Innovation Performance and its Determinants: What does it take to succeed?

Pedro Cavalcante, Ph.D
Institute for Applied Economic Research (Ipea)
cavalcante.pedro@gmail.com

WORKING PAPER – PLEASE DO NOT CITE

Abstract
This paper departs from the National System Innovation (NIS) arguments that countries' institutional arrangements and performance result from various complementary factors generating innovative activities and products within economies. To explore these dimensions further, the main goal of this paper is to address the determinants of worldwide heterogeneity in the nations’ innovation outcomes. Thus, the inquiry employs descriptive data analysis and multivariate regression models, using data from the Global Innovation Index (GII), to compare individually and cross-regionally the innovation governance in terms of institutional arrangements and performance. The GII, since 2013, measures and ranks over one hundred countries annually based on a comprehensive and sophisticated analysis of their innovation inputs and outputs under a multidimensional approach. The empirical results are quite interesting in many ways. The different innovation inputs indexes together affect the level of country performance; however, not all of them show a statistically significant impact on innovation outputs. Institutions and infrastructure indexes do not present effects on the innovative performance of economies. In fact, the main determinants of innovation performance worldwide are business sophistication, human capital and research and market sophistication.

Keywords: innovation policy; national innovation system; performance; determinants; governance.

Introduction
The financial crisis and the current COVID-19 pandemic have impacted the global economy in general and the developing economies with public debt growth, slowdown in productivity and recession in particular. Due to these dynamic challenges to governments and firms, strengthening a nation's innovation capacity is seen as a way to generate inclusive and sustainable development. According to Kattel and Mazzucatto (2018), nations around the world have been pursuing economic growth, with a strict focus on increasing the gross domestic product (GDP). Instead, this new development model must be smart (innovation-led), inclusive, and sustainable, based on coherent policy mixes (instruments and funding) and capabilities of coordination.

Three assumptions among scholars and practitioners emerge from this debate. The first is that innovation is essential for driving economic progress in both developed and developing countries (Lundvall, 2016; Cirera & Maloney, 2017; Edler & Fagerberg, 2017). Innovation, by
definition of the 2018 edition of the Oslo Manual (OECD & Eurostat 2018), is a new or improved product or process (or a combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process). It may also contribute to solutions for urgent societal challenges (Edler et al., 2016; Edler & Fagerberg, 2017) and improve citizen's welfare.

The second assumption is that the innovation governance of countries differs both in their structure for innovation and their performance. This heterogeneity also occurs among world regions. The levels of innovation governance include governments that have historically placed innovation at the center of their growth strategies, such as most countries that are members of the Organization for Economic Co-operation and Development (OECD). In recent decades, East Asian countries are also competing for the top positions in the innovation rankings after having experienced caught-up processes (Rodrik 2008). In contrast, the majority of nations worldwide are still struggling to build an innovative capability to move up the manufacturing, service, or agriculture value chain towards higher-value-added activities. This group includes the Latin American countries that keep facing the well-known Middle-Income Growth Traps (MIT), i.e., the situation when economies are stuck on the intermediate level but are not able to raise their total factor productivity in order to upgrade to the high-income group (Agenor, Canuto & Jelenic, 2012).

The third and last assumption is that a country’s innovation, including its capacity and outputs/outcomes, is not a consequence of a unique cause but a multidimensional phenomenon that varies in time and space. Drawing from the National System Innovation (NIS) literature (Lundvall, 2016), the institutional arrangements and, consequently, performance result from a variety of complementary factors that generate innovative activities and products within economies (Cirera & Maloney 2017).

To explore these dimensions further, the main goal of this paper is to address the determinants of a country’s heterogeneity for innovation outcomes. Thus, the inquiry employs descriptive data analysis and multivariate regression models, using the Global Innovation Index (GII) data to compare individual and cross-regionally the innovation governance in terms of institutional arrangements and performance. The GII, since 2013, annually measures and ranks over one hundred countries based on a comprehensive and sophisticated analysis of their innovation inputs and outputs under a multidimensional approach (Cornell University, Insead & Wipo, 2020).

