Perspectiva Econômica, 14(2):71-91, julho-dezembro 2018
2018 Unisinos – doi: 10.4013/pe.2018.142.01

Comparing the performance of technological and social capabilities in Latin American and East Asian countries, 2000-2012

Comparando o desempenho das capacidades tecnológicas e sociais nos países da América Latina e do Leste Asiático, 2000-2012

Pablo Felipe Bittencourt*
UFSC, Brasil
pablofelipe.bittencourt@gmail.com

Carlos Eduardo Matos*
UFSC, Brasil
carloseduardo.matos@hotmail.com

Tulio Chiarini**
INT, Brasil
tulio.chiarini@int.gov.br

Abstract. The factors that explain economic development of a country continue to generate controversies, even after decades of scientific advances. In line with heterodox tradition, this paper accepts the divergence in the level of development as something intrinsic to the creative destruction process of Technological Revolutions. By this token, the objectives here are: (i) to check for a longer period, the adequacy of relations, already tested once between a set of analytical dimensions can influence the processes of economic development of countries and (ii) to present and discuss evidences of progresses and setbacks of National Innovation Systems of Latin American and East Asian countries. For this, technological ad social capabilities were analyzed, relying on multivariate statistical analysis and econometric. In addition, variations in the performance of the technological and social capacities of three Latin American countries and three of East Asia were also observed and compared rapidly. The results indicate that the higher growth rate of Chinese and South Korean per capita income was sustained by the rapid growth of their technological capabilities, but also by different social capacities, while Argentina, Brazil and Mexico lost the best moment in decades, the commodity boom.

Key Words: National Innovation Systems, catching-up, falling behind.

Resumo. Os fatores que explicam o desenvolvimento econômico de um país continuam a gerar controvérsias, mesmo depois de décadas de avanço científico. Em linha com a tradição heterodoxa, esse *paper* aceita a divergência entre os diferentes níveis de desenvolvimento como algo intrínseco ao processo de destruição criativa das revoluções tecnológicas. Com base nisso, seus objetivos são: (i) verificar por um período mais longo, a adequação das relações, já testada uma vez entre um conjunto de dimensões analíticas, que podem influenciar os processos de desenvolvimento econômico dos países e (ii) apresentar e discutir evidências de progressos e contratempos dos Sistemas Nacionais de Inovação dos países da América Latina e do Leste Asiático. Para isso, as capacidades tecnológicas e sociais foram analisadas, baseando-se em análise estatística multivariada e econométrica. Adicionalmente observou-se e comparou-se rapidamente as variações do desempenho das capacidades tecnológicas e sociais de três países Latino Americanos e três do Leste Asiático. Os resultados indicam que a maior velocidade do crescimento da renda *per capta* Chinesa e Sul Coreana foram sustentados pelo rápido crescimento de suas capacidades tecnológicas, mas também de diferentes capacidades sociais, enquanto a Argentina, o Brasil e o México perderam o melhor momento em décadas, o *boom* da *commodities*.

Palavras-Chave: Sistemas Nacionais de Inovação, emparelhamento, ficando para trás.

* Universidade Federal de Santa Catarina. Bairro Trindade, 88040-970, Florianópolis, SC, Brasil.
** Instituto Nacional de Tecnologia. Av. Venezuela, 82, Praça Mauá, 20081-312, Rio de Janeiro, RJ, Brasil.

Introduction

The notion of Innovation System considers the ability to generate and disseminate innovations as a central element of the development process. Nevertheless, the way to do that is not clear.

Attempts to broaden the understanding of the elements able to explain the economic development differences among countries emerge from the divergences empirically verified, as well as from the generation and dissemination of both technologies and innovations in a historical perspective. In this sense, the purpose of this article is to compare the Innovation Systems of Latin American and East Asian countries, from the perspective of technological capabilities and social capabilities. To accomplish this goal, we revisit the study carried out by Fagenberg and Shrolec (2009), in order to assess the suitability, for a long run period, of the relationship between technological and social capabilities and the level of economic development attained by some countries. We confirm the format of the relationships found by the authors, which show a direct relation (but not necessarily a causal relation) of the level of economic development achieved by a country and the level of technological capability and social capability.

After confirming the previous relationship, we focus the analysis on two groups of countries. The first is formed by Argentina, Brazil and Mexico (from Latin America) while the second is formed by China, South Korea and Thailand (from East Asia) for the period 2000-2012, commonly called 2000s commodities boom due to the increases in the price of commodity exports.

According to Rosnick and Weisbrot (2014), the effect on an economy of changes in its export prices is unclear. For instance, if the prices of a country's major exports rise continuously, it may either expand domestic production or shift that production from domestic to foreign consumption, thus, affecting the development path of each country in a different manner. Still, it can be expected that with the increase in exports, additional resources can be invested in social capability building such as investing in the education system or even investing in modernization of business financing system. Thus, we consider that the 2000s commodities boom presented a great potential for accelerating the development of technological and social capabilities, i.e., for catching-up. The frustration of this hypothesis will reveal a 'lost moment' or a 'falling behind'. In addition to these categories, the possibility of 'forging ahead' is also considered. In this context, we are going to find empirical evidences that support the hypothesis that while China and South Korea are catching up with more developed countries; Argentina, Brazil Mexico and Thailand have lost a precious moment for catching up.

The study used as a basis for this research (Fagenberg and Srholec, 2009) is an important result of the line of research proposed by Jan Fagerberg (1994). The focus in not new, just the way to measure. The idea is identify and test a set of analytical dimensions that help to explain the differentials of economic development of the nations, always taking the Schumpeterian perspective as a background. Is not our objective to do an exhaustive review of the advances, since 1994. But, looking for more recent years, we can highlight the reasons to select the article of 2009 as the base for this one, and is possible to have a notion of the line of research.

Fagerberg, Srholec and Knell (2007) noted that price competitiveness is usually not relevant, whereas technology capacity, social capacity and international demand, showed a positive and significant relationship with measure of economic development. The following year's article Fagerberg and Srholec (2008) used 24 variables to find four dimensions potentially related to different levels of development (measured by GDP per capita). The dimensions, titled "innovation systems", "governance", "political systems" and "openness", led to a rejection of the hypothesis of relationship between the last two and the levels of development. Fagenberg and Srholec (2009), reinforced the explanatory power of technological

capacities and social capacities. Two great innovations of this article have proved to be promising for the continuity of the research. The first one was the observation of different dimensions of social capacities, which pointed out a more precise sense of what would be in the cause (even if from the statistical one cannot assume causality) of the differentials of development of the nations. Educational level, financial system, business regulation, social capital, showed dimensions with a strong relation with GDP / per capita, whereas the level of openness and the political system did not. Secondly, the broad set of variables used to infer these dimensions is also a very positive because they cover qualitative aspects of these dimensions, and quantitatively because, the high level of percentages of variance, explained by the first factors of the multivariate statistical analysis applied to this broad set of variables.

This set of analytical dimensions and indicators that compose them were used in Fagerberg and Srholec (2010) as empirical evidence on innovation and development, in which the authors advance in a theoretical discussion about the topic. Also in Fagerberg, Fedman and Srholec (2013) the dimensions were used to investigate factors that shape the European and American technological capacity, highlighting, in this case, advances in the deduction of the causality between technological capacities and a set of social capacities. And, more recently, they used the same dimensions to explain the different effects of the crisis of 2007/2008 between European, Asian and African countries (Fagerberg and Srholec, 2017). This line of work inspired others such as Castelacci, Natera (2011), and Castelacci e Natera (2013), for examples. In fact, many other advances specially in empirical evidences about the relations between economic development and innovation were based on the work of this authors. Anyway, the work of 2009 still represents the best alternative for a comparative investigation in the format carried out here, basically because they contemplate the broader set of variables observed for each of the dimensions and that, therefore, enable the analysis to identify the specificities potentially important for the understanding of the transformation in the SNIs of the selected countries.

Based on this, the objectives here are: (i) to check for a longer period, the adequacy of relations, already tested once between a set of analytical dimensions can influence the processes of economic development of countries and (ii) to present and discuss evidences of progresses and setbacks of selected National Innovation Systems of Latin American and East Asian countries. Besides this brief Introduction, we divided this paper in four other sections. In the second section, we present a concise theoretical review, which contextualizes the empirical efforts done in this study. In section three, we show the methodology and the data sources. In the fourth section, we discuss the results. Finally, in the last section we present some concluding remarks.

