A Comparative Analysis of the Innovation Systems

of Brazil, Korea and Mexico

Abstract

At first glance it would seem that Brazil and Mexico are so different from the high-income Korean economy that a comparison among them is pointless. However, Korea's GDP/capita was lower than Brazil's 20 years ago. How do they manage to innovate? What policies are key to foster economic development? What is the role of the cultural factor to embed innovation policies that work? A comparative analysis of the innovation system of Brazil, Korea and Mexico provides useful lessons aimed at guiding policy makers, economists, managers, entrepreneurs and other developmental organizations towards designing tailored policies that help their nations flourish.

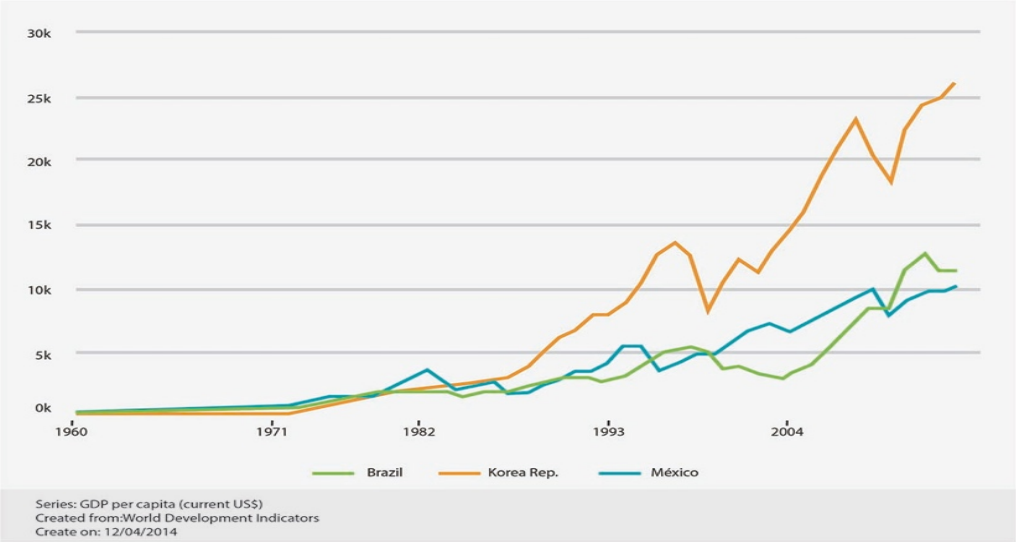
Key words: innovation, Brazil, Korea, Mexico

Introduction

According to the Global Innovation Index (2015) South Korea ranks 14th while Mexico is in 57th position and Brazil in 70th. At first glance it would seem that these emerging Latin American countries are so different from the high-income South Korean economy that a comparison among them is pointless. South Korea's GDP/capita was lower than Brazil's 20 years ago and the country has survived a number of crisis and faces tremendous challenges both from competition from Japan and China and threats from its neighbor in the North. Latin American countries can learn from South Korea's success story and they can benefit from each other's experience and practices with regards to their innovation system.

In 1960, Korea's GDP per capita (current US$155.6) was considerably lower than Brazil's (current US$208.4) and Mexico's (current US$337.6). This trend was reversed in 1983, when Korea (current US$2268) surpassed Brazil (current US$1558.4) and Mexico (current US$1988.1). From then on, Korea's GDP per capita current US$ has significantly increased in comparison to Brazil and Mexico (see Figure 1).

Figure 1. Brazil, Korea and Mexico's nominal GDP per capita current US$ from 1960 to 2013.



Source: World Bank 2014.

Asia's rapid development during the second half of the 20th century was praised as a miracle for the international community. Asian tigers not only were able to achieve unprecedented rates of economic growth, but also lifted most of their populations out of poverty. Through a mix of strong political leadership and directed private sector development, these countries turned into global innovators leading the path of the economy through technological change. Latin America emerged at the dawn of the new century as one of the most dynamic regions in the developing world. Most countries graduated as Middle Income Countries (MICs), after a decade of sound economic management coupled with social progress led by the sprout of natural resource-based corporations and the spur of social innovators.

In both regions, innovation is a critical success factor. Their approach to development is highly dependent on the particular socioeconomic and cultural context. In general, their development usually ramps when stakeholders align towards a policy environment that conduces to an innovation ecosystem that stimulates them to cooperate towards a shared goal. Fast-growing trade and investment between Asia and Latin America have transformed the two regions into powerful motors for the world economy. However, an interconnected global economy affected by a period of recession led by stagnated economies in Europe and China, rising inequality, scarcity of resources and environmental global pressures, pose eminent challenges on both regions.

How do they manage to innovate? What policies are key to foster economic development? What is the role of the cultural factor to embed innovation policies that work? What are the critical issues challenging their future

progress? What can they learn from each other? Can the rest of the world learn from their experience? A comparative analysis of the innovation system of Brazil, Korea and Mexico provides useful lessons aimed at guiding policy makers, economists, managers, entrepreneurs and other developmental organizations towards designing tailored and customized policies that help their nations flourish.