Besides this introduction, this paper has three other sections. The next discusses the literature of the innovation systems’ determinants and presents the study’s hypotheses. The third section describes the methods, empirically analyzes the differences among countries and regions, and tests the hypothesis. Lastly, final remarks and future agenda research are debated.

Innovation’s Determinants: the NIS Approach

The deep investigation on the factors that affect the countries’ innovation performance and the heterogeneity observed among them and world regions is grounded in the National System Innovation literature. The NIS approach emerged during the late 1980s and early 1990s and became popular since then among policymakers willing to undertake the
generation of scientific knowledge, technology, and innovation (Edler & Fagerberg 2017). The innovation system means two complementary concepts: i) a tool for designing innovation policy and; ii) an analytical framework for scholars to assess innovation policies and their results.

The National Innovation System literature is openly skeptical, with government interference restricted to market failure, as innovation flourishes in an arrangement of interactions between firms and entrepreneurs with bounded rationality and institutions in constant evolution (Cirera et al. 2020). According to Nelson (2016), NIS is a strand of research that recognizes, on the one hand, the complexity of many market relationships, their embedment in broader social and institutional structures, and the elements of cooperation and trust that often are essential if markets are to work well and. On the other hand, the role of non-market institutions, like university and public-research systems, scientific and technical societies, and government programs, in the innovation process of many sectors.

An ‘innovation system’ encompasses various institutions involved in supporting and orienting the dynamics of economic activity where innovation is the key driving force (Lundvall 2010). The system comprises elements and relationships that interact in the production, diffusion, and use of innovation, based within or embedded inside a nation-state. Suppose the most fundamental resource in the modern economy is knowledge and the critical process is learning. In that case, the main function of the NIS is to promote interactive learning, encompassing individual, organizational and inter-organizational levels, that should generate positive feedback and by reproduction, and link innovation capabilities to economic development (Lundvall 2016).

The NIS approach is in line with the evolutionary theory that assumes the economy is constantly changing with agents and organizational routines differing, which is fundamental for the dynamics of the system (Nelson 2016). Moreover, institutional structure and innovation processes are path-dependent and occur mainly in an unplanned manner, and above all, are gradual and cumulative (Lundvall 2016). It is far from a single event as the well-known catching-up, meaning the "process in which a late-developing country narrows its income gap (as one may specify by the word 'economic catch-up') and in technological capability (equally 'technological catch-up') vis-à-vis a leading country" (Nelson et al. 2011, 2-3).

Orthodox economics is preoccupied with the institutional arrangement that affects the optimal allocation of existing resources and emphasizes how agents make choices based on given sets of information and competencies. The NIS scholars worry about how different institutional set-ups impact creating new resources and address how knowledge – both information about the world and agent’s know-how – changes in the economic process. In the current ‘globalizing learning economy’ (Lundvall et al. 2009), to understand how a countries’ innovation performs, the analysis must go beyond the traditional focus on science or core of the innovation system (firms and the knowledge infrastructure) and encompass the wider setting, i.e., institutions and organizations that nurture competence-building and institutions that shape human interaction concerning innovation.
This comprehensive view of the phenomenon goes beyond the focus on research and development (R&D). It includes in the innovation system other dimensions of analysis, such as labor market, education system, financial institutions, regulatory structures, and other institutions that shape economic dynamics. Figure 1 below shows the NIS framework with its institutions and three dimensions: supply, accumulation/allocation, and demand.

**Figure 1 – The National Innovation System**

The system elements tend to reflect the structure of the innovation capabilities and the outputs, which may also be influenced by a variety of other factors, such as historical experience, language, and culture, and so on. Undoubtedly, as much of technology is science-based, education, research, and financial systems are vital. For instance, the countries that have been catching up, for instance, South Korea and Taiwan, have prioritized these systems for decades. The public sector plays a crucial role in education and R&D, whereas the financial sector affects how firms organize and form networks (Nelson 2016; Cimoli *et al.* 2016; Lundvall 2010). In this approach, as public policies and programs are not only an essential part of the engine but inevitable (Nelson 2016), governments must plan, design, and implement innovation initiatives systematically and in a dynamic way (Cirera & Maloney 2017).