Technological and social capabilities

Technological capability is the ability to absorb, generate and use knowledge commercially. Not only does this involve skills directly related to innovation, but also the organization, production and commercialization of goods. Many of them are internalized in companies, but they can also be found in the interaction networks with other agents, which make this analysis dimension difficult to be measured.

The study of innovation and technological capabilities – inevitably depend on each countries' competences – is directly related to 'social capabilities' (Abramovitz, 1986; 1994), 'National Systems of Innovation' (Lundvall, 1988; Nelson, 1993; Freeman, 1995; Edquist, 2005) and 'Technological Revolutions' and 'techno-economic paradigms' that accompany them (Perez, 2003; Freeman; Louçã, 2001).

Technological Revolutions matter as they define the diffusion of new technologies. Such revolutions and the underlying paradigms form a set of radical innovations, which arise in a given period and place, and gradually replace old technologies in a creative destruction progressive process

(Schumpeter, 2008 [1942]) that pervades the entire productive structure.

This background of the Schumpeterian analysis, pointing out the direction of the advancement of the international technological frontier as a condition (continuous or disruptive), highlights the increase of technological gap between nations and, consequently, introduces the possibility of catching up.

However, as it is emphasized by Freeman and Soete (2008), the diffusion process of a new paradigm is neither automatic nor simple, once causes structural adjustment problems. The diffusion process requires, at least, the redesign and a new configuration of the stock of capital, a new profile of competences and skills of the workforce, new management and work organization structures, a new pattern of industrial relations and a new pattern of institutional and international regulation.

Diverse institutional arrangements generate differences in technological capabilities as well as in innovation creation competence. Such institutional arrangements are defined by both planned and unplanned decisions done by those who are able to either promote or constraint technological improvements. The way agents interact, the way S&T infrastructure is organized, the way financial system is arranged, the way basic and technical education is structured, they all shape the historical constitution of a specific National System of Innovation. Revisiting the seminal work of Abramovitz (1986) we find elements that according to the author can contribute to a country's potential for rapid growth: when it is technological backward and socially advanced. However, technological backwardness is not a mere accident; rather, it is a result of tenacious societal characteristics that keep a backward country from making the full technological leap – these societal characteristics were called 'social capabilities'. By the same token, the catch-up process is subordinate to institutional aspects which are hardly and reluctantly transformed such as lack of honesty and trust among agents.

Among the so-called social capabilities there are:

i. experience with the organization and management of large-scale enterprise;
ii. financial institutions and markets capable of mobilizing capital on large scales;
iii. a stable government capable of defining rules and supporting economic growth, and
iv. an environment of honesty and trust.

All these dimensions are considered in Neo-Schumpeterian attempts to understand particular characteristics of National Systems of Innovation.

Regarding the first topic *i*), we ought to remember that, as shown by Abramovitz (1986), the importance given to large-scale enterprises to the increase productivity of many countries was proposed by Chandler (1977). According to him, because large-scale enterprises are the main source of productivity increase, support was given to the emergence and development of such large companies. Chandler (1977) was mainly referring to the beginning of big business in American industry and the advantages they provided to the United States, mainly during the Fordist Paradigm. However, with the emergence of the Information and Communication Technology (ICT) Paradigm, sustainable growth was performed by relatively smaller enterprises which were organized in a way that enable them to quickly absorb foreign knowledge and to launch new products and processes continuously. This was a characteristic of both Japanese and South Korean enterprises, representing an important feature of the growth of Japan and South Korea, post-WWII and in the 70s, respectively.

The Asian experience made the 'capacity to innovate' idea more appropriate than Chandler's large company in more contemporary analyzes. In the National Systems of Innovation approach, the analysis of the productive structure and the

way market is organized are central, since they indicate the possibilities of building new competences in a System of Innovation (Edquist, 2005; Lundvall, 2007).

In this sense, a significant set of more recent concepts seek to capture what happens in the innovation process of different firms. In this sense, Kim's (2006) concept of technological capability, in an analysis of South Korean catching up area good reference to understand the object. Also the "technological capacities" discussed by Lall (1992), Bell and Pavitt (1995) and Bell and Figueiredo (2012) are relevant to understand the construction of internal capacities of the firms, specially because it includes the learning processes that explain such construction. Any way, it is still impossible to have access to a significant set of information about the firm's technological capabilities. Because of this, the proxies remain the best alternative.

The roles of *ii*) the educational system, iii, the financial system and *iv*) government regulation in defining rules can be easily noticed in Lundvall (1992), Nelson (1993) and Edquist (2005) works. They have relevant contributions and they are facing challenges in improving the Nation Systems of Innovation concept taking into account countries' peculiarities and similarities. Basically, the formal Educational System represents the level of development of the agents that make up the financial system to provide the unconditional support to the development of SNI capacity of financial actors capacity building in the Innovation system; iii) finally, "business regulation" refers to innovations that enhance innovation, by accelerating processes. Basically, ii) the formal education system represents one of the ways to build capacity essential to the development of the SNI; iii) the level of development of the financial system represents the capacity of the SNI to provide the unconditional support of innovative business; iv) finally, "business regulation" refers to innovations that enhance innovation, by accelerating processes.

Finally, *iv*) an environment of honesty and trust is further exploited by a broader view of the National System of Innovation proposed by Lundvall (1992; 2007). He shows that intangible elements as loyalty, trust and power can help explaining forms of coordination and cooperation in different National Systems of Innovation.

This set of social capabilities are part of the action of the state development strategies around catching-up. In order to remember, the efforts to build social skills are indispensable to the effectiveness of catching up, considering the advance of the technological frontier propitiated by the technological revolutions movements (Perez, 2004).

Based on this notion, we present at the end of the article (Table 4) a categorization of the advances or setbacks of the six selected countries, in each of the dimensions of social capacity and to the technological capacity, based on the set of selected indicators. The objective is to point out the progress of these countries relative to the others. And additionally, to have a notion of the performance of these countries in their efforts to accelerating the level of per capita income. For this, the countries' performances were classified in the following four categories, in descending order: foreign ahead, catching up, losing moment and falling behind. The criterion is presented in the methodology.

The discussion proposed previously sought to present the concept on 'social capabilities' and how it can be incorporated in the National Systems of Innovation approach. In the next sections we revisit the work of Fagenberg and Shrolec (2009). Doing so, we can assess the suitability, for a longer period, of the relationship between the set of analytical dimensions proposed by them and the level of economic development attained by some countries. They use 75 countries and data for the period 2000-2004. We propose to use the same set of variables for 88 countries, for the period 2000-2012. Below we present the methodology and the database used to meet the goals proposed in this paper.

Methodology and database

Technological capabilities have different perspectives: knowledge-intensive technological capabilities, quality of labor-work within firms, skills in the production stages, marketing capabilities and TICs infrastructure. The set of more knowledge-intensive technological capabilities was measured by R&D expenditure, patent applications, and scientific articles publications. The technological capabilities related to the quality of labor-work within firms were measured by the enrollments in doctoral programs, education in science and engineering, and participation of professionals and technicians in the labor market. To capture skills perspective in the production stages, it was used ISO 9000 certifications as a proxy for the quality management and assurance program. For marketing capability, it was used the number of registered trademarks. Finally, related to TICs infrastructure, it was used the number of PCs, Internet users and telephone users (fixed and mobile).

To 'capture' the social capabilities of a country, Fagerberg and Srholec (2009) proposed six dimensions: educational system, financial system, business regulation system, social capital, political system and economy openness.

Table 1. Indicators of technological and social capabilities.
Tabela 1. Indicadores de capacidades tecnológicas e sociais.