In this paper we argue that most research on innovation performance of a country is generally focused on technological innovation and the variables used are mainly suited for developed countries that have largely invested in human resources, infrastructure and other resources to enhance their innovation systems. Therefore, the main variables used such as patents and number of scientific publications does not reflect the other types of innovations (i.e. business model, organizational or social, among others) that are developing in emerging markets. To identify the main characteristics that distinguishes and determines the innovation that is produced in many developing countries we use a different approach. The economic and political context, as well as the different types of innovation developed and the socio-cultural traits is used to illustrate the innovation capabilities of developing countries that transcend the traditional conceptions.

According to the Oslo Manual, innovation is the implementation of a new (i.e. to the market, to the world) or significantly improved product (good or service) or process, new marketing method, or a new organizational method in business practices, workplace organization or external relations (OECD & Eurostat, 2005). Lundvall (1992) defines National Innovation Systems as "the elements and relationships which interact in the production, diffusion and use of new, and economically useful knowledge". Social innovation "refers to new strategies, concepts, ideas and organizations that meet social needs of all kinds- from working conditions and education to community development and health- and that extend and strengthen civil society" (OECD, 2011).

Brazil, Mexico and South Korea[1]

Brazil and Mexico are upper middle-countries, according to the 2013 Global Entrepreneurship Monitor, in a transition phase between Efficiency-Driven and Innovation Driven Economy, and large economies (Brazil was ranked 7th and Mexico 15th) with large populations (Brazil has a population of over 198 million and Mexico

[1] Most of the data used in this chapter, unless stated otherwise, was obtained from the 2015 Global Innovation Index, we are grateful for all their support for this paper.

over 120 million) while South Korea is a high-income and an Innovation Driven Economy and a large economy (ranked 13th) with a population of over 50 million (see Table 1).

Table 1. Selected indicators for Brazil, Mexico and South Korea.

	Brazil	México	South Korea
Population (millions)[1]	198.7	120.8	50.42
GDP (US$ billions)[2]	2,346	1,282	1,410
GDP per capita (PPP$)[3]	11,612.5	10,361.3	27,970.5
Gross expenditure on R&D (%GDP)	1.2	0.4	4.4
Income group	Upper-middle	Upper-middle	High-income
Ranking in the 2014 GII	71	57	14
GEM classification	In a transition phase between Efficiency-Driven and Innovation Driven Economy	In a transition phase between Efficiency-Driven and Innovation Driven Economy	Innovation Driven Economy
Ranking of the world's largest economies by GDP[4]	7	15	13

[1]Data from the World Bank. Last accessed 12 September 2015
[2]Data from the World Bank. Last accessed 12 September 2015
[3]Data from the World Bank. Last accessed 12 September 2015
[4]According to the IMF

Source: Author's based on data from the 2014 GII https://www.globalinnovationindex.org, World Development Indicators http://data.worldbank.org/, the World Bank http://data.worldbank.org/indicator and GEM http://www.gemconsortium.org

South Korea is often portrayed as the poster child of a country's development success. Devastated after the Korean War and with minimal natural resources, the government concentrated its focus in early 1960s on building up a "knowledge-based economy" with a strong National Innovation System (NIS) based on heavy investments in education, science and technology. The adaptation of Western-wise capitalism and management practices to the idiosyncrasy of a Confucian-based society -the so-called Confucian Capitalism (Chang, 1998)- created a synergetic effect towards industrialization and economic development. This synergy was capitalized by the government, which focused its innovation policies on supporting strong conglomerates of large firms with a high capacity to accessing the international markets, both in terms of technology acquisition and export promotion.

The Innovation System of Brazil, Mexico and South Korea

In Brazil, Mexico and South Korea there are public and private actors at different levels (i.e. national, state or local) that interact, in some cases more directly (e.g. South Korea) than others (e.g. Mexico), in their innovation system. For Lundvall (1992) the interaction between the structure of production (e.g. institutions) and the institutional set-up (e.g. policies) explains the performance of the different innovation systems. Identifying the main actors can be a challenge as innovation systems evolve.

In South Korea, the government has traditionally played a catalytic role in building a robust science and technology capacity that has been key in the economic success of the country[2]. Its main concern is to develop the concept of innovation cluster hinging upon strategic sectors that have achieved a stunning success as global technological leaders[3]. Envisioning the future, the government has identified three growth engines in the areas of green technology, hi-tech convergence and value-added services. The main actors for designing the future strategy and innovation policy coordination are the National Science and Technology Council (NSTC) and the Presidential Advisory Council on Science and Technology. The NSTC, created under the Specific Law for Scientific and Technological Innovation in 1997, decides the policy agenda, policy directions, priorities for R&D allocation and evaluation of national R&D programs. In addition, the Ministry of Trade, Industry and Energy (MOTIE) and the Ministry of Science, ICT and Future Planning (MSIP) perform a central role in setting innovation policies. MSIP is the most influential, as it is primarily responsible for formulating policies for basic science and technology development along with research and development (R&D) investment and supporting the nation's universities and research institutes (both government and private). MOTIE, on the other hand, works primarily in driving industrial innovation policies.

