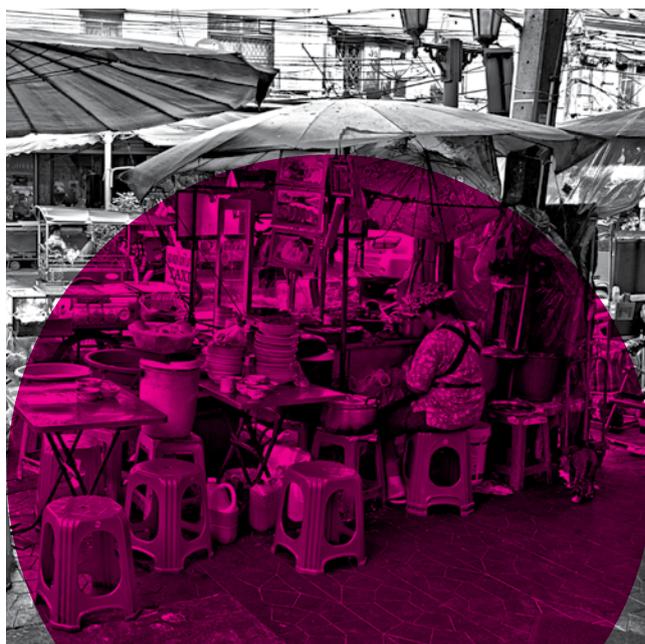
In conclusion, Thailand is going to face various issues as the country becomes an aged society. This will have a large negative impact on the economy. Thus, Thailand must develop its economy and escape the so-called middle-income trap (Box 1) in the next decade, or else the Thai demographic structure will become aged before the country becoming affluent enough to afford an adequate social safety net to accommodate these issues.

Box 1 Escaping the “middle-income trap”

Countries often have lower rates of economic growth when their income level increases. In the past, many middle-income countries' rate of growth significantly decreased well before their income levels approached that of a high-income country. As a result, they were unable to transition into the high-income group and became stuck in the so-called “middle-income trap.”

In this article, the current threshold between the middle and high-income level was US\$ 12,745 in 2013. It is assumed that the threshold will grow by 1.37 percent per year, based on the average rate of growth during the last five years.

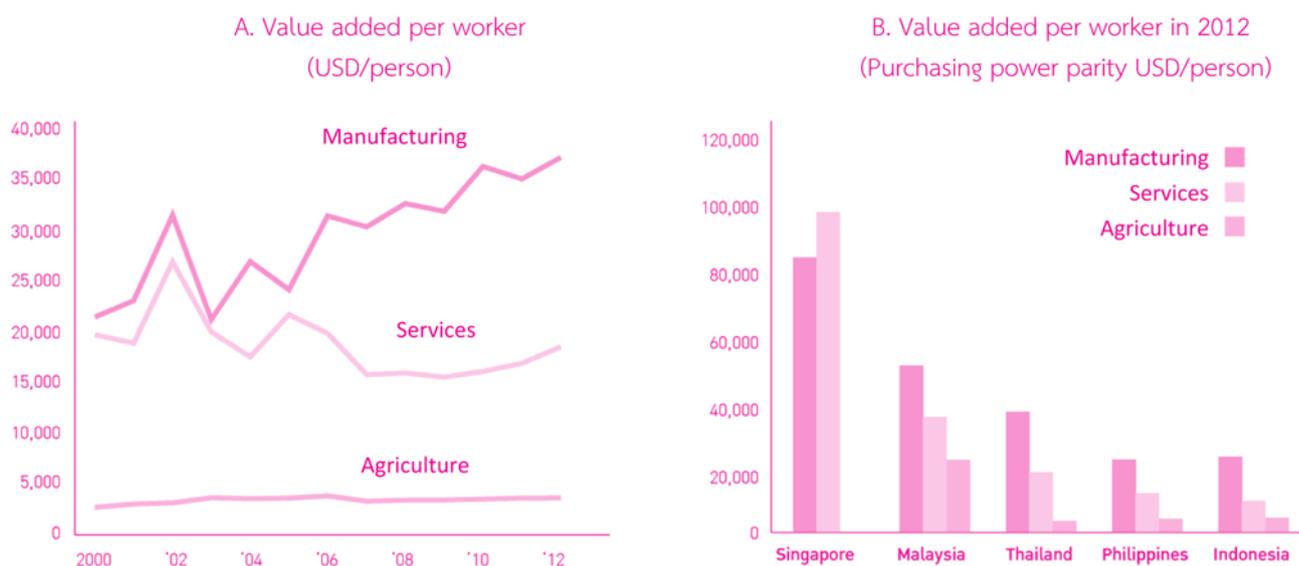
Thailand appears to be in the midst of a prolonged middle-income trap and unable to escape from it. This is because it has industrialized without developing its own technological capability; instead



it emphasizes exporting by suppressing labor wages in order to be competitive in the global market. This developmental model thus means that a large number of people in Thailand have both low income and low purchasing power. As a consequence, the Thai economy is characterized by significant income inequality and is vulnerable to fluctuations in the global economy. Such income inequality also causes political parties to campaign on populist policies to appeal to this population group. Finally, the current development model is also not environmentally friendly as businesses prefer to suppress production costs as much as possible rather than to protect the environment.

In short, Thailand may have successfully shifted from a development model centered in the past on exploiting natural resources to transition toward a model built upon efficiency. However, in the near future, Thailand will have to concentrate on developing its economy based on knowledge and innovation should it want to transition to become a high-income country.

Figure 2 Labor productivity in various economic sectors



Source:IMD (2014).

3. SCENARIOS FOR BUILDING ECONOMIC GROWTH FOR THE FUTURE

Enhancing economic growth can be achieved simultaneously in two ways: migration of workers from sectors with low productivity to ones with higher productivity, and improving productivity within each sector. Figure 2 shows labor productivity in each of Thailand’s economic sectors, namely the agricultural, manufacturing, and service sectors. It also compares Thailand’s labor productivity to that of other countries in the Association of South-east Asian Nations (ASEAN). The Figure shows that manufacturing is the sector in Thailand that has the highest productivity, followed by the service and the agricultural sectors. However, in all these three sectors, Thailand’s value added per worker is lower than that of Singapore and Malaysia. Thus, a key to Thailand’s economic development is to increase labor productivity in all sectors and to transform itself toward sectors with higher productivity.