	Indicators	Scaling	Definition	Source
TechnologicalCapability	Scientific articles	per capita	Counts of articles published in journals covered by Science Citation. Index (SCI) and Social Sciences Citation Index (SSCI).	World Bank
	Patent application	per capita	Applications for patens under the Patent Cooperation Treaty (PCT) classified by country of residence of the first named applicant	WIPO
	R&D expenditure	% of GDP	Expenditure on research and experimental development performed on the national territory	World Bank
	Doctoral enrollment	% gross	Estudantes de doutorado, expresso em porcentagem da população em idade de estar cursando educação superior	UNESCO
	Science and engineering enrollment	% gross	Students of all ages (gross) in science, engineering, manufacturing and construction tertiary programmes expressed as a percentage of the tertiary school-age population	UNESCO
	Professionals	% gross	Share of professionals, technicians and associate professionals in total employment	ILO LABORSTA
	Trademarks applications	per capita	Applications of a resident for registration of a trademark with a national or regional trademark office. Trademarks are distinctive signs that identify goods or services as those produced or provided by a specific person or enterprise	World Bank
	ISO 9000 certifications	per capita	A family of standards approved by the International Standards Organization (ISO) that define a quality management and assurance program.	IOS
	Personal computers	per capita	Computers designed to be used by a single individual.	World Bank
	Internet users	per capita	People with access to the worldwide network.	World Bank
	Fixed line and mobile subscribers	per capita	Telephone mainlines and users of portable telephones with access to the public switched telephone network	World Bank

Social Capability	Educational System	Literacy	%	Adult literacy rate is the percentage of people ages 15 and above who can read, understand a write a short, simple statement on their everyday life	UNESCO
		Secondary school enrollment	% gross	Number of secondary students of all ages (gross) expressed as a percentage of the secondary school-age population.	UNESCO
		Tertiary school enrollment	% gross	Number of tertiary students of all ages (gross) expressed as a percentage of the tertiary school-age population.	UNESCO
	Financial System	Domestic credit to private sector	% of GDP	Financial resources provided to the private sector, such as through loans, purchases of non-equity securities, trade credits and other accounts receivable, that establish a claim for repayment.	World Bank
		Market capitalization of listed companies	% of GDP	The share price times the number of shares outstanding (also known as market value) of domestically incorporated companies listed on the country's stock exchanges at the end of the year.	World Bank
		Interest rate spread	logs	The interest rate charged by banks on loans to prime customers minus the interest rate paid by commercial or similar banks for demand, time, or savings deposits.	World Bank
		Bank non performing loans	%	The value of nonperforming loans divided by the total value of the loan portfolio (including nonperforming loans before the deduction of specific loan-loss provisions).	World Bank
	Business Regulation System	Time to start a business	days	The number of calendar days needed to complete the procedures to legally operate a business.	World Bank
		Time to close a business	days	The number of calendar days required to complete a bankruptcy	World Bank
		Intellectual property protection	index	Adherence to protection of intellectual property rights	World Bank
		Law and order	index	The degree to which the citizens of a country accept the authority of established institutions in making and implementing laws and regulating disputes	World Bank
		Corruption	index	The Corruption Perception Index reflects the perceptions of well-informed people with regard to the extent of corruption, defined as the misuse of public power for private benefit	World Bank
	Social Capital	Trust in other people	%	Answer of the question: "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?"	World Value Survey
		Civic engagement	%	Average answer to a question of whether the respondent has signed, might sign or would never sign under any circumstances (three-point scale) a petition.	World Value Survey
		Tolerance to homosexuality	%	Average answer on a question whether homosexuality can always vs. never (ten point scale) be justified	World Value Survey
		Equal access to jobs for immigrants	%	Average answer on question whether the respondent agrees or disagrees (three point scale) with the statement that when jobs are scarce, employers should give priority to local people over immigrants.	World Value Survey
		Equal access to jobs for women	%	Average answer on question whether the respondent agrees or disagrees (three point scale) with the statement that when jobs are scarce, men should have more right to a job than women	World Value Survey

Source: Authors' own based on Fagerberg and Srholec (2009).

There is a massive literature that addresses the attempts to measure social capabilities and which the most appropriate dimensions and proxies are. Archibugi and

Coco (2005), for instance, compare different methodologies developed by The World Economic Forum (WEF), the UN Development Program (UNDP), the UN Industrial Development Organisation (UNIDO), and the RAND Corporation. We are aware of the limitations of some proxies proposed by Fagerberg and Srholec (2009); however, we opt to use them in this paper as one of our objectives is to check the validation of their results for a longer period and the inclusion of more countries in the database.

Many of the selected indicators presented in Table 1 refer to the same analytical dimension. In order to reduce this large number of variable to a smaller number of factors for data modeling, we made use of multivariate analysis (MVA). The multivariate factors are used to uncover latent dimensions (structures) that can explain the set of observed variables (HAIR *et al.*, 2006). The dimensions presented in Table 1 are: technological capability and social capability (educational system, financial system, business regulation system and social capital).

In general, more than one factor often captures consistently the data covariance. In this study, as well as in Fagerberg and Srholec (2009), the first factor was capable of capturing over 60% of the variance in all the dimensions considered, which makes it suitable to limit the dimensions to only one factor (Hair *et al.*, 2006). In addition, we point out that we used principal component analysis and varimax rotation, once they are the most used in the literature (Pallant, 2007).

In Table 2, we summarize the requirements for the use of factor analysis and the suitability of the database used for the statistical exercise we do in this article.

Table 2. Requirements for the use of factor analysis and the suitability of the database used.
Tabela 2. Requisitos para o uso da análise fatorial e a adequação do banco de dados utilizado.

	Requirements	**Results**	
Sample	Regarding the number of cases, the higher the better. Hair et al (2006) suggested that the sample should have more than 50 observations. It is advisable to have at least 100 to ensure more robust results. Additionally he emphasize that the ratio between the number of cases and the number of variables must exceed five times.	The sample varies between 77 to 88 countries and the ratio of the number of observations and the sample was greater than 5 in all cases.	
Correlation	Regarding the pattern of correlation between the variables, the correlation matrix should display most of the coefficients with value above 0.30.	Frequency in which the correlations were above 0.3:	
		• Technological capability:	81%
		• Educational system:	100%
		• Financial system:	83%
		• Business regulation:	100%
		• Social capital:	100%
		• Political system:	100%
		• Opening:	85%
KMO Test	The Kaiser-Meyer-Olkin (KMO) test varies between 0 and 1. The closer to 1 the better. Palant (2007) suggests 0.6 as a reasonable limit.	• Technological capability:	0.878
		• Educational system:	0.728
		• Financial system:	0.658
		• Business regulation:	0.668
		• Social capital:	0.830
		• Political system:	0.777
		• Opening:	0.660
BTS Test	Bartelett Test of Spherecity (BTS) tends to be statistically significant when $p<0.05$.	• Technological capability:	0.000
		• Educational system:	0.000
		• Financial system:	0.000
		• Business regulation:	0.000
		• Social capital:	0.000
		• Political system:	0.000
		• Opening:	0.000

Source: Authors' own.

The last statistical procedure performed here consisted in the regressions between the scores obtained by factor analysis (independent variable) and per capita income of each country (dependent variable), in order to compare our results to Fagerberg and Srholec (2009). The dimensions 'political system' and 'opening' were not statistically significant (as found by Fagerberg and Srholec) and because of this they are not presented in Table 1 and they will not be presented in section 3.

Table 3 shows the results of percentage variance explained by the factorial analysis and R^2 regressions in this article and those presented by Fagenberg and Srholec (2009). From the factorial analysis, we may note that the variance explained by the first factor has increased in almost all cases. The exception is the dimension of technological capability. This reinforces the challenge of finding good proxies compatible with the challenge of measuring and comparing the different levels of firms' technological capabilities. In the referred regressions, it is noted that the R^2 has decreased in 4 of the 5 analyzed dimensions, however, without any significant fall.

Once we have selected the variables and we have tested them, we selected some countries from Latin American and East Asian**.** We established three criteria to select the group of countries for our analysis. Firstly, we chose the subdivision between Latin American and East Asian countries once they represent economies located in different geographical contexts, which has diverse impacts on resource allocation. Notably, it is known that the Latin American territory has more abundant natural resources if compared to the East Asian, so we would expect a positive impact of 2000s commodities boom in these countries *vis-à-vis* the other region.

Table 3. Comparison between explained variance and R^2.
Tabela 3. Comparação entre variância explicada e R^2.

	Explained Variance of the Factorial analysis		**R^2**	
	Fagerberg and Srholec (2009)	**This article**	**Fagerberg and Shrolec (2009)**	**This article**
Technological Capability	67.0%	62.1%	0.85	0.80
Educational System	67.7%	85.1%	0.69	0.74
Financial System	51.2%	58.9%	0.64	0.56
Business Regulation	56.0%	66.3%	0.83	0.70
Social Capital	57.5%	67.7%	0.72	0.60

Source: Authors' own and Fagerberg and Srholec (2009).