The Brazilian government plays an important role in building their national innovation system. At the federal level, among the key players that actively participate in the innovation system of Brazil are the National Council on Science and Technology (CCT) which defines science and technology priorities and coordinates policies, and the Brazilian Ministry of Science, Technology and Innovation (MCTI) participates in the implementation of the innovation policies. The role of the Studies and Projects Financing Agency (FINEP) and the National

[2] The Ministry of Science and Technology (MoST), established during the years of military rule, was one of the first government ministries devoted to S&T in the developing world (Gupta et. Al, 2013)

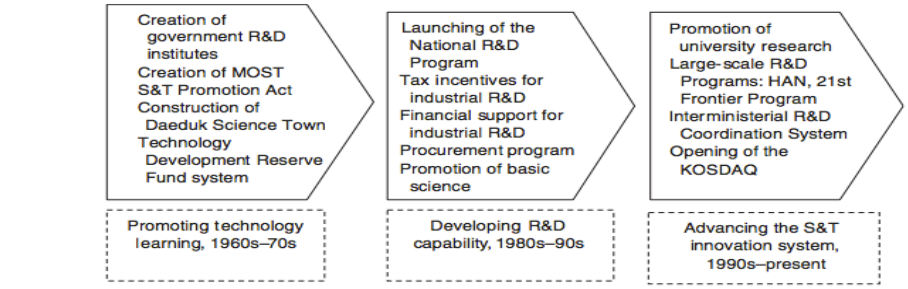
[3] Automobiles, semiconductors, shipbuilding, steel, general machines, textiles, parts and materials (http://www.motie.go.kr/language/eng/policy/Ipolicies_04.jsp). Last accessed 2015/04/12.

Bank for Economic and Social Development (BNDES) has been fundamental. FINEP is a public firm under the Brazilian Ministry of Science, Technology and Innovation to fund science and technology in Brazil while BNDES provides R&D financing for the private sector. Also, the Brazilian Agricultural Research Corporation (Embrapa), linked to the Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA), aims at technological innovation for agriculture and is responsible for agricultural research and technology transfer. More recently the Brazilian Research and Industrial Innovation Company (EMBRAPII) was created to promote business cooperation projects between national companies and national research institutions, supporting projects in the pre-competitive phase, proof of concept and technological scale-up that enable the development of innovative business.

The main actors behind the innovation system in Mexico according to the Science and Technology Law are: the General Council of Scientific Research, Technological Development and Innovation; the Inter-sectoral Budget Committee coordinated by the Ministry of Finance and Public Credit (SHCP) and the Director of the National Council for Science and Technology (CONACYT); The Inter-sectoral Innovation Committee, and; the National Conference on Science and Technology. CONACYT is responsible for articulating the Mexican government's public policies concerning scientific research, technological development and innovation. In 2013, the National Institute of Entrepreneur was created as an administrative body within the Ministry of Economy to develop the entrepreneurial ecosystem in Mexico.

A key feature in South Korea's NIS is the government-led creation of a net of public research institutes (GRI) that conduct basic R&D and the technological infrastructure needed to support applied research. Since the Act of Creation, Operation and Development of GRI's was enacted in 1999, these institutes belong to the Research Council System (RCS) to ensure proper planning, budgeting and evaluation of its assigned GRIs. There are five major research councils, each of them in charge of managing the respective GRIs assigned by thematic research area: 1) Korea Research Council of Fundamental Science and Technology; 2) Korea Research Council for Industrial Science and Technology; 3) Korea Research Council for Public Technology; 4) Korea Council of Economic and Social Research Institutes; and 5) Korea Council of Humanities and Social Research Institutes.

Figure 1. Development of S&T Policy South Korea



Notes: MOST = Ministry of Science and Technology; HAN = Highly Advanced National R&D Program; KOSDAQ = a technology stock market.

Source: Chung (2011)

Innovation policies and the role of government

Governments can become major enablers or obstacles when it comes to innovation. Their policies have an impact on the innovation system. In the last decades, the Brazilian government has implemented some policies to encourage and support innovation such as *Plano Innova Empresa* and *Plano Brasil Maior* (2011). FINEP and BNDES participate in this initiative, *Plano Innova Empresa,* that aims to promote projects to support innovation in sectors that are considered strategic by the Brazilian government. Inova Agro, Inova Energia, Inova Petro and Inova Telecom are among the initiatives that have been launched. The *Plano Brasil Maior* (2011) was created to increase the competitiveness of the Brazilian industry and aims to connect industrial, technological and foreign trade policy sectors. The National Science, Technology and Innovation Strategy 2012-2015 (ENCTI) has three main drivers of the ENCTI: promotion of innovation, capacity building and training, and strengthening STI research and infrastructure. Despite the fact that the government has been making important efforts to improve the innovation system this task has been difficult and many challenges have ensued. Brazil has not been able to meet the country's demands and needs with regards to innovation.