In this section, three possible scenarios are

described to demonstrate the opportunities and challenges that Thailand will be facing in the next three decades. These scenarios are:

- 1 “Business as Usual”
2. “Advanced Manufacturing Economy”
3. “Modern Agriculture and Knowledge-based Services”

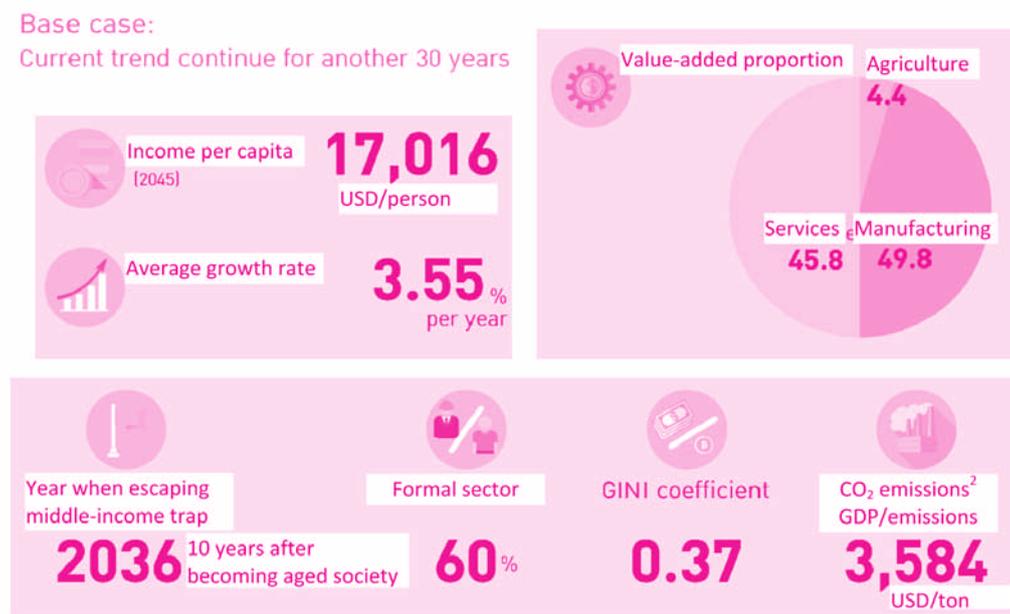
Each of these scenarios takes a unique path and has different developmental outcomes. Each also requires different inputs and supporting factors. The scenarios are based on a simple economic model constructed by the authors. The model takes into account three sectors of Thailand’s economy and the imminent change in Thailand’s demographic profile to mimic reality as closely as possible (see details of the model and assumptions in the Appendix).

3.1 Scenario 1 “Business as Usual”

This scenario is a continuation of Thailand’s current development strategy. However, the annual growth rate under this scenario will gradually



Figure 3 Thailand in 2045 under the first scenario “Business as Usual”



decrease to 3.55 percent for the next three decades, compared with the average growth rate of 4.3 percent during the period 2009-2013. In our simulation, Thailand’s per capita income will be US\$ 17,000 in 2045. The country is projected to escape the middle-income trap by 2036. That is, the country will be a completely aged society 10 years prior to becoming a high-income country.

Under this scenario, the share of labor in the formal sector will increase from 40 percent to 60 percent by 2045 while the Gini coefficient will be 0.37, slightly lower than the current level. This lower Gini coefficient is due to the democratic pressure to redistribute income. However, from an environmental perspective, the current development model will result in a high level of greenhouse gas emissions. In particular, a ton of carbon dioxide (CO₂) will be emitted for every US\$ 3,584 increase in GDP (Figure 3).

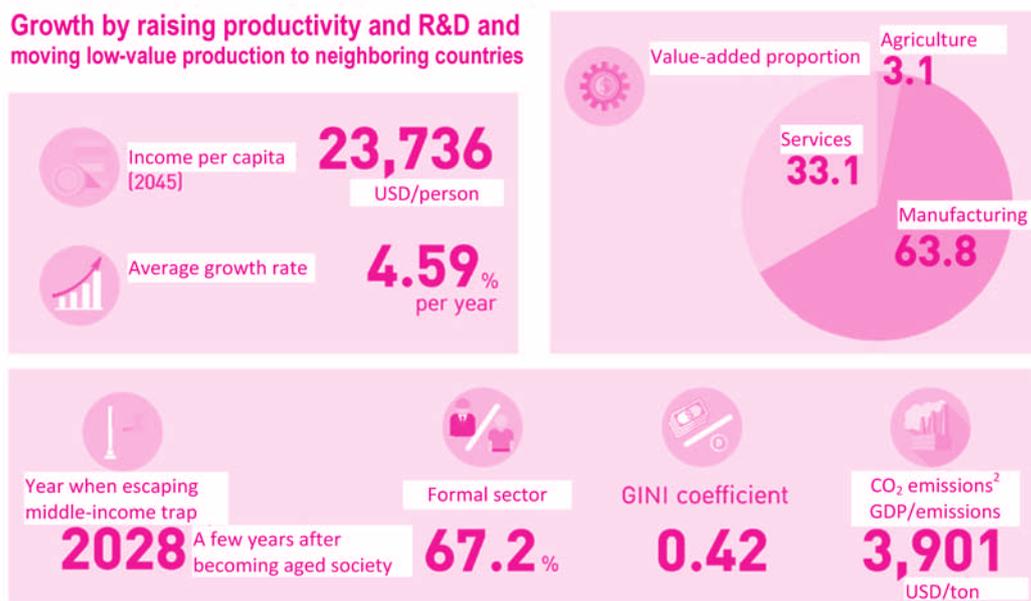
However, it would be very optimistic to forecast that Thailand will transition into a high-income country by 2036 as in the above projection many risks associated within its transition have not been considered. Examples of such risks and their impacts on the transition delay are (see the assump-

tions used in the Appendix):

- Severe climate change would delay the transition for two years due to its impact on the agricultural and tourism sectors.
- Increased fiscal burden due to the rising cost of health care would result in another two-year delay in transition as higher government spending crowds out public investments.
- Assuming an annual cost of 100 billion baht to implement certain “populist policies,” the transition would be delayed for about four years due to the rising fiscal burden.
- Based on historical data, in the event of an exchange rate or banking crisis, the transition would be delayed about two and four years, respectively.
- If severe political conflicts occur, the transition would certainly be delayed. The length of the delay would depend on the severity of the conflict, which is difficult to estimate.

Therefore, if such risks are not properly managed, under the first scenario Thailand may remain in the middle-income trap for at least three more decades.