Once we had selected the regions, we had to choose the countries in each of them. To do so, we used the per capita income level similarities in the first year of the sample, according to the classification proposed by the World Bank: high-income countries, middle-income countries (upper middle and lower middle) and low-income countries. The idea here was to compare the comparable cases, assuming that the presence of a middle-income trap[1] could be a common challenge able to constraint the catching-up process (World Bank, 2000).

After fulfilling the two previous criteria, there were left ten countries from Latin America and five from East Asia. Considering the lack of space for the analysis of all of them, the three largest economies of each region were selected according to their GDP.

From the above mentioned criteria, we selected the following countries: Brazil, Argentina and Mexico representing Latin America; and South Korea, Thailand and China representing East Asia.

[1] The "middle income trap" is understood as the difficulty of countries that have emerged from poverty to reach developed countries. It is an intermediate situation, between low-cost exporting countries and technologically advanced ones. This is because, on the one hand, these middle-income countries operate at high salaries compared to poor commodity-exporting countries, which limits their competitiveness in these segments and, on the other hand, have limited technological and innovation capacity to compete with developed countries.

About the presentation of the comparative analysis, we chose to use tables informing the ranking of selected countries at the beginning and at the end of the period for each indicator used. This allows us to view each country's growth (either positive or negative) in the overall ranking of countries. To make clear the advancement or backwardness of the selected countries in the overall ranking, we show 'up' or 'down' arrows. Importantly, for almost all indicators, the closer to the first position in the ranking, the better it is. For example: the higher the scientific papers per capita index, the closer the country will be to the first place in the ranking. On the other hand, indicators whose high values are a bad condition to economic development, the relationship is reversed. Therefore, the larger the interest rate spread, the further from the first position in the ranking will the country be, for example.

In order to provide greater clarity of the results, a final procedure was adopted in order to indicate a 'falling behind' process, 'lost moment', 'catching-up' or 'forging ahead' in each of the dimensions of analysis. The criteria, which are clearly arbitrary, are summarized in Table 4. Foreign ahead classification suggests a significant advance; catching up, suggests a positive but gentle advance; the losing moment, suggests that efforts were not sufficient to generate an improvement in the relative position and the falling behind suggests a situation of significant delay in relation with all other countries.

Table 4. Criteria for assessing the social processes in each of the social capabilities.
Tabela 4. Critérios para avaliar os processos sociais em cada uma das capacidades sociais.

Social Process	Criteria
Foreing Ahead	More than 50% of the indicators showed the country's growth in the overall ranking; In at least 25% of the indicators, the country was among the 20 best in the world in the last year of the analysis; No indicator was among the 20 worst in the overall ranking at the end of the period.
Catching-up	More than 50% of the indicators showed the country's growth in the overall ranking.
Losing moment	50% or more of the indicators show the country's fall in the overall ranking.
Falling behind	50% or more of the indicators showed a decline in the country's overall ranking; In at least 25% of the indicators, the country was among the 20 worst in the world ranking in the last year of the analysis; No indicator was among the top 20 ranking at the end of the period.

Source: Authors' own.

Results

Table 5 shows that per capita income of Latin American countries grew less than East Asian countries. Latin American countries lost relative positions in the ranking of the 88 countries considered. China and South Korea gained relative position while Thailand remained at 53th. This result is interesting, since this was a period of significant growth in Latin American. Brazil, for example, had the highest increase of GDP per capita since 1980.

Table 5. Per capita income variation of selected countries and their relative positions in the ranking.
Tabela 5. Variação da renda per capita dos países selecionados e suas posições relativas no *ranking*.

	Δ% - PIB per capita	Relative position in the 88 country ranking		Δ Ranking
	(2000 -2012)	2000	2012	(2000-2012)
Brazil	29.8%	46th	52nd	↓8
Argentina	36.1%	41st	44th	↓3
Mexico	8.0%	34th	48th	↓14
China	198.0%	72nd	61st	↑11
Thailand	43.4%	53st	53th	0
South Korea	53.6%	28th	22nd	↑6

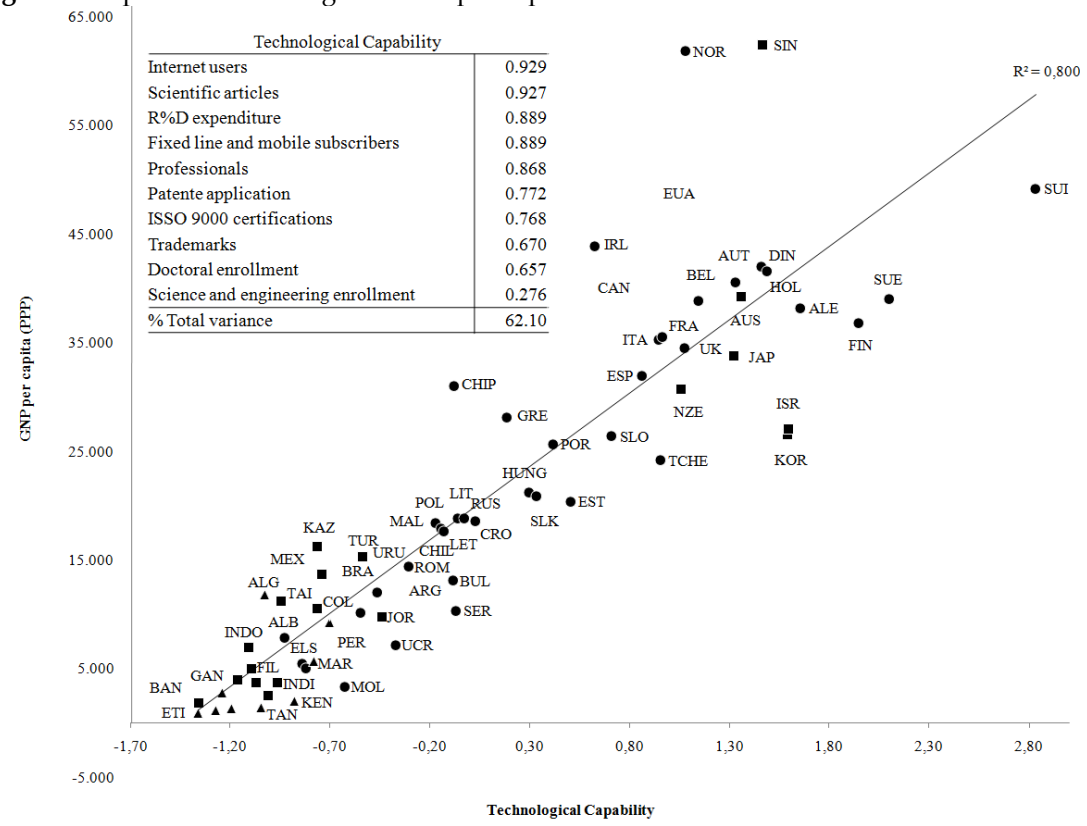
Source: Authors' own.

Technological capabilities

The perspectives used as a proxy of technological capabilities were presented in Table 1. The direction of the line present in Figure 1 shows there is a direct relationship between technological capabilities and economic development.

From a comparative analysis, we notice rare significant advances among Latin American countries and rare setbacks among East Asians. The rapid diffusion of ICTs can be at the root of the better performance of East Asian National Systems of Innovation. This is because industry structure matters. As highlighted by Freeman and Soete, (2008) technological diffusion is faster between nuclear sectors in the current paradigm. The proportion of nuclear industries from the current paradigm (electronics, microelectronics, in particular) is much higher than that found in Latin American economies.

Figure 1. Technological capability and GNP per capita.
Figura 1. Capacidade tecnológica e PNB per capita.



Source: Authors' own.

Among Asians, Chinese advancement is outsanting, especially regarding its technological sophistication indicator (proxy: R&D expenditure as proportion of GDP). But also, China's advancemente is not restricted to this, as can be noted when analyzing other technological performance indicators (proxies: ISO 9000 certifications, trademarks and patents applications). This is enough to suggest that the Chinese System of Innovation is undergoing a transition from 'imitation to innovation', probably escaping from the 'middle-income trap'.

Thailand's technological capabilities suggest a comparatively stable performance. With the exception of the number of Internet users, whose fall in the ranking is remarkable, the indicators do not point advances or significant setbacks, keeping the country next to the mean position in the ranking (between the 40th and 60th).