The Mexican Government has also been confronted with important challenges in its efforts to foster innovation in a country that for many years did not have an explicit innovation policy. While most programs for STI had a 6-year horizon, the Special Program for Science, Technology and Innovation 2012-2037 (PECiTI) is the first with a horizon of 25 years and will be updated every three years. PECiTI is divided into four phases. The first phase aims to transform the institutional setting and consolidate innovative businesses. In the second, STI capabilities are oriented to strategic sectors to accelerate innovation. The third phase aims to boost financing from the business sector for innovation. In the fourth phase, the Mexican business sector should account for

most of the financing for innovative activities. Also, the four phases of the PECiTI are associated to the six-year Presidential term of office. Mexico decided not to create a Ministry of Innovation but instead designated CONACYT as the entity in charge of coordinating the Mexican innovation system.

Historically, the Korean STI policy has been based on two fundamental pillars: (i) the creation of a state-led research and educational capacity and (ii) the intensity of corporate R&D efforts carried out by the country's large firms. The National R&D Program that was launched in 1982 by the Ministry of Science and Technology –in form of 5-year STI plans paired with the 5-year Economic Development Plans and based on the Technology Development Promotion Law- was the major STI policy instrument. It proved successful in strengthening a NIS characterized by a strong capacity of large firms to undertake R&D activities; heavy investments in a solid ICT infrastructure; a wide network of GRIs; and a highly educated labor force.

However, the assessment of NIS weaknesses posted new challenges that the government is trying to address since the arrival of the new millennium: bipolarized productive capacity between strong large firms versus weak SMEs; lack of creative human resources; lagging capacities to conduct basic and fundamental research; poor competitiveness and innovativeness of the service sector; imbalances between Seoul metropolitan area and other regions; and low interactive policy-making system (Lim, 2008). As a consequence, in 1999 the government restructured the GRIs under the RCS and launched the "*21st* Century *Frontier R&D Program"* as major turning points for the transition to a knowledge-based economy. The new program was part of the Long-term Vision for Science and Technology Development toward 2025 (or Vision 2025), an initiative aimed at guiding STI policy in the long run.

The Frontier program concentrated the R&D efforts on emerging technologies such as biotech, ICT, nanotechnology and aeronautics, and also included the modernization of conventional industrial technologies like textiles and shipbuilding. A parallel plan was introduced in 2003, identifying ten "growth engine industries for the future", ranging from biomedicine to next-generation semiconductors and intelligent robots. In 2008, President Lee's mandate gave a new impulse on STI policy, launching the "577 Initiative", a plan specifically aimed at accelerating the country's advancement in science and technology. 577 holds a value that directs ambitious targets behind the national plan; "5" stands for the objective to raise the percentage of GDP spent on R&D; the first "7" refers to the seven priority industries that give Korea a competitive edge, namely space, nuclear energy, military technologies, convergence sciences such as nanotechnology and robotics; and the

second "7" is the estimated ranking of the country in the science citation index and its international patent applications. In order to monitor progress and track the effectiveness of new R&D policies, following the recommendation of the OECD (2014), in 2011 the National Science and Technology Commission (NSTC) transformed from the National Science and Technology Council with reinforced roles and functions for evaluation, inter-departmental coordination, and allocation of departmental R&D.

Evaluation studies evidenced a slow progress and confirmed NIS' weaknesses and challenges. Thereby the government decided to gear innovation policies previously aimed at building a "knowledge economy" towards the brand-new "creative economy". With the objective to address Korea's NIS weaknesses and to move from a fast hi-tech mover (or catch up follower) to a first mover (or leader), Korea designed the Creative Economy Plan under the mandate of current President Park. The plan introduced a new vision for "realizing a new era of happiness for the Korean people through a creative economy". It consisted of three goals: (i) create new jobs and markets through creativity and innovation; (ii) strengthen Korea's global leadership through a creative economy and; (iii) creating a society where creativity is respected and manifested.

Goals and implementation of the innovation policy

In Table 2 the innovation strategies of Brazil, Mexico and South Korea are presented. There are significant differences in their strategies, especially in South Korea. Brazil and Mexico seem to focus more on building a national innovation system and how it can be used as a tool for development while South Korea is focusing more on SMEs and enhancing their innovation ecosystem. In South Korea, the MSIP articulate the strategies through the 2013-2017 Basic Plan for Science and Technology. It consists of three goals, which include (i) the contribution of 40% of economic growth to R&D; (ii) the creation of 640,000 jobs; and (iii) to raise Korea's innovation capability to the level of the top seven globally. The Plan involves raising R&D investment from KRW 68 trillion to KRW 92.4, a 35% increase from the previous government. Strategic technological development includes setting priorities on smart grids, carbon capture and storage, bid data applications and personalized pharmaceuticals.

Table 2. The innovation goals of Brazil, Mexico and South Korea.