Figure 4 Thailand in 2045 under the second scenario “AdvancedManufacturing Economy”



3.2 Scenario 2: “Advanced Manufacturing Economy”

In this scenario, Thailand’s economic development would be driven by elevating its productivity in the manufacturing sector. This can be achieved by implementing lean manufacturing, conducting more research and development (R&D), creating companies’ own brands and creating intellectual property, instead of relying on outsourced work. At the same time, low value-added production should be outsourced to neighboring countries that offer lower wages.

In this scenario, per capita income is estimated to be around US\$ 23,700 in 2045, as a result of the average growth rate of 4.6 percent per year. This also means that Thailand would escape the middle-income trap around 2028, or 3-4 years after becoming a completely aged society. An advanced-manufacturing economy would change the Thai economic structure by increasing the contribution of the manufacturing sector to 64 percent of GDP. The ratio of labor in the formal sector would rise accordingly to 67 percent of the total labor force.

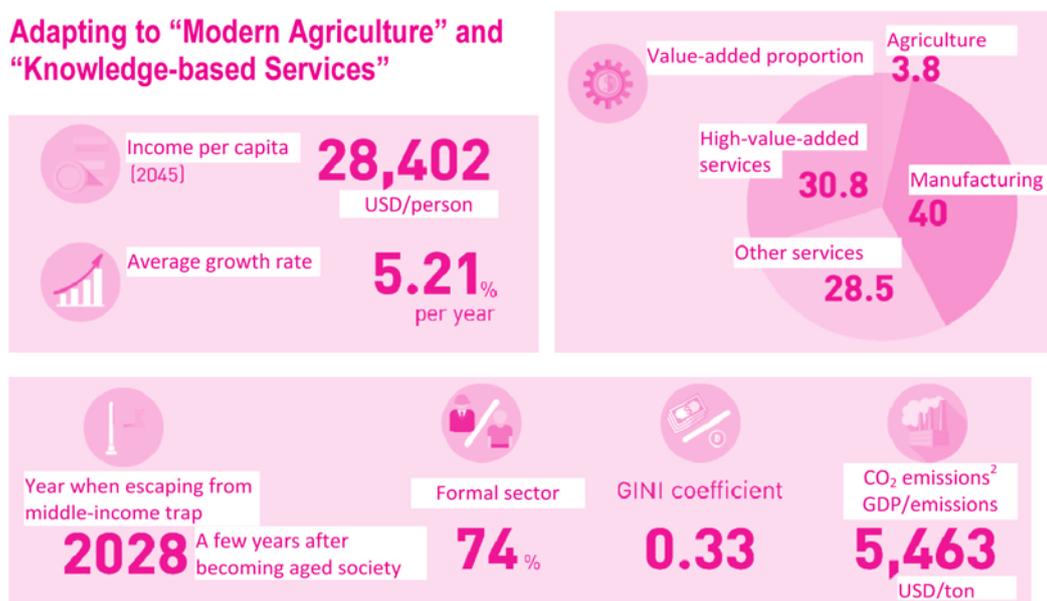
However, the emphasis on developing the manufacturing sector in this scenario could lead to

an increase in the Gini coefficient to 0.42. This is because most gains from industrialization would be in the form of increased corporate profits, rather than higher wages for workers. Furthermore, greenhouse gas emissions, especially CO₂, would be increased as the manufacturing sector is the most energy-intensive among all production sectors (Figure 4).

For Thailand to be successful under this scenario, the government must undertake a number of policy measures to support the transition, including developing physical infrastructure, especially transportation and telecommunication systems, to lower the operating cost of Thai manufacturers and enable them to compete in the global market, producing sufficient numbers of qualified engineers and technicians, encouraging the private sector to implement lean manufacturing, and providing businesses with incentives to invest, innovate and create intellectual property and branding. The government should also promote the outsourcing of low-value-added activities to neighboring countries.

On the other hand, the government should not encourage low-skilled foreign workers to work in Thailand as that would make the country dependent on cheap labor and discourage industrial upgrading.

Figure 5 Thailand in 2045 under the third scenario “Promoting Modern Agricultural and Knowledge-based Services”



3.3 Scenario 3: “Promoting Modern Agriculture and Knowledge-based Services”

Under this scenario, Thailand would simultaneously transition from traditional to modern farming and from traditional services (which have low labor productivity) to knowledge-based services (which have higher labor productivity). The twin transition would enable the per capita income to reach US\$ 28,400 in 2045, as a result of reaching an average growth rate of 5.2 percent per year. The country would escape the middle-income trap in 2028, or 3-4 years after becoming a completely aged society. In this scenario, the share of the service sector would reach 59.3 percent of GDP, with the share of knowledge-based and traditional services constituting 30.8 and 28.5 percent of GDP, respectively. The share of the agricultural sector would account for only 3.8 percent of GDP.

The focus on developing the service and agricultural sectors would reduce the Gini coefficient to 0.33 due to an increase in relative income for workers versus that of capital owners. Moreover, greenhouse gas and CO₂ emissions per unit of GDP would be greatly reduced as the service sector is less energy-intensive than the manufacturing sector (Figure 5).

The development from traditional to modern agriculture could be achieved through the use of machinery in large farms, precision farming technologies (such as the Global Positioning System (GPS), Geographic Information System (GIS) and sensors), more efficient supply-chain management, logistics, marketing and research and development, especially in the areas of life sciences and food safety. In addition to mainstream modern agricultural sectors, organic farming and other high-value-added but labor-intensive farming can also coexist. The size of the latter would grow with the demand from high-income consumers who would likely become more and more conscious of their health and the environment.

There are important policy measures the government should take to develop the modern agricultural sector: effective management of water and natural resources, compliance with food safety standards, research and development, and the provision of effective extension services for farmers. In addition, capacity-building should also be provided for farmers to become “smart farmers,” in particular in the areas of new production technology and control of inputs, such as fertilizer, pesticide, and animal medicine.

On the other hand, the government should refrain from subsidizing farmers too much as it would incentivize them to concentrate on the quantity rather than the quality of their products. In addition, the government should not encourage farmers to produce agricultural products without properly considering the long-term demand for and supply of the products, especially those for which Thailand does not have a clear comparative advantage. In addition, there should be a mechanism to reduce conflicts in contract farming, especially by protecting small farmers from any unfair exploitation.