South Korean National System of Innovation, in addition to the relative growth in almost all indicators, points out to rank among the 20 most 'productive' of the world in almost all indicators in 2012, what corroborates the forging ahead process.

Among the Latin American countries, the setback in many indicators suggest a losing moment for Argentina and Brazil and falling behind process fo Mexico. In the Mexican case, the drop position in virtually all indicators reveals a position almost always close to 60th position in the ranking in 2012. Positive exceptions are growing position in trademarks per capita and the number of students enrolled in science and engineering courses.

The National System of Innovation of Argentina also presented relative decrease in most of the indicators, also suggesting a losing moment process. Positive changes were restricted to the growth of R&D/GDP and trademark applications.

Table 6. Selected countries in the ranking of technological capability, 2000 and 2012.
Tabela 6. Países selecionados no ranking de capacidade tecnológica, 2000 e 2012.

	Brazil	Argentina	México	China	Thailand	South Korea
Scientific articles	**49th ↑ 47th**	35th ↓ 41st	53rd ↓ 57th	**60th ↑46th**	**62nd ↑60th**	**27th ↑ 20th**
Patent application	44th ↓ 50th	39th↓ 54th	56th ↓ 57h	**45th ↑22nd**	54th ↓55th	**4th ↑ 2nd**
%P&D/PIB	22nd ↓ 24th	**40th ↑ 35th**	**42nd ↑ 41st**	**26th ↑15th**	44th ↓52nd	**7th ↑ 3rd**
Doctoral enrollment	14th ↓ 31st	49th ↓ 55th	48th ↓ 53rd	n.a.	**53rd ↑ 49th**	**40th ↑ 36th**
Science and engineering enrollment	**62nd ↑ 53rd**	51st ↓ 52nd	9th = 9th	n.a.	**49th ↑48th**	2nd↓ 4th
Professionals	**62nd ↑ 44th**	38th ↓ 39th	41st ↓ 48th	n.a.	**49th ↑47th**	**47th ↑ 11th**
Trademarks	28th ↓ 32nd	**12nd ↑ 6th**	**39th ↑ 28h**	**53rd ↑12th**	41st ↓42nd	**4th ↑ 1st**
ISO 9000 certifications	46th = 46th	42nd ↓ 44th	53rd ↓ 58th	**52nd ↑37th**	**43rd =43rd**	**25th↑ 20th**
Internet users	**53rd ↑ 50th**	37th ↓ 40th	43rd ↓ 65th	**61st↑59th**	45th ↓ 72nd	**30th ↑ 10th**

Source: Authors' own.

The evaluation of the Brazilian case suggests that this was the National System of Innovation that has less regressed in terms of technological capability among the Latin Americans. Just as the case of Argentina, the falls and the growths are not very significant, but we found more indicators in relative growth (scientific articles, applications engineering, technical professionals and Internet users.). For Brazil, the indicator R&D/GDP is not a good proxy of firms' 'technological capability', since research activity is concentrated in universities for decades. Still deserves attention the 'doctoral enrollment' indicator, which expresses the number of PhD students in relation to age population to study because of the intense fall. In fact, the period was marked by expantion of the number of scholarships awarded to students and, to a lesser degree, of profesores dedicated to graduate programs. In summary, one can not say that the Brazilian National System of Innovation has made significant progress in building technological capabilities in the period, once there was significant setbacks. However, it is certain that it has moved less than necessary

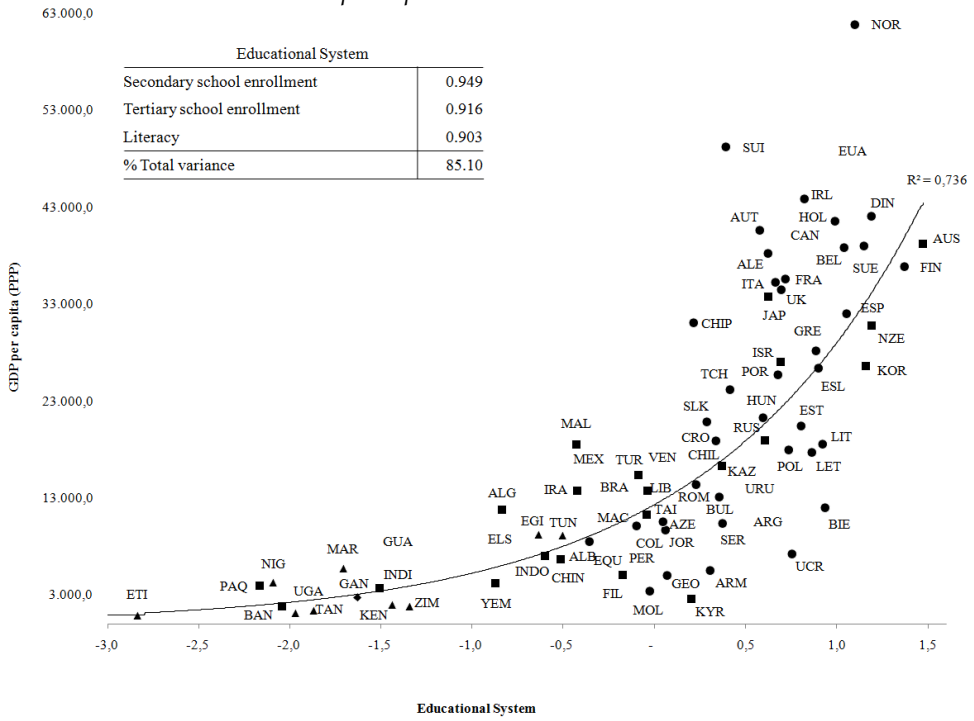
for a process of catching-up. The performance is closer to 'losing moment' process.

Social capabilities

Educational system

The distribution of countries in the curve that relates the education system to GDP per capita shows that there is not a linear relationship. It is possible to identify basically two important groups of countries: one group that has developed a high level educational system but did not reach high levels of per capita income and are mainly located in Eastern Europe (Ukraine, Lithuania, Estonia, Poland and Belarus) but also in Latin America (Argentina and Uruguay). Another group formed by all the other countries with high levels of per capita income and has high levels of their educational systems.

Figure 2. Educational system and GDP per capita.
Figura 2. Sistema educacional e PIB *per capita*.



Source: Authors' own.

Table 7. Selected countries in the ranking of educational system, 2000 and 2012.
Tabela 7. Países selecionados no ranking de sistema educacional, 2000 e 2012.

	Brazil	Argentina	Mexico	China	Thailand	South Korea
Literacy*	21st ↑ 15th	1st = 1st	13th↑10th	**12th↑5th**	**9th↑8th**	1st = 1st
Secondary school enrollment*	n.a.	39th ↓ 40h	56th↓60th	**62nd↑55th**	58th↓64th	19th↓26th
Tertiary school enrollment	n.a.	**18th ↑ 10th**	58th↓62nd	**63rd=63rd**	39th↓40th	**2nd↑1st**

Source: Authors' own.
Note: (*) Data available for 2001 and 2011.

The information available about Brazil suggest advances in basic education in the country however, due to lack of comparable data in Brazil we cannot compare it with other countries regarding secondary and tertiary school enrollments.

For a significant number of countries, the variable 'literacy' is not under radar anymore because it is assumed that the share of the population over 15 years of age who are illiterate is not significant. Among them are Argentina and South Korea, which puts these two countries in the first position in the ranking. The performance of these two countries is similar in the other indicators: Argentina and South Korea lost their

positions in what regards secondary school enrollments however, both have gained positions in tertiary school enrollments. Regarding the tertiary school enrollments both Argentina and South Korea are among the twenty most advanced Innovation Systems in the world, which puts these two countries in the first position in the ranking.

It is interesting to note that the negative performance of 'secondary school enrollment' indicator can be misleading. Falling vacancies in secondary education may reflect the low need for its expansion, especially in countries that already have a high basic educational level for a relative long time. This may be the case of both Argentina and South Korea.

In the case of Mexico and Thailand, the fall in secondary and tertiary school enrollment is accompanied by poor performance in basic education. This reflects Mexico and Thailand are 'losing moment' if compared to the other countries. In addition, the performance of the Thai educational system does not suggest significant advancements. Finally, it is noteworthy that the China has not have setbacks in any educational indicator, suggesting a catching-up of its educational system.