Based on the same assumptions of multi-causality and dynamism, the literature on the literature technology upgrading support that sustained economic development results from structural changes grounded in industrialization, technological innovation, and diversification (Lin 2012; Rudosevic & Yoruk 2017). Scholars also go beyond the limited focus on R&D indicators towards a broader understanding of innovation. They analyze technology upgrading, arguing that there is no single path to reach it. In this sense, technology upgrading is defined as the interactions of the following three dimensions (Castellacci & Natera 2013; Lacasa *et al.* 2019):

i. Technology upgrading - the intensity of production, R&D and technology generation activities;
ii. Breadth of technology upgrading - which is about the diversity of technological knowledge, types of supporting infrastructure and organizational capabilities of firms which are the primary carriers of technology upgrading;

iii. Role of global interaction - inflows and outflows in and out of the economy through a variety of forms such as trade, FDI and disembodied knowledge flows.

In general, institutions and government policies/programs matter, for better or for worse, in the process of innovation. As a result, the State normally diversifies responsibilities by supporting science and development, providing a business environment, setting regulations and standards, fostering interaction and cooperation between firms, and being the primary user of innovations from the private sector. In this sense, how are these functions formulated and implemented?

One way of looking at it is the idea of government as a gardener in which policies should identify, protect, and promote interactive learning spaces (World Bank, 2010). Based on this perspective, governments must perform in a governance model that requires enabling innovation processes by using the right policy mix in different areas - education, research, trade, finance, industry, among others, in order to:

- support innovators through appropriate incentives and mechanisms;
- remove obstacles to innovative initiatives;
- establish responsive research structures, and;
- form a creative and receptive population through appropriate educational systems.

However, these policy challenges are faced by countries in different strategies and conditions that may result in different stages of the NIS: mature (well-functioning) or systemic failure. The latter occurs whenever emerging innovation systems lack the building blocks needed to support creating, absorption, use, and disseminating useful knowledge through interactive learning (Lundvall et al., 2009). It tends to be shared in developing countries trapped with structural issues, such as poverty and inequality, where resources are limited and managers can carry out these programs and policy measures are scarce (Cozzens & Kaplinsky, 2009; World Bank, 2010). According to Cirera and Maloney (2017), the challenge seems even harder for developing countries that face the innovation policy dilemma, i.e.:

“The greater magnitude of the market failures to be resolved and the multiplicity of missing complementary factors and institutions increase the complexity of innovation policy; at the same time, governments’ capabilities to design, implement, and coordinate an effective policy mix to manage it are weaker.” (Cirera & Maloney, 2017, p. 111).

On the contrary, the consensus is that the quality of the innovation policy and the functioning of the governance arrangement matters, with its organizations, governmental and outside the public sector, resources institutions, strategic goals, among others. They create knowledge accumulation, foster the process of learning, and, as a result, technological transformation and economic progress (World Bank 2010; Lundvall 2016). In addition, Cirera et al. (2020) suggest that policy maker’s conception of the NIS must advance the
traditional institutions and policies to overcome the innovation-related market failures and include these broader complementary factors and supporting institutions.

Indeed, there is a great variety of country- and sector-specific combinations between the types of policies. For instance, it is well-known that countries from the Organization for Economic Co-operation and Development (OECD) have a national innovation system with mature institutions and comprehensive, multifaceted, and sophisticated policy mixes. In contrast with emerging economies, innovation policies are often embryonic and fragmented (Cirera et al., 2020). Innovation policies—usually needed to balance initiatives addressing capacity-building with mechanisms curbing inertia and rent-seeking, as Cimoli et al. (2009, p. 7) puts, “the latter is indeed one of the major elements missing in the old Latin American experience of import substitution while the former is what is lacking under many more recent liberalization policies.”

Nevertheless, for analytical purposes, the research must focus not on ideal types of innovation systems but on the understanding of how different they are in terms of structure and performance as well as the correlation among these dimensions.