With regard to the service sector, the country should move from traditional services, such as hospitality, restaurant, spa, and traditional retail businesses that utilize low-skilled workers and limited technology, to “knowledge-based” services that include:

1. Modern services that employ skilled workers and advanced technology, which are highly tradable, including finance, telecommunication, and business services.
2. Social services, for instance, health care, education and governmental services, which also use skilled workers but utilize less technology. These services are also tradable through the mode of consumption abroad, as described below.

According to the classification of WTO, there are four modes of trade in services which can be applied to the export of modern services:

1. Trade through cross-border supply, for example, exporting software and digital content (games and animation) to consumers in other countries through the Internet or other electronic media.
2. Trade through consumption abroad, for example, providing special-interest tourism services, including cultural and medical tourism, which involve higher spending per person than traditional tourism.
3. Trade through commercial presence, for example, establishing Thai-owned hospitals

in neighboring countries through greenfield investments or acquisitions.

4. Trade through the mobility of business people, for example, sending to neighboring countries Thai engineers, technicians and quality control consultants to improve production processes in factories.

To develop the Thai economy into a knowledge-based service economy, the government should focus on developing general skills through high-quality tertiary education. This is because a knowledge-based service economy requires workers who have general problem-solving skills, an ability to communicate, and creativity, instead of specific skills needed by the manufacturing sector.

In addition, the government should upgrade the country’s information infrastructure and business environment. This can be done by liberalizing the service sectors, especially telecommunication and business services, which are important inputs for other service sectors, as well as the manufacturing sector.

The government should also encourage the movement of skilled workers and professionals from abroad to work in Thailand. This would facilitate the transfer of technology and knowledge to Thailand and enable the country to build larger knowledge-based service sectors. At the same time, the government should refrain from protecting certain service sectors because that would result in monopoly, limited competition, or inefficiency, which would increase the cost of doing business in Thailand.

There are a few cautions in the transition to a service economy. First, the improvement in economic equality will not be automatic but will depend on the proportion of workers in each service sector. For example, in the United States, which has a large service industry, income inequality persists due to a large proportion of low-wage service workers while the rest of the workforce belongs to the knowledge-based service sectors, which provide high compensation. Public investment in higher



education is another factor that will determine the level of income inequality in the service economy. Income disparity will be higher if households, instead of the government, bear most of the costs related to higher education.

Second, having a large financial sector without prudent regulation and supervision could lead to financial crises, as exemplified by the United States and other countries in 2008/09. In addition, an increase in medical tourism could reduce access to medical services for low-income Thai patients. This problem will arise as the country does not have enough medical professionals, at a time when foreign medical professionals are not allowed to work in Thailand.

4. TOWARD HIGH-QUALITY GROWTH: CHALLENGES AND OPPORTUNITIES IN THE NEXT THREE DECADES

Table 1 compares the current economic indicators for Thailand (2014) with the projections for 2045 under the three scenarios previously discussed. The third scenario, “Modern Agricultural and Knowledge-based Services,” produces the most desirable outcome. First, this scenario brings about the highest economic growth rate, which would enable the country to escape the middle-income trap by 2028, just a few years after Thailand becomes a completely aged society. In addition, the per capita income in 2045 under this scenario is higher than that of the two other scenarios. Furthermore, the level of economic inequality and the intensity of greenhouse gas emissions are the lowest among the three scenarios.

However, Thailand’s current economic structure is more similar to the second scenario than to the third, as the manufacturing sector makes the largest contribution to the country’s GDP. As a result, the second scenario would be easier to achieve than the third. Therefore, during the transition, the most probable scenario is likely to be a mixture of the second and the third scenarios. The link between the two is the business service sector that supports



Table 1 Thailand under various scenarios in 2014 and 2045

Indicator	Current (2014)	“Business as Usual” (2045)	“Advanced Manufacturing Economy” (2045)	“Modern Agriculture and Knowledge-based Services” (2045)
Average GDP growth rate (% per year)	5.94	3.55	4.59	5.21
Real income per capita (USD)	5,480	17,016	23,736	28,402
Year when escaping the middle-income trap		2036	2028	2028
Contribution to GDP (%)				
- Agriculture	12.3	4.4	3.1	3.8
- Manufacturing	37.9	49.9	63.8	37.0
- Services	49.8	45.8	33.1	59.3
Traditional services	39.1			28.5
Knowledge-based services	10.7			30.8
Gini coefficient	0.39	0.37	0.42	0.33
Labor share (%)				
- Formal sector	40.2	60.4	67.2	73.9
- Informal sector	59.8	39.6	32.8	26.1
Labor share (%)				
- Agriculture	34.9	16.5	13.1	13.0
- Manufacturing	15.6	15.7	12.0	16.7
- Services	49.4	67.8	75.5	70.3
Traditional services	43.3			59.4
Knowledge-based services	6.1			10.9
CO ₂ emissions (millions of tons)	329,973	522,671	669,932	572,359
CO ₂ emissions per capita (tons/population)	5.17	8.19	10.20	8.97
GDP per unit of emitted CO ₂ (USD/ton)	1,109	3,584	3,901	5,464

Source: Authors' estimation.

manufacturing activities. Likewise, the processed food industry connects the manufacturing and the agricultural sectors.

All in all, the future of Thailand under any of the desirable scenarios depends on the following four factors:

1. Human capital: The most important challenge is to develop high-quality human capital. On one hand, manufacturing industries need specialized skills to improve productivity in the long run, which in turn requires a low turnover rate of workers. On the other, the service sector needs general problem-solving skills, which in turn requires a strong higher education sector. Thailand's best response to this challenge is to equip its citizens with “21st century skills” (see Bellanca and Brandt, 2010) and promote life-long learning.
2. Capital: the allocation of capital in the economy must create incentives to increase productivity from research, development and innovation, rather than encouraging speculation in non-tradable sectors, such as real estate. To promote funding in innovative activities, a combination of grants from the government, credit from banks and venture capital are needed.
3. Management: the public sector needs to be radically reformed to support the private sector in increasing its productivity. To be more specific, the government should not be too large to crowd out the private sector and must be accountable in helping the market to function properly. Fiscal discipline is also a necessary pre-condition.
4. Market: the open global economy mandates

Thailand to develop its trading and investing capability in addition to production capability. The country should start by connecting with its ASEAN neighbors before progressively integrating into the global economy.