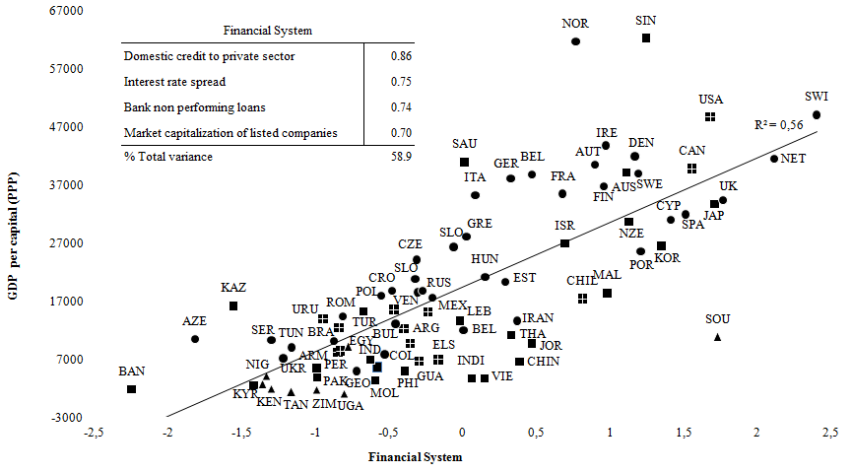
Financial system

The further the indicators of 'bank non performing loans' and 'interest rate spread' are from the first position in the raking, the worse they are. Brazil is raked in the first place regarding the interest rate spread, which means that the highest interest rate spread in the world is practiced in Brazil. Despite the poor performance of this indicator, all others signal in the opposite direction, suggest a catching up process in Brazil. The recognized role of the Brazilian National Development Bank (*Banco Nacional de Desenvolvimento Econômico e Social* – BNDES) and other public and private institutions seem to have been complemented by the capital market sophistication, as shown by the first two indicators, that is 'domestic credit to private sector' and 'market capitalization of listed companies'.

In Argentina, the same first two indicators have significant drop, placing the country among the 20 worst in the world ranking. Mexico, on its turn, has the best result among Latin American countries, with small improvements on all indicators suggesting a catching up process.

Regarding the East Asian countries, Chinese advances were quite restricted, only the level of default (bank non-performing loans) improved. The Thailand financial system showed very good performance in what regards the domestic credit to private sector and market capitalization indicators, whereas the other indicators point to difficulties in financing period. Finally, the South Korean financial system diverges from the others positively: regarding the three indicators, which had improvements, we can note significant relative advances able to place the country among the 20 best in the world. So even the relative decline in interest rate spread, it is clear that the system moved significantly ahead the others.

Figure 3. Financial system and GDP per capita.
Figura 3. Sistema financeiro e PIB *per capita*.



Source: Authors' own.

Table 8. Selected countries in the ranking of financial system, 2000 and 2012.
Tabela 8. Países selecionados no ranking de sistema financeiro, 2000 e 2012.

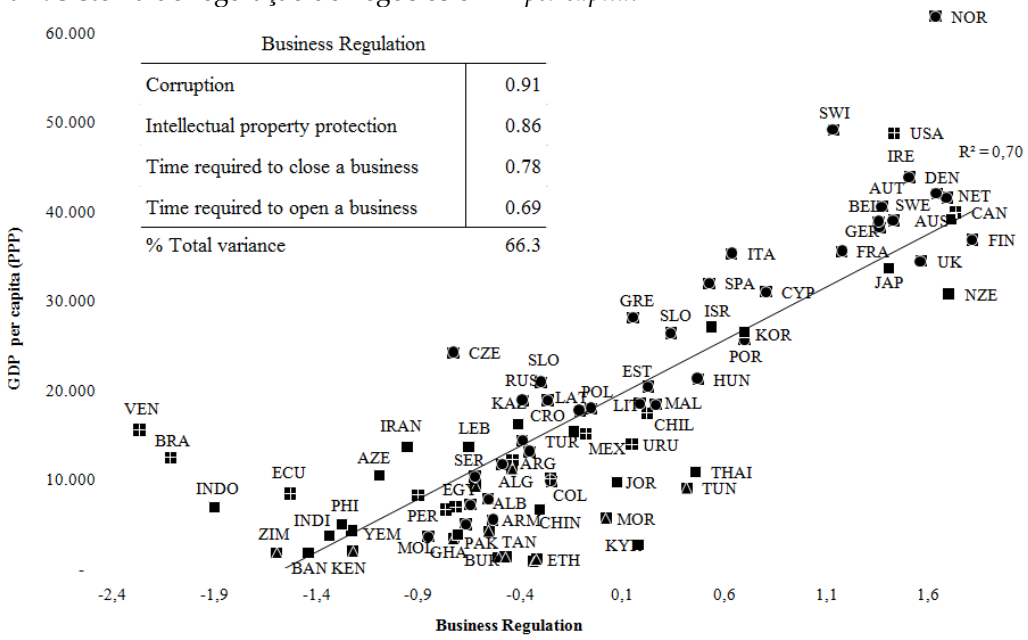
	Brazil	**Argentina**	**Mexico**	**China**	**Thailand**	**South Korea**
Domestic credit to private sector	**48th ↑ 36th**	57th ↓ 71st	**67th ↑ 63th**	12th ↓15th	14th↑12th	**24th ↑ 13th**
Market capitalization of listed companies	**33rd ↑ 26th**	23rd ↓ 66th	**46th ↑ 35th**	28th ↓34th	**42nd↑12th**	**35th ↑ 13th**
Bank Non-performing loans	36th ↓ 43rd	20th ↓ 71st	43rd ↓ 63rd	9th ↓73rd	57th↑43rd	35th ↓ 69th
Interest rate spread	1st = 1st	17th ↓ 47th	31st ↓ 35th	61st ↑40th	48th↑29th	**71st ↑ 58th**

Source: Authors' own.

Business regulation

The third dimension of the so-called social capabilities is the Business Regulation, which is the level of difficulty to undertake, produce and innovate, caused by (lack of) governance and local bureaucracy. Corruption, the level of bureaucracy to open and close a business and intellectual property protection are considered indicators.

Figure 4. Business regulation system and GDP per capita.
Figura 4. Sistema de regulação de negócios e PIB *per capita*.



Source: Authors' own.

Thailand showed improvements in both indicators and worsening in the other two, suggesting it is 'losing moment'. The South Korean National System of Innovation showed significant improvement in most indicators. However, the Chinese seems to have been 'losing moment', since the advance was restricted to the 'time required to close a business' indicator (17 positions), which contrasts with the 'time to open a business' (down 21 positions) and the fall in the corruption perception indicator (21 positions).

Table 9. Selected countries in the ranking of business regulation, 2000 and 2012.
Tabela 9. Países selecionados no ranking de regulação de negócios, 2000 e 2012.

	Brazil	Argentina	Mexico	China	Thailand	South Korea
Time to start a business	87th = 87th	**70th ↑ 68th**	**65th ↑ 18th**	58th ↓ 79th	**52nd ↑ 15th**	**15th ↑ 14th**
Time to close a business	**88th ↑ 79th**	45th ↓ 51st	21st ↓ 27th	**40th ↑ 23rd**	**46th ↑ 40th**	**16th ↑ 15th**
Intellectual property protection	33rd ↓ 41st	37th ↓ 53rd	36th ↓ 51st	**51st ↑ 49th**	48th ↓ 61st	19th ↓ 25th
Corruption	38th ↓ 43rd	23rd ↓ 61st	31st ↓ 63rd	28th ↓ 49th	**54th ↓55th**	**44th ↑ 28th**

Source: Authors' own.

Among the Latin American countries, there is no evidence to suppose a catching-up process. In Mexico, significant decreases in key indicators such as corruption (32 positions) and intellectual property (16 positions) suggest a 'losing moment process'. The falls in these two indicators were also significant in Argentina. In this case, however, there has been poor relative position in all indicators, suggesting a 'falling behind' process. In Brazil, there is also a 'falling behind' process in course, marked by great difficulties relating to 'opening and closing a business'. Moreover, also the indicators of corruption and intellectual property suggest worsening of the business environment.