**Countries’ Innovation Performance and Determinants**

*The Global Innovation Index*

As discussed above, analyzing and comparing the innovation systems’ performance demands a comprehensive and diversified approach. For this reason, this paper uses the global innovation index (GII), a joint partnership led by Cornell University, Institut Européen d’Administration des Affaires (INSEAD), and the World Intellectual Property Organization (WIPO), which, since 2013, publishes an annual ranking with around 130 countries/economies. The GII encompasses eighty (80) indicators, single and composite, from different sources and meaning. The following figure depicts the index, sub-indexes, and main indicators.

---

1 For detailed information regarding the GII conceptual framework and data sources, see https://www.globalinnovationindex.org/gii-2019-report.
To capture innovation as it happens worldwide, the GII differentiates between two dimensions or sub-indexes. The overall GII score is the average of the Input and Output Sub-Indices, and they vary in terms of scores and ranks as well.

i) Innovation Input Sub-Index captures the main components of the national political economy relevant to the innovative activities and is divided into five pillars:

a. Institutions: the institutional framework of an economy (political, regulatory and, business environments);
b. Human capital and research: level and standard of education and research activity (education, tertiary education and research & development);
c. Infrastructure: including indicators of information and communication technologies (ICTs), general infrastructure, and ecological sustainability;
d. Market sophistication: credit, investment environment, access to the international market, competition, and market scale tend to be essential for businesses and innovation;

e. Business sophistication: to assess how conducive firms are to innovation activity involving knowledge workers, Innovation linkages and knowledge absorption.

ii) Innovation Output Sub-Index meaning the results from the innovation activities (above) within the economy with two pillars:
a. Knowledge and technology outputs: covering variables that are results of inventions and/or innovations (knowledge creation, knowledge impact and, knowledge diffusion);

b. Creative outputs: to encompass the NIS’ dimension of creativity, the pillar has three sub-pillars: intangible assets, creative goods and services and, online creativity.

**Innovation and Development**

The first assumption involves the idea that innovation and economic progress are highly correlated in developed and developing countries (Lundvall 2016; Cirera & Maloney 2017; Edler & Fagerberg 2017). A straightforward way to test this assumption is by analyzing the relations of the nations’ innovation index and their Growth Development Product (GDP). Figure 3 below plots this relationship, including the overall GII and the countries’ GDP per capita in natural logs and PPP (purchasing power parity in US$):

**Figure 3 – Global Innovation Index and GDP per capita**
The evident and primary result is that the higher the GII of the country, the more developed the economy tends to be and the correlation ($R^2$) is almost .7 (Cornell University, Insead & Wipo (2020). The relation is also clear when we look at the trend line that indicates that among the innovation leader (blue bubbles), the level of GDP per capita has less impact on the GII. Among the rest, China is an interesting case because although it is still considered a developing economy in terms of income level, its innovation system is among the top. On the other extreme, six high-income economies from the Middle East (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates), economies with a large oil-related GDP, stand out for their poor performance in the GII.

**Innovation Structure and Performance**

In this subsection, the analysis explores how the national innovation systems are structured (GII inputs) and how they have succeeded (GII outputs) over the last eight years. The assumption to be tested is that countries’ innovation governances are very different in their structure for innovation and performance. To do so, the GII indexes differentiate by continents and divide between OECD and Non-OECD economies. Theoretically, the scores could vary from 0 to 100; however, the lowest is 7 (GII output of Togo – 2017) and the highest 74.2 (GII input of Singapore – 2018).

Graph 1 and 2 below depict the distribution of the GII indexes of innovation inputs (II) as well as the pillars of institutions, human capital and research (HC&R); infrastructure; market and business sophistication. As presumed, heterogeneity is the rule either among these groups of countries or inside the continents.

**Graph 2 – Innovation Inputs Indexes, by continents (2013-2020)**
Even though all six indexes have different distributions, Oceania and Europe have the most structured national system with II scores of 60 and 53, respectively. The Asian average is also the same of the general mean (43), while Africa (33) and America (41) present indexes below it. Regarding the variation in each continent, Asia has the highest standard deviation (11.5), reflecting not only the great number of economies, but also the gap between few innovation leaders, South Korea and Japan, for instance, and the majority of countries that are way behind in terms of innovation governance. With only two nations, Oceania has the lowest variation (8), while the other three continents converge with standard deviation around 9. The five innovation structure pillars also have very different distributions; institutions and infrastructure stand out with the highest scores among all economies. Human capital and research have the lowest average and the second-highest variation in general.