Finally, the transformation of the Thai economy in the next three decades will inevitably create a more diverse and complex society. Diversity and complexity could lead to tensions and conflicts due to the increased variability of individual interests, beliefs, and ideas (Saxer, 2014). Conflicts will be unavoidable if the government remains centralized, fragmented, closed and undisciplined. The transition will be smooth only if the government is open, disciplined, balanced, and able to coordinate with various stakeholders effectively. Therefore, the most important challenge in this long transition will be reform of the public sector.

APPENDIX: MODEL FOR THAI ECONOMY IN THE NEXT THREE DECADES

GDP is the sum of the products of productivity in each sector, proportion of workforce for each sector in the population and the population. The following equation captures the aforementioned idea.

$$GDP = \sum_{sector} \frac{VA_i}{L_i} \times \frac{L_i}{L} \times L$$

Productivity in each sector is the value added per worker in the *i*th sector ($\frac{VA_i}{L_i}$). The three sectors in consideration are agriculture, manufacturing and services.

The proportion of the workforce in the *i*th sector ($\frac{L_i}{L}$) is based on historical data while its future value is estimated by the rate of mobility between sectors.

The size of the population (*L*) is based on estimates under the United Nations medium-fertility scenario. In addition, there are the following exogenous variables:



- The rates of labor mobility among the agricultural, manufacturing and service sectors.
- The rate of growth in labor productivity in each of the three sectors.

Exogenous variables are determined based on:

- Historical trends.
- Expert opinions from macroeconomic experts and experts in each economic sector.
- Actual data from the role model countries, such as South Korea (for the second scenario) and the United States (for the third scenario).

Impacts from risks that may delay the transition out of the middle-income trap are based on the following assumptions:

- Severe climate change resulting in a 10 percent decrease in GDP. This is a one-time effect (Stern, 2007).
- Medical care costs will create a loss in investment opportunities, which is equivalent to 6 percent of GDP with a fiscal multiplier of 1 (Splimberg et al. (2009) and Ilzetzki et al. (2010).
- Populist policies with a fiscal cost of 100 billion baht per year will result in a 1 percent drop in sectoral productivity in all economic sectors.
- Currency and banking crises generally require an economic recovery time of 2-3 and 3-5 years respectively (Reinhart and Rogoff, 2011).

Appendix Table 1 Five exogenous variables used in model

Assumption	“Business as Usual”	“Advanced Manufacturing Economy”	“Modern Agriculture and Knowledge-based Services
Rate of labor mobility (percentage per year)			
Migration from agriculture	-2.30	-3.00	-3.03
Migration from manufacturing	0.00	-0.60	0.20
Rate of labor productivity (percentage per year)			
Agriculture	4.99	5.68	7.00
Manufacturing	6.88	9.74	7.38
Services	4.47	4.17	6.89

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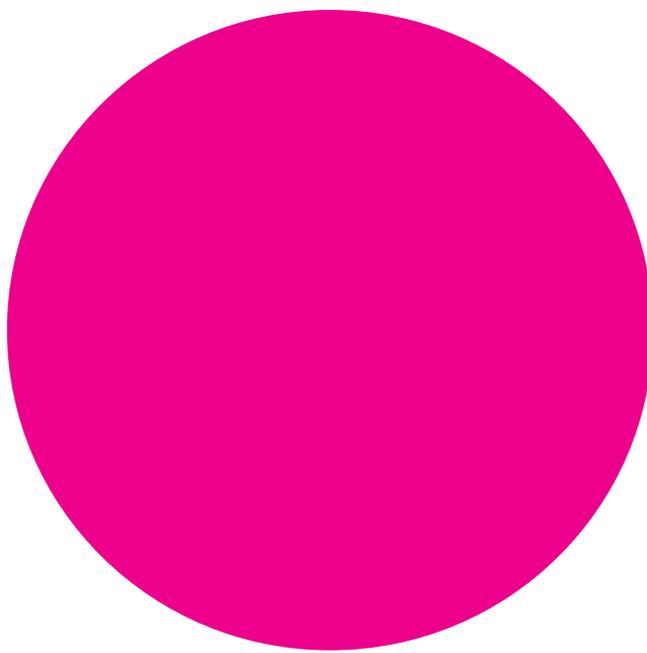
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4G TECHNOLOGY AND THE MOBILE TELEPHONE INDUSTRY

*Chatra Kamsaeng**

1. INTRODUCTION

The telecommunications industry underwent a major structural change in 2009 when 3GPP, a group of telecommunications standard development organizations, announced a global standard for Long-term Evolution (LTE) technology. This marked the initiation of the fourth generation (4G) of mobile telephone technology characterized by ultra-broadband Internet access via mobile devices. Since then, LTE has been commonly commercialized as 4G LTE technology. The new technology fosters digital convergence (convergence of telecommunications, information technology, electronics and entertainment), which exposes mobile phone operators to competition from content service providers, or over-the-top (OTT) services.¹

This 4G technology poses a threat to the profitability of mobile telephones in various coun-

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¹ *Consisting of OTT content and OTT messaging. OTT content refers to the delivery of audio, video and other media over the Internet without a system operator, such as a mobile operator, controlling the distribution. Consumers can access OTT content through multiple devices, including laptops, desktop computers and so-called smart phones.*

tries because of its markedly higher mobile Internet speed and its substantially improved quality of services. For example, the short messaging service (SMS)—to a large extent—has been replaced with online messaging applications, such as Whatsapp, WeChat and Line, which are usually available free of charge. Most messaging applications boast the provision of free voice and/or video calls as well. According to Bloomberg, China Mobile is blaming WeChat, the largest Chinese instant messaging application, for creating financial difficulties for the company. Moreover, Ovum reported that the mobile network industry in advanced European countries, such as the United Kingdom, Germany, and Switzerland, as well as some Asian countries have experienced a decline in revenue for this industry. Also, in the United Kingdom, Everything Everywhere slashed the price of its data plan to about two-thirds that of its competitor's comparable plan, which might trigger a price war. Undoubtedly, the introduction of 4G technology has had a non-trivial impact on the competition landscape of the telecommunications industry and thus the strategies of telecommunications companies (telcos).

The purpose of this article is to conduct an





empirical study in order to assess the effect of this specific technological innovation on market competition by focusing on the wireless telecommunication industry in 55 countries.² The method of estimation, the fixed-effect model, controls for country-specific economic conditions and market environment such that the direction and the size of the impact of 4G technology can be isolated and verified.

The article is organized as follows: section II contains a description of the 4G technology standard. The third section illustrates the impacts of 4G on the mobile industry. Estimation results are reported in section IV. Finally, conclusions are presented with a brief description of implications.