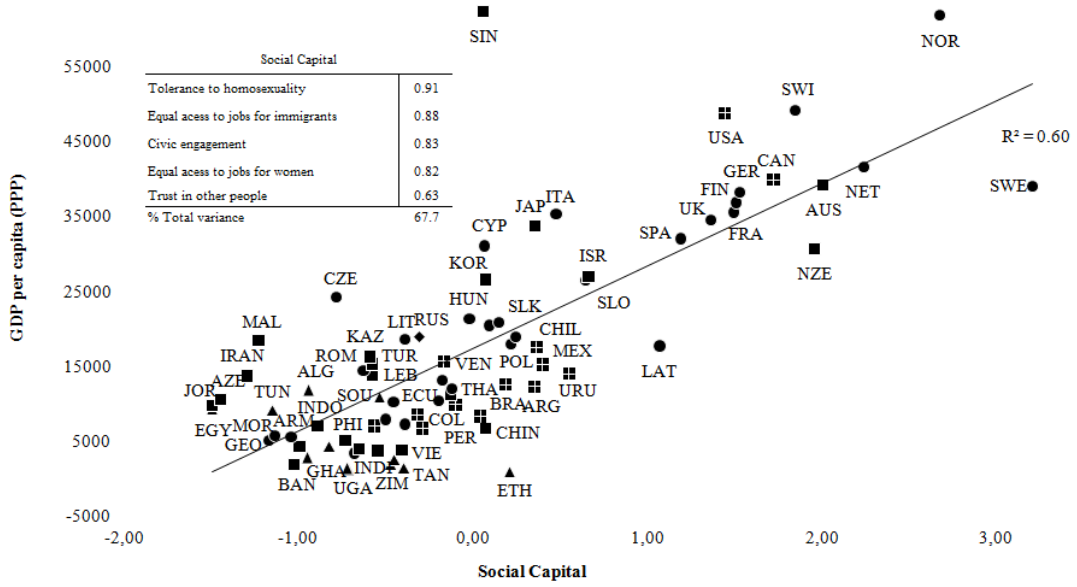
Social capital

Social capital measures the openness of society to different characteristics related to immigration questions, gender, sexual

orientation, level of trust between citizens and civic activities engagement.

The positive linear relationship between social capital and GDP per capita is marked by a high density of countries concentrated in the lower left quadrant as shown in Figure 5. Latin American countries have pretty much the same level of social capital – such as Brazil, Uruguay, Argentina, Mexico and Chile – if compared to other higher income countries – as Italy, Japan and Israel. On the other hand, we clearly see that countries with the highest levels of social capital are located in Western Europe. The four exceptions were strongly influenced by English culture: United States, Canada, Australia and Singapore.

Figure 5. Social capital and GDP per capita.
Figura 5. Capital social e PIB per capita.



Source: Authors' own.

Comparison between countries reveals that, in general, countries showed no major changes in the ranking during the period of analysis – except for Mexico (fall in 24 positions). For indicators of 'trust in other people', 'civic engagement' and 'tolerance to homosexuality' behaved as expected, once those indicators involve changes in the way people think.

Table 10. Selected countries in the ranking of social capital, 2000 and 2012.
Tabela 10. Países selecionados no ranking de capital social, 2000 e 2012.

Country	Brazil	Argentina	Mexico	China	Thailand	South Korea
Trust in other people*	65th ↓ 70th	51st = 51st	40th ↓ 64th	**4th ↑3rd**	11th↓12th	23rd ↓ 25th
Civic engagement*	12th ↓ 15th	37th ↓ 40th	**35th ↑ 33rd**	**62nd↑50th**	n.a -72nd	11th ↓ 18th
Tolerance to homosexuality*	17th ↓ 23rd	**16th ↑ 15th**	23rd ↓ 24th	**58th↑ 47th**	n.a- 36th	29th = 29th
Equal acess to jobs for immigrants*	30th ↓ 60th	**26th ↑ 24th**	**33rd ↑ 16th**	22nd↓ 32nd	n.a**-21st**	**50th ↑ 45th**
Equal acess to jobs for women	**23rd ↑19th**	12th ↓ 26th	**17th ↑ 14th**	31st↓ 46th	n.a -44th	43rd ↓ 50th

Source: Authors' own. Note: (*) data available from 1999-2004 to 2010-2014, except from Brazil whose data are available from 1990 to 1994.

The second aspect to be considered is the distance in the ranking among East Asian and Latin American countries regarding the 'trust in other people' (confidence) indicator which translates either the recognition of reciprocal values (virtues), or lack of

character (addiction), which allow to give a credit on loyalty. This feature can support virtuous learning processes, as highlighted by Lundvall (1988), and, therefore, support the formation of networks of innovative companies, by strong ties (Granovetter, 1973), for example.

The third important aspect is that Latin American countries seem to have more advanced societies in what regards gender differences. There is generally more tolerance of homosexuality and better opportunities for women. Therefore, there is to equal access to jobs for immigrants (the exception is Brazil, which has lost 30 positions between 2000 and 2012 regarding this indicator). Civic engagement puts Brazil to close South Korea and away from Latin American.

Results summary

Table 11 below summarizes the results and identifies a series of advances and setbacks that suggest, in short, a catching-up process for China with more advanced countries, while the Latin Americans seem to have lost a favorable historical moment (at least in theory) related to the commodity boom period. This same 'losing moment' process seems to have been the case of Thailand. South Korea, on the contrary, moves to a higher level, experiencing a 'forging ahead' process'. It is also notable that, for the South Korean case, no 'falling behind' process was found in any dimension analyzed.

Table 11. Latin American and East Asian social process in different dimensions of the NIS: forging ahead, catching-up, losing moment or falling behind.
Tabela 11. Processo social da América Latina e do Leste Asiático em diferentes dimensões do NIS: avançando, aproximando-se, perdendo momento ou ficando para trás.

	Brazil	**Argentina**	**Mexico**	**Thailand**	**China**	**South Korea**
Technological capability	Losing moment	Losing moment	Losing moment	Losing moment	Catching-up / Forging ahead	Forging ahead
Educational System	Catching-up / Losing moment	Catching-up	Losing moment	Losing moment	Catching-up	Forging ahead
Financial System	Catching-up	Losing moment	Catching-up	Losing moment	Losing moment	Forging ahead
Business Regulation	Falling behind	Falling behind	Losing moment	Losing moment	Losing moment	Forging ahead
Social Capital	Falling behind	Losing moment	Catching-up	n.a.	Catching up	Losing moment

Source: Authors' own.

A general look at the processes captured by those indicators proposed in this paper would point out the fact that Brazil, Argentina, Mexico and Thailand have lost a historical moment, China has experienced a catching-up process while South Korea has forged ahead.

It is interesting to note that this classification refers exactly to each country's technological capabilities, which are strongly correlated to the respective country's level of income per capita. This set of variables that seek to capture the companies' performance, necessary and usually essential locus of innovation processes, involves overcoming a structural weakness of Latin American innovation systems. That is, their inability to make innovation processes endogenously determined. Overcoming this weakness, which derives from its historical processes of constitution (Fajnzielber, 1990), cannot dispense with the determined and patient effort of companies around the domain of the technologies that are engaged (Kim, 2005; Bell; Figueiredo, 2012).

In fact, Latin American countries have shown superior performance in many countries in different dimensions: Brazil, financial and educational system, Argentina, educational system, and Mexico, not financial system and social capital.

Nevertheless, they have not been able to keep pace with improvements in the technological capabilities of companies, from what they have improved. In other words, the economic an innovation environment have been improved in different ways, but this did not mean an improvement in the necessary (and almost essential) actor of the innovation process, the firm and its technological capabilities.

Although the causal relationship between the dimensions is not the object of the study we conducted here, this result suggests the relevance of the following question for future research: what is the causal relationship between the level of technological capability of domestic firms and the level of development of indigenous structures such as educational system, financial system, business environment and social capital?

In addition to this general result, we point out that each National Innovation System reveals specific challenges. The Brazilian case, for instance, beyond the limited technological capabilities, still suffers from a problematic business regulatory environment, as well as difficulties to improve its social capital. Argentina seems to be the case with more challenges, since only its educational system seems to have good performance. The Mexican case, in contrast, showed its worst performance regarding the educational system. China showed advances in a great deal of indicators, with special emphasis to technological capabilities. South Korea, even though revealed poor performance in indicators related to cultural aspects, has the best performance for the period analyzed, reflecting a relative more advanced National Innovation System if compared to the others. Finally, Thailand showed weak performances in all analyzed dimensions.