Another strategy to analyze the overview of the innovation structure globally is by dividing the countries among non-members and members of the Organisation for Economic Co-operation and Development (OECD). This group includes most of the high-income countries of the world. As depicted in graph 2, the distances between these groups are much more accentuated, which exposes how rich countries prioritize the innovation agenda. In most of the pillars, mean's differences are around 30%, except for the (HC&R) indexes, in which the average of OECD countries is almost 50% higher.

**Graph 2 – Innovation Structure, by Non-Members and OECD Members (2013-2020)**

Graphs 3 and 4 focus on economic performance, using the distribution of the GII indexes of innovation output (IO) with the pillars of Knowledge and technology (KTO) and creative outputs (CO). Similarly, to the inputs, the innovative results of the economies are also very diverse.
As expected, countries' performances in Europe and Oceania (mainly Australia and New Zealand) are far from the rest. The former average of the OI is 40, the latter is 37, while the general mean is around 26. Inside each continent, the variety is also evident, with a higher standard deviation in Europe (11) and Asia (10.6). On the other extreme, Africa has the lowest average of the innovation outputs (18), but poor performances are more homogenous than the rest, as the standard deviation is 6.

Regarding the two output pillars, Europe has the best indexes’ average on the KTO pillar (37.5), and Oceania is slightly better in the CO indexes (43 to 42). Africa and the Americas present the worse means in these two performance dimensions. However, the latter has more outliers that represent the outstanding results of the United States and Canada over the years. The same heterogeneity is observed in Asia, since the continent’s performance average aggregates innovation leaders, such as South Korea and China, and countries far behind, e.g., Yemen and Myanmar, in the rank.

By comparing non-members and members of the OECD, the distance is even greater than previously observed in the last graph. While OECD economies have an IO average of 43.6, the rest of the countries are almost half (lower than 24), and the same pattern occurs in knowledge and technology outputs.

The heterogeneity inside these groups of economies is also evident. Since they combine a considerable number of countries, it is also expected; however, what draws attention is the fact that the standard deviations are similar, 8.7 for the non-members and 9.5 for OECD nations. Considering the variety of development of the former, it would be more reasonable to see the contrary.
Another performance pillar involves the innovation capacity of the ecosystem to be creative. Among the sub-pillars, e.g., intangible assets, creative goods and services and, online creativity, the scores’ distributions are also heterogeneous. The distances in the pillar index from developed to developing nations are not as high as in the previous output. Except for the dimension of online innovation, including generic and economy/country-code top-level domains, average yearly edits to Wikipedia, and mobile app creation, those OECD countries, on average, have an outstanding performance.
Graph 5 shows a different focus: the correlation between the scores of the innovation inputs, how the NIS is structured in all countries, and their performance in terms of outputs. The empirical results show that the indexes are highly correlated with a R² of around .73, which can be seen in the trend line in red (fitted values). The correlation is even more significant than between the GII and countries’ development, exposed previously in Figure 3. In other words, the higher the scores of innovation inputs in the economy, the better tends to be the success in terms of innovative products and services.

**Graph 5 – Global Innovation Input X Output indexes (2013-2020)**

![Graph showing the correlation between innovation inputs and outputs](image)

Source: Global Innovation Index.

**Innovation Determinants**

The empirical evidence in the exploratory, descriptive analysis helps to confirm the two theoretical assumptions previously discussed: i) a countries’ innovation capacity and performance are highly correlated to economic development, and ii) a nations’ innovation system also vary considerably.