² Countries included in the study are as follows: Angola, Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, Egypt, Finland, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Kenya, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Philippines, Poland, Portugal, Russia, Saudi Arabia, Singapore, Slovakia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Tanzania, Thailand, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States, and Vietnam.

2. 4G TECHNOLOGY STANDARD

Telecommunications technology researchers have revolutionized technology standards from analog (1G) to digital (2G), and from 3G to 4G currently. According to Ofcom (United Kingdom telecommunications regulator), 2G technology was optimized for voice communications and text messaging. The introduction of 3G enabled Internet connection via mobile devices. Although 4G technology does not provide any new feature for subscribers, it facilitates ultra-high-speed data transmission on mobile devices. Peak download speed is boosted to 100 megabits per second (Mbit/s), which is almost five times faster than the previous standard, namely HSPA+. Peak uplink speed is about eight times faster. Broadband communications facilitate speedier Internet browsing as well as ease of access to OTT services, such as social networking, voice over Internet protocol (VoIP) and video streaming, via the mobile platform. Voice over LTE (VoLTE) technology deploys a new multimedia system and transmission technique, promoting richer and clearer voice calls. In short, the latest technology enables much more efficient

and less costly data communications (Gupta and Patil, 2009).

For operators, employing 4G can substantially reduce operating costs because of its superior spectral efficiency (using less spectrum for the same amount of data transmission) and the most advanced bandwidth-sharing technology. The cost of transmitting data through LTE is estimated to be half that with HSPA+, according to Capgemini (2011). The superior efficiency of 4G technology enables operators to carry 45 VoIP users per MHz as opposed to 25 users per MHz on the 3G standard. More capacity over less bandwidth provides a clear competitive edge over previous technology standards.

How does 4G technology change competition in the telecommunications industry? For a number of reasons, market concentration is possibly reduced due to the deployment of 4G technology.

First, because of its superior spectral efficiency, 4G technology may help reduce the resources required for providing the same services and, hence, the minimum efficient scale (MES), the size of a firm operating at the most efficient level. A smaller MES implies that smaller firms can operate efficiently, allowing in more suppliers in the long run.

Second, because the Internet acts as a platform for valued-added data services, speedier access to the Internet on multiple mobile devices can accelerate competition among OTT communication providers. High-speed data transmission enhances the quality and reliability of VoIP such that it becomes a near-perfect substitute for traditional voice transmission services provided over a public switched telephone network (PSTN). The ability to synchronize data across different devices, such as iPhones, iPads, and computers, is another attractive feature of OTT. Thus, users with only computers but no phones can communicate with one another without involving mobile operators. Most importantly, however, many forms of data and voice communications over the Internet, such as Line, Skype, Facetime, and WeChat, are free of charge as they derive revenue from advertisements and/or

sales. Undoubtedly, the Internet-based communications technology afforded by OTT providers eats into the market share of traditional infrastructure-based telcos. Thus, such technology results in a less integrated mobile service market with more layers of competition.

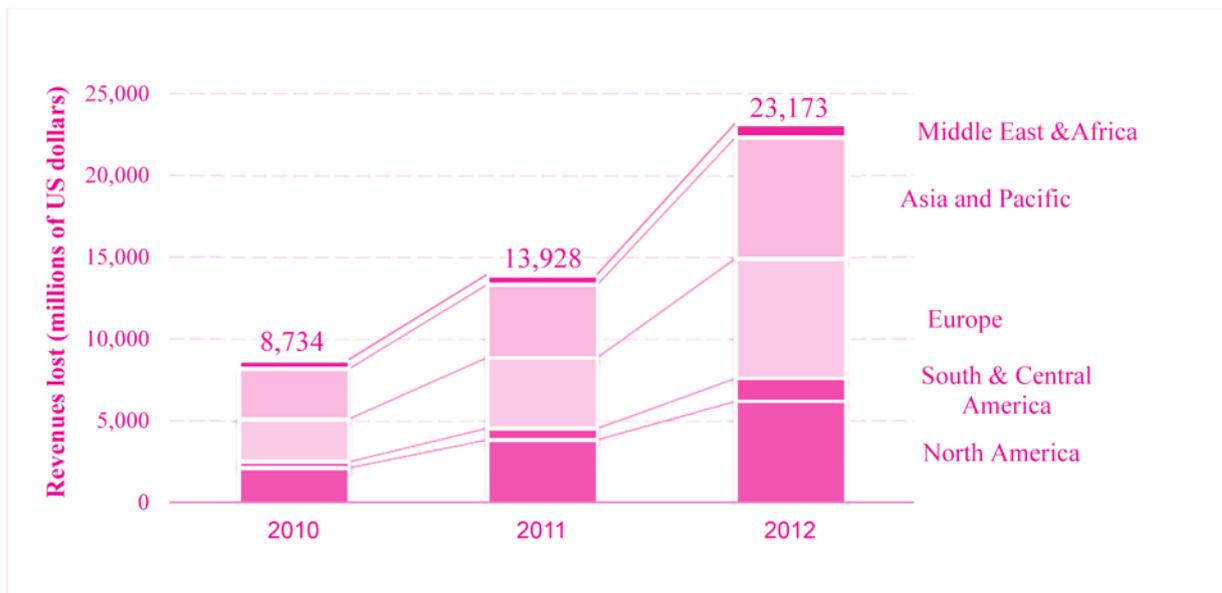
Another benefit stems from the interoperability of LTE technology (Gupta and Patil, 2009). Since LTE dominates 4G technology, there is a unique global standard which enhances mobility and service portability across borders. The technology also leads to digital convergence, meaning the coexistence of voice, data communications and multimedia in a single network with a universal standard. Better interoperability and convergence should increase the ease of switching from one provider to another, thereby enhancing competition in the market.

On the other hand, Sutton (1999) pointed out that innovations which improve the quality of services or reduce marginal costs may lead to greater market concentration, because producers who offer superior-quality products at lower cost will likely gain market share. In addition, large capital investment is still necessary to be able to operate a 4G network, that is, the cost of new infrastructure and operating license. Because profitability tends to fall for the reasons explained previously, the incentive of new telco to enter the market will be lower. The traditional mobile market is likely to undergo consolidation as a result of the new mobile technology.

3. IMPACTS ON THE MOBILE NETWORK INDUSTRY

So far, data service has begun to put pressure on traditional services; for instance, mobile Internet access has cannibalized revenue from SMS. Growing numbers of social messaging applications combined with the spread of smartphones encourage people to replace traditional texting with online applications. Ovum has reported a significant upward trend in social messaging usage: in the first quarter of 2013, 10 billion messages were sent daily

Figure 1 SMS revenue lost to social messaging



Source: Ovum, with calculations by author.