Final remarks

The creative destruction gales from time to time produce technological revolutions, which create both windows of opportunities and constraints to the development process of the countries (Perez, 2003). This is why economic development levels differ worldwide. The ability of each country to absorb, diffuse and generate new technologies in tune with each technological revolution is a decisive element for forging ahead or falling behind. Capability building is totally affected by specific features of each country: social, economic, political, cultural and environmental factors.

The article aimed to contribute to this line of argument to update a study using different technological and social capability dimensions. Strong relationships of these dimensions with the level of economic development achieved by the countries were confirmed. The inability to derive causal relationship between the dimensions of analysis suggests the sense for new contributions. Nevertheless, it reinforces the intuition that economic development is a systemic nature phenomenon.

In addition to this first contribution, the article compared social and technological capabilities of Latin American – Argentina, Brazil, Mexico – and East Asian countries – China, South Korea and Thailand. With the exception of Thailand, those East Asian countries advanced more quickly suggesting a catching-up process, while the Latin Americans had modest advances and setbacks. Nonetheless, it has been found that systems in Latin American countries have showed higher levels of performance, compared with the most SNIs in the world, in different dimensions. Brazil in financial and educational system, Argentina in educational system and México in financial and social system.

However, none of the Latin American SNIs studied was able to reflect such an improvement in the technological performance of companies. This is the most worrying conclusion of the study, because despite of some improvements, the necessary (and often essential) element of innovation processes continues to exhibit the same type of weakness already identified. This leads to the conclusion that, given the extraordinary level of commodity prices in the period analyzed, Latin Americans Innovation Systems seem to have lost their best moment in decades.

Finally, when pointing out the different variations on the levels of social and

technological capabilities, we hope to have contributed to the increasing evidence on the priority focus for development policies of the selected countries.

References

ABRAMOVITZ, M. 1986. Catching Up, Forging Ahead, and Falling Behind, **Journal of Economic History**. 46(2): 385-486. https://doi.org/10.1017/s0022050700046209

ABRAMOVITZ, M. 1994. Catch-up and Convergence in the Postwar Growth Boom and After. In: BAUMOL, W. J.; NELSON, R. R.; WOLF, E. N. **Convergence of Productivity**: Crossnational studies and historical evidence. Oxford: Oxford University Press. p. 86-125.

ARCHIBUGI, D.; COCO, A. 2005. Measuring technological capabilities at the country level: A survey and a menu for choice. **Resarch Policy**, 34(2): 175-194. https://doi.org/10.1016/j.respol.2004.12.002

BELL, M; FIGUEIREDO, P. N. 2012. **Building innovative capabilities in latecomer emerging market firms**: some key issues. Innovative firms in emerging market countries. New York and London. 1ed. Oxford: Oxford University Press. v. 1, p. 24-109. https://doi.org/10.1093/acprof:oso/9780199646005.003.0002

BELL, M.; PAVITT, K. 1995. The development of technological capabilities. **Trade, technology and international competitiveness**, *22*(4831): 69-101.

CASTELLACCI, F.; NATERA, J. M. 2011. A new panel dataset for cross-country analyses of national systems, growth and development (CANA). **Innovation and Development**, 1(2): 205-226. https://doi.org/10.1080/2157930x.2011.605871

CASTELLACCI, F.; NATERA, J. M. 2013. The dynamics of national innovation systems: A panel cointegration analysis of the coevolution between innovative capability and absorptive capacity. **Research Policy**, 42(3): 579-594. https://doi.org/10.1016/j.respol.2012.10.006

CHANDLER, A. D. 1977. **The visibile hand**. The Managerial Revolution in American Business.

EDQUIST, C. 2005. Systems of innovation – perspectives and challenges, In: FAGERBERG, J; MOWERY, D.; NELSON, R. R. (eds.) **The Oxford Handbook of Innovation**. Oxford: Oxford University Press. p. 181-208. https://doi.org/10.1093/oxfordhb/9780199286805.001.0001

FAGERBERG, J.; SRHOLEC, M.; KNELL, M. 2007. The competitiveness of nations: Why some countries prosper while others fall behind. **World development**, 35(10): 1595-1620. https://doi.org/10.1016/j.worlddev.2007.01.004

FAGERBERG, J.; SRHOLEC, M. 2008. National innovation systems, capabilities and economic development. **Research policy**, 37(9): 1417-1435. https://doi.org/10.1016/j.respol.2008.06.003

FAGERBERG, J; SRHOLEC, M. 2009. **Innovation systems, technology and development**: unpacking the relationships. Handbook of Innovation Systems and Developing Countries: Building Domestic Capabilities in a Global Setting. p. 83-115. https://doi.org/10.4337/9781849803427.00010

FAGERBERG, J.; FELDMAN, M. P.; SRHOLEC, M. 2013. Technological dynamics and social capability: US States and European nations. **Journal of Economic Geography**, 14(2): 313-337. https://doi.org/10.1093/jeg/lbt026

FAGERBERG, J.; SRHOLEC, M. 2017. Global dynamics, capabilities and the crisis. In: **Foundations of Economic Change**. Springer, Cham. p. 83-106. https://doi.org/10.1007/978-3-319-62009-1_5

FAJNZYLBER, F. 1990. **Industrialización en América Latina**: de la caja negra al casillero vacío: comparación de patrones

contemporáneos de industrialización. Santiago: Cepal. https://doi.org/10.18356/1a9a3ac2-es

FREEMAN, C.; SOETE, L. 2008. **A economia da inovação industrial**. Campinas: Editora da UNICAMP.

FREEMAN, C.; LOUÇÃ, F. 2001. **As time goes by**: form the industrial revolutions and to the information revolution. Oxford: Oxford University.

GRANOVETTER, M.; S. The strength of weak ties. In: **Social networks**. Academic Press, 1977. p. 347-367. https://doi.org/10.1016/b978-0-12-442450-0.50025-0

HAIR, J. F. et al. 2009. **Análise multivariada de dados**. São Paulo: Bookman Editora.

KIM, L. 2005. O sistema nacional de inovação sul-coreano em transição. In: KIM, L.; NELSON, R. R. (eds.). **Technologia, aprendizado e inovação**. As experiências das economias de industrialização recente. Campinas (SP): Editora da Unicamp. p. 449-483.

KIM, L. 2005. **Da imitação à inovação: a dinâmica do aprendizado tecnológico da Coreia**. Campinas: Unicamp. https://doi.org/10.1590/s0101-31572006000400012

LALL, S. 1992. Technological capabilities and industrialization. **World development**, 20(2): 165-186. https://doi.org/10.1016/0305-750x(92)90097-f

LUNDVALL, B. A. 1988. Innovation as an interactive process: From user-producer interaction to the National Innovation Systems. In.: DOSI, G., FREEMAN, C., NELSON, R.R., SILVERBERG, G.; SOETE, L. (eds.). **Technology and economic theory**. London: Pinter Publishers.

LUNDVALL, B. A. 1992. **National systems of innovation**: towards a theory of innovation and interactive learning. London: Pinter.

LUNDVALL, B. A. 2007. National innovation systems – analytical concept and development tool. **Industry and Innovation**,14(1): 95-119. https://doi.org/10.1080/13662710601130863

MAHROUM, S.; AL-SALEH, Y. 2013. Towards a functional framework for measuring national innovation efficacy. **Technovation**, 33(10-11): 320-332. https://doi.org/10.1016/j.technovation.2013.03.013

NELSON, R. R.; ROSEMBERG. N. 1993. **Technical innovation and national systems**. National innovation systems: a comparative analysis. Oxford University Press, Oxford. p. 1-18.

PALLANT, J. 2007. **SPSS Survival Manual**. Berkshire: Open University Press.

PEREZ, C. 2003. **Technological revolutions and financial capital**. Cheltenham, UK: Edward Elgar Publishing.

ROSNICK, D.; WEISBROT, M. 2014. **Latin American Growth in the 21st Century**: the 'commodities boom' that wasn't. Washington: Center for Economic and Policy Research (CEPR).

SCHUMPETER, J. A. 2008 [1942]. **Capitalism, socialism and democracy**. New York: Harper Perennial Modern Thought.

Submetido: 03/01/2018
Aceito: 03/08/2018

Os Editores agradecem a Henrique Bidarte Massuquetti pelo apoio editorial.