Brazil	México	South Korea
Reduce the scientific and technological gap that separates Brazil from most of developed nations	Contribute to the annual growth of national investment in scientific research and technological development to reach 1% of GDP	Properly compensate for creativity and create an ecosystem that promotes the creation of start-ups
Expand and consolidate the Brazilian leadership in the Natural Knowledge Economy	Contribute to high-level human capital formation and enrichment	Strengthen the role of venture firms and SMEs in the creative economy and improve their ability to enter global markets
Expand the basis for environmental sustainability and the development of a low carbon economy	Drive the development of vocations and abilities of local Science, Technology and Innovation to strengthen regional sustainable and inclusive development.	Create growth engines to pioneer new markets and new industries
Consolidate a new pattern of international insertion of Brazil	Contribute towards the generation, transference and exploitation of knowledge by linking HEI and businesses research centers	Foster global creative talent that has the spirit to rise to challenges and pursue dreams
Overcome poverty and reducing social and regional inequalities	Strengthen the scientific and technological infrastructure in the country	Strengthen innovation capacities in science, technology and ICT, which form the foundation of the creative economy
	Strengthen the STI biotechnology capacities to solve the needs of the country according to the legal framework on biosecurity	Promote a creative economic culture together with the Korean people.

Source: Author's based on information from the government's innovation strategies.

Human capital, a key driver for innovation

Higher education is one of the outstanding tasks of the Brazilian and Mexican government. Access, equity, relevance and quality are among the common challenges their governments are facing. Human capital is considered a key driver for innovation. There are links between education, skills, productivity, economic growth, development and innovation. A highly skilled labor force is a key driver for innovation. However, there are important factors that need to be addressed. For example, Mexico has a high number of engineering students and graduates, in many cases, they have difficulty finding a job in Mexico were they can use their skills. Matching supply to labor demand is essential. There are weak links in Brazil and Mexico between the industry and the higher education institutions. South Korea's expenditure on education (4.9% of GDP) is lower than Brazil's (5.8% of GDP) and Mexico's (5.8% of GDP) but ranks in 2nd place in the human capital & research pillar in the GII while Mexico ranks 52 and Brazil 63. There are many factors that could explain the differences and we will highlight some of them.

Higher education is highly appreciated in South Korea, reflecting one of the key values of a Confucian society. This is shown by the high amount of investment made in education during the second half of the 20th century. In 2010, Korea spent 7.6% of its GDP on all levels of education, above OECD average of 6.3% (2.6% spent in tertiary education, above OECD average of 1.6%). Demand for education is reflected on the country's pervasive ratio of private tuition/GDP (Lee, 2010). Indeed, the value of education is regarded as one of the critical success factors of Korea's rapid development (Lim, 2008).

According to the Global Innovation Index, South Korea ranks 10th in tertiary education and 2nd in research and development. Among South Korea's strengths are: tertiary enrolment is high at 98.4% and their gross expenditure on R&D is 4.2% of GDP. In contrast, Mexico ranks 34th and Brazil 111th in tertiary education and 47th and 33rd in research and development with a gross expenditure on R&D of 0.5 % and 1.2% of GDP respectively, see Table 3.

Table 3. Selected data on human capital and research for Brazil, Mexico and South Korea.

	Brazil	México	South Korea
Tertiary education ranking	111	34	10
Tertiary enrolment (% gross)	25.5	29	98.4
Graduates in science and engineering (%)	12	26.9	31.1
Research and Development ranking	33	47	2
Researchers (FTE/mn pop.)	710.3	386.4	6533.2
Gross expenditure on R&D (%GDP)	1.2	0.5	4.2
QS university ranking (average score top 3)	54	43.2	579.84

Source: Author's with data from 2015 Global Innovation Index.

In the 2015-2016 QS World University Ranking there are 27 South Korean universities, 22 Brazilian and 14 Mexican. Among the best South Korean higher education institutions are: Seoul National University (36) KAIST –Korea Advanced Institute of Science & Technology (43), and Pohang University of Science & Technology (POSTECH, 87). Among the best Brazilian higher education institutions are: Universidade de Sao Paulo (143), Universidade estadual de Campinas (Unicamp, 195), Universidade Federal do Rio de Janeiro

(323), Universidade Federal do Rio Grande Do Sul (451-460), UNESP (481-490), Universidade de Brasilia (491-500), and Universidade Federal de Sao Paulo (UNIFESP, 491-500). Among the best Mexican universities are: Universidad Nacional Autónoma de México (160), Instituto Tecnológico y de Estudios Superiores de Monterrey (238), Instituto Tecnológico Autónomo de México (551-600) and Instituto Politécnico Nacional (601-650). The Brazilian higher education is divided in three categories: universities, university centers and, integrated faculties and schools of higher education. The universities are institutions that carry out research while university centers are not required to conduct research, and integrated faculties and schools of higher education are smaller institutions. There are also Colleges, Universities, Federal Centers of technological teaching, Federal Institutes. There are more than 2,350 higher education institutions in Brazil. The Mexican higher education system is complex. In the Mexican public higher education system there are: 9 public federal universities, 34 state universities, 23 universities with support, 132 technological institutions, 104 technological universities, 50 polytechnic universities, 12 intercultural universities, 51 public research institutions and 261 public normal schools. The South Korean higher education system (HES) comprises 411 institutions: 179 universities, 145 vocational colleges, 40 graduate schools, 20 cyber-universities, 11 universities of technology, 10 universities of education and 6 others (Michalski et al., 2013). Korean universities are classified into state universities that are established and managed by the government; public universities established and managed by local governments; and the most predominant private universities (around 85% of total), managed by private trustees and education conglomerates.