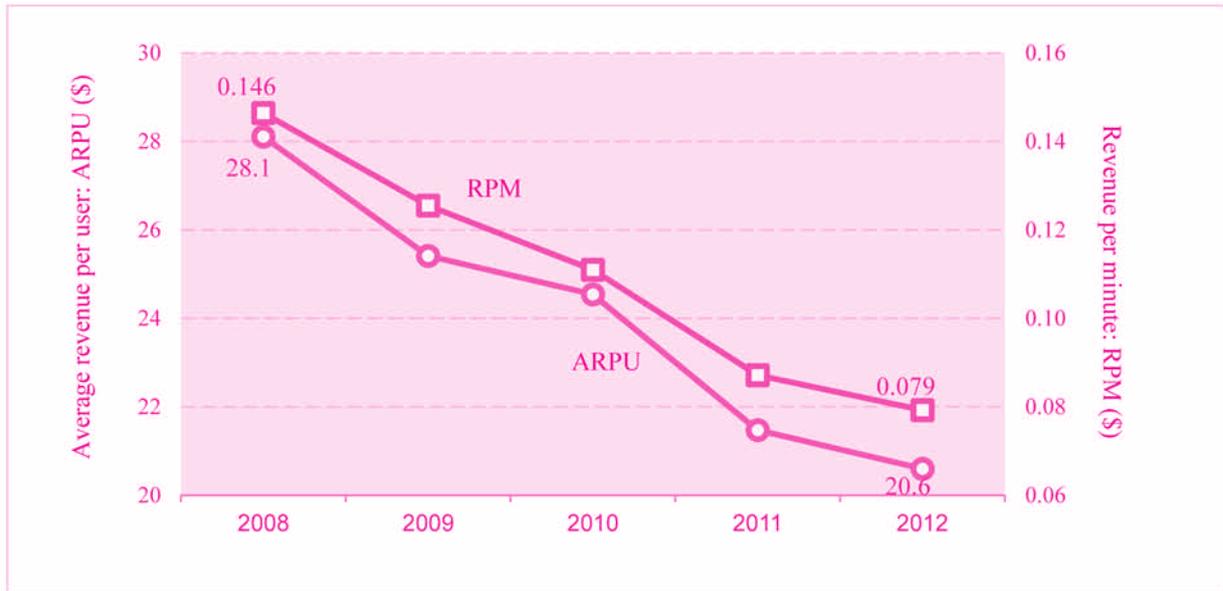
through Facebook; Line experienced 29 percent quarter-to-quarter growth in the number of registrations during the period from the first quarter of 2012 to the second quarter of 2013. The Chinese application WeChat has dominated the country with nearly 300 million users as of the end of 2012. Ovum has estimated that \$23 billion in SMS revenue was lost to social messaging worldwide in 2012, as shown in Figure 1.

In addition, Ovum has estimated that demand for VoIP on mobile will accelerate considerably. VoIP usually has been conducted on a fixed broadband network, i.e., a call from one computer to another. Currently, ultra-high-speed mobile Internet access can escalate demand for VoIP via mobile devices substituting voice services by telcos. Well-known social messaging applications, such as Kakao Talk, Line, Tango, Viber, WeChat and WhatsApp, have developed their own Internet calling feature as well, following the successful example of Skype with this service.

Figure 2 illustrates that both average revenue per user (ARPU) and revenue per minute (RPM) figures from 55 countries had plunged through the period 2008-2012, where 4G became commercialized in 2009. The ARPU fell roughly 30 percent during the period. A decrease in ARPU indicates that people on average are spending less for their subscription; however, this could result from either lower tariffs or a reduction in the volume of usage. Here, the RPM data, used widely as a proxy for phone call tariffs, plummeted almost 50 percent during the particular time period. This indicates that falling tariffs have been the underlying factor of the telcos' revenue decline. In countries such as the United Kingdom, Switzerland and Germany, telecommunications industries are now experiencing a decline in total revenues since the plunge in voice revenues cannot be offset by the increase in data revenues. Therefore, it is evident that the introduction of 4G LTE technology squeezes the revenue base of mobile phone operators.



Figure 2 Average revenue per user and revenue per minute across year



Source: Ovum, with calculations by author.

4. ESTIMATION RESULTS

Although the descriptive data depict the changes that have occurred in the telecommunications industry, to isolate the impact of the introduction of 4G LTE technology on the structure and performance of the industry, an econometric tool is required for controlling for other possible factors that may also contribute to the declining revenue and price trend described above.

Table 1 reveals that the introduction of 4G technology has had a negative impact on the voice service market but a positive effect on the data

service market. Overall industry revenue fell on average by 2.7 percent per annum in the sample countries accompanied by a 5.3 percent decrease in ARPU, suggesting a shrinking mobile service market. This is due to a fall in both the price of and demand for traditional services, which account for about 75 percent of the industry’s revenue. The price of the traditional voice service (as proxied by the revenue per minute of voice calls) has been estimated to have fallen by 9 percent per annum, and the demand, or the number of minutes of voice call per user, by 2.4 percent per annum.

Table 1 Effect of 4G per annum on industry performance and structure

Industry revenue	Average revenue per user	Revenue per minute of voice call	Minutes per user
-2.7%	-5.3%	-9.0%	-2.4%
Data revenue	Share of data revenue	Data average revenue per user	HHI*
+6.7%	+3.7%	+4.2%	+120.85

* HHI is a market concentration index calculated from the summation of the squared market share of each operator in the market. An HHI of 10000 means that the market structure is a monopoly. With a large number of firms and equally split market shares, HHI reduces toward 0, which indicates a perfectly competitive market.

By contrast, the introduction of 4G spurs data services. Internet service revenue is estimated to have increased by 6.7 percent per annum. This increase is contributed by both the increase in the number of non-voice service subscribers and the amount of spending of the average subscriber. The econometric exercise revealed that, due to 4G technology, customer spends 4.2 percent per annum more on data services, boosting the data revenue share by 3.7 percent per annum.

Even though consumers are paying more for data services, data revenue is not growing fast enough to offset the revenue lost from traditional services. As a consequence, the mobile industry's total revenue diminishes by 2.7 percent per annum. Undoubtedly, shrinking industry size undermined new mobile operators' incentive to enter the market. Mergers and acquisitions activity is on the other hand more likely to occur to keep the businesses afloat.