This section addresses the third assumption, i.e., the innovative activities and products within economies are a multidimensional phenomenon affected differently by complementary factors (Lundvall 2016; Cirera & Maloney 2017). To do so, this paper employs multivariate regression models with, on the left side, the dependent variables, the innovation output sub-index and the knowledge and technology and creative outputs indexes, and on the right side, all five innovation inputs indexes. In the regression cover data from 2016 to 2020, as in the previous years (2013 to 2015), the dependent variable did not show statistically significant means, compromising the model’s fitness. Therefore, the equation for the fixed effects model is defined as follows:
Innovation Performance ($Y_{it} = \beta(X)_1 Institutions_{it} + \beta(X)_2 Human Capital and Research_{it} + \beta(X)_3 Infrastructure_{it} + \beta(X)_4 Market Sophistication_{it} + \beta(X)_5 Business Sophistication_{it} + \alpha_i + u_{it}$)

Where,

- $\alpha_i (i=1,...,n)$ is the unknown intercept for each entity ($n$ entity-specific intercepts);
- $Y_{it}$ is the dependent variable (DV) where $i = entity$ and $t = time$;
- $X_{it}$ represents the independent variable (IV);
- $\beta_i$ is the coefficient for that IV, $- u_{it}$ is the error term.

The number of observations includes most countries in the world; however, it is unbalanced panel data. The models of fixed effect in time (year) with longitudinal data, shown in Table 1, demonstrate that the models show interesting estimates to analysis despite their different determination coefficients. Considering the large sample, T-test and F-test are valid asymptotically. Although not all variables are statistically significant, generally, the significance of the regressions is confirmed (Wooldridge, 2006).

Table 1 presents the estimated coefficients, standard errors in parentheses, and the models’ coefficients of determination ($R^2$). To begin with, the $R^2$ (overall) that measures how much of the variation in the dependent variable is captured by the regression, in model $a$, indicates input's indexes explain almost 80% of the countries’ innovation performance. While in the output sub pillars, the explanation capacity of the models is 66% and 68%, which are expressive.
Table 1 – Innovation Performance’ Determinants

<table>
<thead>
<tr>
<th>Inputs Indexes</th>
<th>Innovation Output (a)</th>
<th>Knowledge and Technology Outputs - KTO (b)</th>
<th>Creative Outputs - CO (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutions</td>
<td>0.14</td>
<td>0.51</td>
<td>-0.08</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Human capital &amp; Research (HCR)</td>
<td>0.17***</td>
<td>0.07</td>
<td>0.27***</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.05)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0.21***</td>
<td>0.24</td>
<td>0.40***</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Market sophistication</td>
<td>-0.12***</td>
<td>-0.15***</td>
<td>-0.10***</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Business sophistication</td>
<td>0.19***</td>
<td>0.20***</td>
<td>0.18***</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Constant</td>
<td>13.0***</td>
<td>19.7****</td>
<td>6.29***</td>
</tr>
<tr>
<td></td>
<td>(3.94)</td>
<td>(4.53)</td>
<td>(6)</td>
</tr>
<tr>
<td>N</td>
<td>641</td>
<td>641</td>
<td>641</td>
</tr>
<tr>
<td>R² within</td>
<td>0.23</td>
<td>0.1</td>
<td>0.19</td>
</tr>
<tr>
<td>R² between</td>
<td>0.79</td>
<td>0.68</td>
<td>0.2</td>
</tr>
<tr>
<td>R² overall</td>
<td>0.78</td>
<td>0.66</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Source: Elaborated by the author based on the Global Innovation Index.
Note: Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001.

Although the empirical results do not refute the assumption that the economies’ innovative activity is a multidimensional phenomenon and is affected differently by complementary factors (Lundvall, 2016; Cirera & Maloney, 2017), surprisingly, some estimates of some IVs do not impact the performance indexes as expected. Only two inputs have statically significant effects on all three models. The market sophistication index, which includes credit, competition, and investment environment indicators, shows that the worse the input score, the better innovation performance. Business sophistication goes the opposite way since, on average, an increase of this index tends to reflect a raise of about .20 in all three performance indexes. Therefore, it means that the level of knowledge workers, innovation linkages including public/private/academic partnerships and international ones, as well as knowledge absorption, seems to be a key determinant of the economies’ outputs and outcomes.

Another result concerns the index of institutions, which encompasses political, regulatory, and business environments. On any of the models, the estimates are statistically significant. In CO (model c), the coefficient is even negative, which would suppose that a worse score in the institutions pillar negatively impacts countries’ innovation performance. One possible explanation for this unexpected result may come for the complexity and weakness of the institutional index, primarily grounded in the World Bank indicators that are constantly criticized by the literature (Andrews, 2008; Peters, XXX).