Despite the appreciation and magnitude of higher education in Korea, there is a growing "dissatisfaction about the quality of university education in South Korea, its lack of focus on independent thinking and inadequacy in preparing students for the workplace" (Gupta et. al, 2013). The quality of tertiary level education –still much focused on textbook learning instead of practical experimentation- is not good enough to satisfy the demands of advanced firms, which drive the competitiveness of the nation (Lim, 2008). University R&D is weak, and whereas GRIs received major proportion of public R&D investments, they have a diffuse impact on the transfer of their knowledge to the market. Overall, the role of universities and GRIs poses serious weaknesses and raise future challenges. The education system in Korea is facing a strong pressure for transformation. The human cost of performance pressure and the increasing unemployment rate among university-educated youth, is giving

rise to doubts about the value of a college education. Korea's R&D system has one of the widest gender gaps[4], for which the government is designing new programs to support women in STI careers. The pressure of an aging workforce is also affecting the education system, which challenges its openness to embrace foreign students that can later build a career on STI in the country. All in all, the education system is currently under a reform process to improve its overall performance and efficiency in order to make the transition to a creative economy.

Innovation and the private sector

In the 2014-2015 Global Competitiveness Report South Korea ranks in 26th, Brazil in 57th and Mexico in 61st. There are some developed clusters and industries in Brazil and Mexico, however, there are weak ties between higher education institutions, the government and the private sector. In both countries, the government accounts for most of the expenditure on R&D and their goal is to increase the contributions from the private sector. In Mexico, the latest survey on research and technological development (ESIDET) shows that the private sector investment on R&D in 2011 was 0.2% of GDP and 5% of businesses conducted R&D activities, the percentage of businesses that executed innovation projects was 11.7%, around 8.2% of businesses introduced a new product to the market or implemented a new process and 10.3% developed at least one product or process innovation project (INEGI-CONACYT, 2012). According to PINTEC, the Brazilian survey of technological innovation, in 2009-2011, around 45,590 businesses implemented new or significantly improved products or processes. Around 35.7% of the industrial sector firms introduced innovative products, a significant decline from 38.1% in the 2006-2008 period. While Korea has combined policy-driven S&T investments with market-driven business strategies to become one of the most innovative economies today (Gupta et al, 2013 - p. 35). Since its initial economic growth in the 1960s, the government push to build a NIS with strong ties with large private firms is reflected with the decisive innovation drive taken by the private sector. It is responsible of the 72% of the overall Korea's R&D investments (OECD, 2012), above the OECD average. As a result of large firms' R&D commitment, South Korea has an impressive record in patenting, especially regarding infrastructural technology and platforms, with a sound specialization on ICT. According to the GII 2014, the country ranks 1st in knowledge creation (including the number of patent applications).

[4] OECD Science, Technology and Industry Outlook 2012.

The government's efforts in building a sound business environment with a progressive openness of the Korean economy and an advanced IT infrastructure is reflected in the Ease of Doing Business Index elaborated by the World Bank, which places South Korea in the 5th position. This notwithstanding, R&D is heavily monopolized by large firms, who definitely take the lead as the real innovators in Korea, leaving SMEs far behind in terms of resources, skills and capabilities to conduct R&D activities. Strong economic polarization is reflected on Samsung and Hyundai's share of Korea's GDP, which stands up to the 35% of the total[5].

Against this backdrop, SMEs are often found constrained by vertical value chains where large firms have superior bargaining power due to large economies of scale. SMEs' competitive advantage lays mostly in production costs, thereby having a limited scope to conduct its own R&D activities that could allow them breaking the loop and making its own innovative leap forward freed from large firms' chains. Hence, addressing the structural bipolarization between large firms and SMEs is one of the main priorities of the government. The MOTIE committed in 2012 to allocate 40% of the R&D budget to SMEs by 2015, and the Creative Economy Plan openly targets its first two priorities in supporting the creation of start-ups and strengthening the access to venture capital. Among the constraints of fueling innovation through the private sector, Korea faces two important handicaps. One is the low productivity of its economy, the lowest among OECD countries (OECD, 2012[6]). Two, the low level of entrepreneurial aspiration of highly educated graduates whom overly value working for a large firm (i.e. Samsung or Hyundai) as a means to increase their social status.