The revenue squeeze resulting from greater competition from OTT content providers renders the mobile industry more concentrated. Table 1 reveals that the HHI index of the mobile industry in the sample countries is estimated to increase by more than 120 points annually. However, the association between the introduction of 4G and the increase in the mobile market concentration index can be misleading. This is because the new technology induces competition, not from within the mobile market but from non-mobile operators, namely the OTT content providers. Thus, the measurement of market concentration that includes only traditional mobile operators as widely used among regulators is erroneous.

Application developers face a relatively low cost of investment (ranging from as low as \$3,000 to as high as \$250,000 per application based on an estimation by Crispy Codes) compared with that for 4G infrastructure investment (about \$750 million for initial 4G investment in the United Kingdom, according to a Capgemini report, 2011). Thus, competition is fierce in the Internet-based communication service market, unlike that in traditional



infrastructure-based services. The rise of OTT service providers translates into a fall in the market power and the market share of mobile phone operators in the voice and data communication markets.

Telcos are now faced with the option of either fighting or accommodating OTT services. They can fight by developing their own OTT services or accommodate by providing complementary services to OTT service providers. Because most OTT applications are free, network operators have to cut prices for traditional services, such as SMS and long-distance calls, in order to secure demand. At the same time, telcos need to seek new revenue sources, perhaps from OTT providers. For example, many mobile operators now provide payment services for online game applications or online shopping for a fee. Users can choose to pay for a product purchased online with a credit card or through telephone bills.

Figure 3 Changes in competition landscape

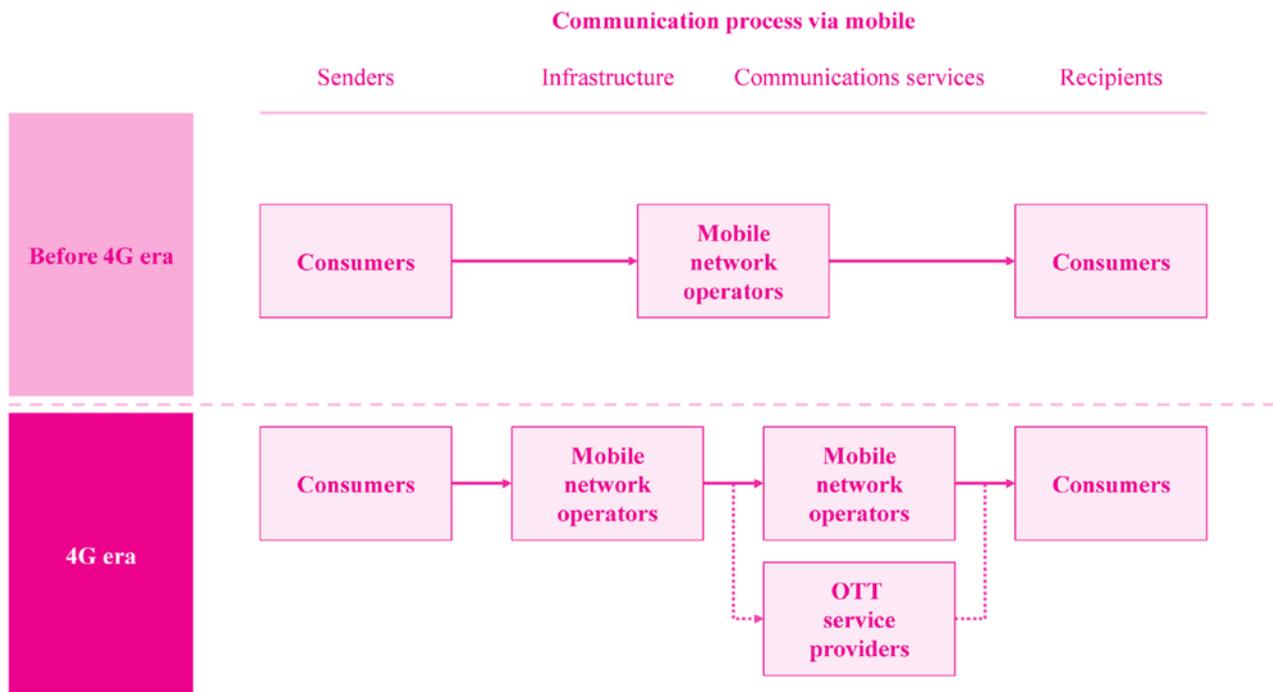


Figure 3 illustrates the change in the competition landscape of the mobile industry. In the past, mobile telephone operators were the sole providers of both the communications network and communication services, be they data or voice. With low mobile Internet speed, the early introduction of communication applications was limited to such non-mobile devices as desktop computers (Skype in times past). Also, with low speed, VoIP is of very low quality, unlike that transmitted over the traditional PSTN system.

With the introduction of 4G technology, which unleashed markedly faster mobile Internet, OTT communications became closer substitutes for mobile calling and texting. Consumers can choose between calling via traditional services or via mobile data, which is less expensive. As a result, mobile operators are gradually confined to the operation of the Internet platform on which

the OTT applications operate. Thus, mobile communications services are effectively split into two different markets: the infrastructure service market, the exclusive domain of telcos; and mobile voice and data service provision, where both telcos and OTT providers compete head on.

5. CONCLUSIONS

This study reveals that the introduction of 4G mobile communication technology fosters greater competition in the voice and data communications market by enabling non-infrastructure-based OTT content providers to compete directly with mobile operators. This is because very-high-speed data transmission significantly improves the quality of Internet-based communication service alternatives provided by value-added OTT services, such that they become very close substitutes for equivalent



services provided by mobile operators over PSTN. As a result, network services and communications services are effectively unbundled, with the latter becoming more competitive with non-mobile players in the market. As the market power of mobile operators inevitably dwindled with the vertical disintegration of the infrastructure and value-added services, telcos have had to struggle to cut costs and find new revenue sources.

Greater competition from low-cost OTT providers helps reduce the cost of communications and enables a greater variety of non-voice services with improved ease of access benefiting consumers as well as country competitiveness. Increasing reliance on Internet-based services helps slash operating costs, as this technology is twice as efficient as the previous technology.

This piece of evidence indicates that innovations that are pro-competition can generate significant benefits for the economy over time. Therefore, countries should attempt to adopt such innovations as early as possible, because they would stand to generate greater static as well as dynamic efficiency, and stay ahead of late adopters.

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