In models a and b, the coefficients of HC&R and infrastructure showed statistical significance and a positive effect on the DVDs. In both cases, the estimated effects on CO
are higher than on the general index of innovation outputs, as expected. However, what is striking is the human capital & research estimate that in model b is not statistically significant on KTO. This result clearly diverges from the literature, which supports that investments in education and research and development (R&D) are an influential factor that allows innovation to succeed (Nelson 2016; Cimoli et al. 2016; Lundvall 2010).

Final Remarks

This paper aimed at discussing how countries are structuring the innovation governance to promote prosperity in their firms and public organizations and to deal with dynamic societal challenges. To address this, three theoretical assumptions were explored with a comparative cross-national and cross-regional approach based on descriptive data analysis and multivariate regression models. Then, it used the Global Innovation Index (GII) that depicts the economies building national innovation systems and how they succeed in this policy dimension.

The first assumption relates innovation to the level of economic progress of countries and regions, as supported by the field of study (Lundvall, 2016; Cirera & Maloney 2017; Edler & Fagerberg 2017). The inquiry confirmed it by comparing the GII and the countries’ GDP per capita based on the last edition of the indexes. Results demonstrate a high correlation between the two variables and that richness may not be the only innovation determinant since six Middle East countries, economies with oil-dependent GDP, perform poorly on the index. Besides, among innovation leaders, the level of GDP per capita is not essential, and China is still an upper-middle-income country. However, the nation is among the top and has been rapidly climbing the innovation ladder in recent years.

Secondly, the premise that countries’ innovation governance is heterogeneous is also analyzed in terms of structure and performance (Lundvall et al., 2009). As expected, in all indexes pillars, there are evident asymmetries among continents and within them. Oceania and Europe not only have the most advanced national systems, on average, but also present the best scores of innovative productions, followed by Asia, the Americas, and Africa. By analyzing the distribution of the scores between members and non-members of the OECD, the empirical results showed that the gap among them is even more highlighted. Nonetheless, the variations in almost all GII pillars are not different between the rich (OECD) and low/middle-income nations.

Finally, this paper analyzed the assumption that a country’s innovation success or failure is not a product of a single factor since a set of drivers may affect its performance (Lundvall, 2010; Cirera & Maloney 2017; Cirera et al., 2020). To test that, the inquiry employed panel data regression to determine which innovation inputs affect the GII performance scores. The results confirmed the assumptions but not entirely, because institutions dimension does not seem to have a significant impact and market sophistication, surprisingly, showed negative estimates in the models. On the contrary, infrastructure, business sophistication and human capital & research, in this order, are innovation drivers.

In short, the analysis, drawing from the National Innovation System literature and grounded in a comprehensive and current database, reinforces these three key premises about how globally the nations are structuring and performing their innovation capacity. A
fundamental lesson to the ones with continuously failing systems is that innovation policy must always be on the prioritized agenda as the majority of the OECD countries have done for the last decades.

Despite this inquiry's contribution to the field of study, some findings are still demanding further investigation, especially the determinants of innovation performance. Undoubtedly, the analysis is negatively affected by the quality of some indicators that make up the GII. For instance, the 'good governance' indexes used in the institution's index are constantly criticized for not having a theoretical model that supports them and focuses predominantly on “statistical gymnastics”, which can generate problems, such as lack of consistency, correction and replicability in their uses (Andrews, 2008). The future research agenda to cope with this issue and deepen in the causal explanations for the success and failure of the countries' innovation governance may rely on different and complementary methods. The qualitative comparative approach (QCA) can provide comparisons with more accuracy and the possibility to include other influential factors, such as democracy, bureaucratic capacity, and economic complexity, among others. In addition, case studies are also an exciting alternative to the detailed description and better understanding of why some NIS are mature and others are not.

References


---

¹ After running a Hausman test, which tests whether the unique errors (ui) are correlated with the regressors, the results in all three models show that the fixed effects technique is more appropriate than random.