Whereas the linkages between the government and the private sector are clear-cut and strong, the main challenge for South Korea's coordination of its innovation ecosystem remains the weak integration of universities and GRIs' R&D with the private sector. Despite high academic publications and patenting rates[7], the relative number of citations and technology transfers remain low. Low levels of international cooperation and partnerships among researchers is another pitfall of the weak link with the academia; only 26% of scientific articles are produced with international co-authorship and only 4% of patents were produced with international collaboration (OECD, 2012). Furthermore, access to R&D funds from overseas is very limited (Lim, 2008).

[5] http://www.koreatimes.co.kr/www/news/biz/2014/01/488_149731.html
[6] http://www.businesskorea.co.kr/article/3698/insider-perspective-seven-reasons-why-korea-has-worst-productivity-oecd
[7] Gupta et al. (2013), p. 38.

Types of innovation and cultural traits

Latin American countries, generally, have been known for having a poor innovation culture and mind-set. This has generated some misconceptions in the private sector that produced underinvestment in innovation activities in these countries. Most researchers in Brazil and Mexico work for the public sector (universities) in contrast with South Korea where most of them work in the private sector. South Korea's competitive edge has been forged upon technological innovation. Decisive leadership from the government based on the selection, prioritization and concentration on key hi-tech industries stands as a critical success factor behind Korea's NIS. Socio-cultural value systems play an important role in shaping means of economic development, as they are related to the entrepreneurial behavior that drives innovation.

In the case of S. Korea, the hierarchical organization of institutions, and a collectivistic approach for managing social order based on obedience and respect to authority -characteristics of a Confucian society- were key to the introduction of a market-oriented economy that became the basis for the country's astonishing economic development success. Therefore, the government capitalized values such as hardworking and long-term orientation with the sense of individual sacrifice for the sake of the group -at the family, organizational and national level- in order to implement a long-term strategy focused on technological development driven by big national champions (Korean large firms or *chaebols*).

Confucian Capitalism proved to be related to economic development in S. Korea, as it did in other Confucian-based countries such as Taiwan, Singapore and China (and previously Japan). The main advantage of this synergy is, assuming skilled and high-quality top leadership and management as a common practice (both at the public and private sector), that decision-making and implementation of strategies take place faster; thereby innovations' time frame from idea creation to market reduces and companies get first mover advantages. This is the case of Samsung, whose success hinges upon the concept of 'speed innovation'[8].

However, the prevalence of such values also poses certain risks. Hierarchical organizations discourage creativity coming from lower and mid-levels of management, as well as it undermines risk-taking and therefore cultivating a strong entrepreneurial individual attitude. Against this backdrop, lateral thinking, horizontal communication and bottom-up open innovations are not incentivized, thereby small-scale entrepreneurship and

[8] Song, J. & Lee, K. (2014). The Samsung Way: transformational management strategies from the world leader in innovation and design. McGraw.Hill.

SME development are more difficult to emerge. South Korea's path to the creative economy will not be free from social transformations. Political commitment towards economic democratization by reducing the power of large firms and empowering SMEs entails re-thinking its value system and re-design the NIS to adapt it to the ever-changing socioeconomic challenges if the country wishes to realize a 'new era of happiness for the Korean people through a creative economy'.

In countries like Brazil and Mexico, cultural, political and economic factors, among others, influence their ability to exploit on their natural advantages. Both countries have not invested in key inputs that drive innovation such as infrastructure, R&D and human capital as South Korea. However, that does not mean that there are no innovations in these countries. In Brazil, according to Pintec (2011) firm investments in innovation and R&D grew but they pursued more process than product innovation. Also, Mexican firms carry out organizational and market innovations more than introducing new products in the market (INEGI-CONACYT, 2012). InnovaLatino (2011) presents some examples of innovative organizations in Mexico and Brazil. Cemex-Patrimonio Hoy is displayed as an innovative Corporate Responsibility program that has benefited more than 300,000 families by providing assistance and resources to build and improve houses with a low-cost micro-credit system. Pineda Covalín as a successful marketing/branding innovative company that promotes Mexican culture via de production and distribution of design piece, Softek, a firm specialized in providing information technology services is portrayed as a business process innovation and Cinepolis (film distributor and theater chain) is presented as an example of business model innovation. For Brazil Havaianas, a Alpargata's brand, became globally successful in part to their marketing innovation repositioning their product from the low end of the market to the high end. Embraer, the Brazilian aircraft manufacturer, built a 'reverse outsourcing' model which facilitated flexibility in their production and deliver lower labor costs than their competitors. Natura, a cosmetics manufacturer, has been very successful in taking a local brand global.

One of the challenges we are facing is to capture other types of innovations such as business model, organizational and marketing to portray a more accurate Latin American innovation landscape. However, it is clear from the research presented in this paper that the South Korean strategy for innovation, with its challenges, has been yielding striking results compared to Brazil and Mexico. South Korea's success story can be replicated in Latin America, and beyond, keeping in mind that it is important to adapt and adopt it to local sociocultural value systems in order to ensure the best results.

Comparative Analysis. Main findings

Brazil and Mexico have comparatively embarked late in prioritizing innovation policies. And while innovations can be used to leapfrog (e.g. mobile telephones), government policies need to be in place to support and accelerate innovations. South Korea had a clear and logn-term vision around fostering its economic development by creating the conditions for technological innovation to flourish. First, the government took the lead and progressively empowered large firms to conduct their own. Research has shown that the allocation of resources for innovation policies, measured as % of GDP endorsed to R&D, is critical to develop a strong technological capacity and infrastructure that supports private-led innovations (i.e. broadband infrastructure), as exemplified in the case of South Korea. However, capitalizing and building innovation policies upon cultural values is likely to produce a synergistic effect on economic development.

On the one hand, despite investing less resources in education compared to similar countries, South Korea takes advantage of the willingness of its citizens to privately invest in education. Therefore, the government has more resources to invest in technological innovation. On the other hand, South Korea's single focus on supporting technological innovation geared towards industrial-led economic development undermined its capacity to foster creativity and open-base social innovation policies.

Tensions generated by poverty and inequality in many Latin American countries could jeopardize the prioritization of investing in technological infrastructure and innovation in Brazil and Mexico. The high levels of informal economy can undermine the implementation of a more efficient fiscal policy and extract reliable data to monitor the conditions to access the labor market. In Table 4, selected success factors and challenges for Brazil, Mexico and South Korea are presented.

Table 4. Brazil, Mexico and South Korea selected success factors and challenges.

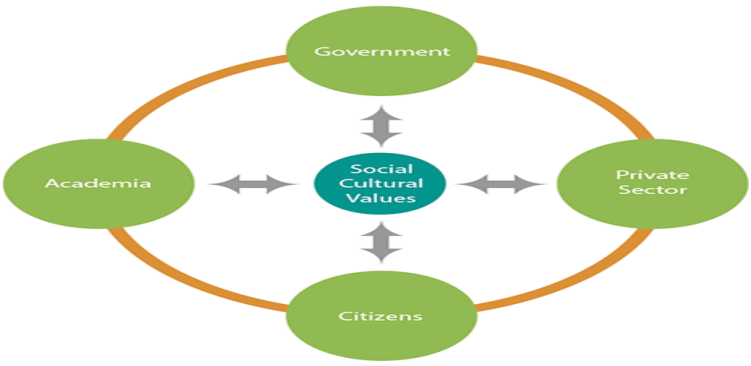
	South Korea	México	Brazil
Success Factors	•Technological Innovation oICT infrastructure (i.e. broadband internet) •Long-term Government commitment to R&D oFunding private sector development oCreation GRIs •Private Sector lead R&D investment •Confucian Capitalism (synergy between culture and economic development) •Highly educated workforce •Progressive ease of doing business	•Open economy (FTA) •Geographical proximity to the US •Ease of doing business •High number of engineers •Natural Entrepreneurship culture: resilient entrepreneurs	•Public Institutions financing innovation: FINEP and BNDES •Plano Inova Empresa •Strong research institutions that support innovation activities: EMBRAPA, EMBRAPII •Natural Entrepreneurship culture: resilient entrepreneurs •Social innovation
Challenges	•Polarization between strong large firms and weak SMEs •Lack of entrepreneurial culture (restrained creativity) •Low interactive policy-making system? •Weak capacity for undertaking basic research •Low services sector's competitiveness •Imbalanced regional development (Seoul metropolitan area vs. the rest) •Weak university R&D, away from PS needs •Education not tailored to companies' needs Wide gender gap	•Informal economy •Lack of venture capital •High number micro-entrepreneurs •Lack of funding from the private sector for R&D •Weak coordination between the public sector, private sector and higher education institutions •Fragmentation and weak coordination of innovation activities	•Informal economy •Lack of venture capital •High number micro-entrepreneurs •Lack of funding from the private sector for R&D •Reduction of inequality •Asymmetric innovation system •Fragmentation and weak coordination of innovation activities

Source: Authors.

Final remarks

In the analysis of National Innovation Systems the socio-cultural variable and non-technological innovation are the missing drivers. Developing countries need to discover and implement their own innovation model, endogenously-based on their own socio-cultural values, economic development stage and ecosystem. They might adopt and adapt an innovation strategy 'tailored to fit' building upon their strengths and considering their weaknesses in order to progress according to their optimal capacities. In this paper, we highlight the need to introduce the socio-cultural variable both for the analysis of the National Innovation System and innovation policymaking. In Figure 2, the socio-cultural-based innovation system is illustrated.

Figure 2. The Socio-Cultural-based Innovation System



Source: Author's.

Learning from developed countries who have successfully implemented innovation policies and possess a strong national innovation system is important to draw the best practices and policies which could be adopted instead of just following or mirroring the implementation of their policies without considering the socio-cultural factor that can be key in developing countries. Brazil and Mexico can learn from the best practices and challenges that South Korea is facing with regards to their national innovation system. Future research could focus on capturing the different types of innovation and their main drivers.

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